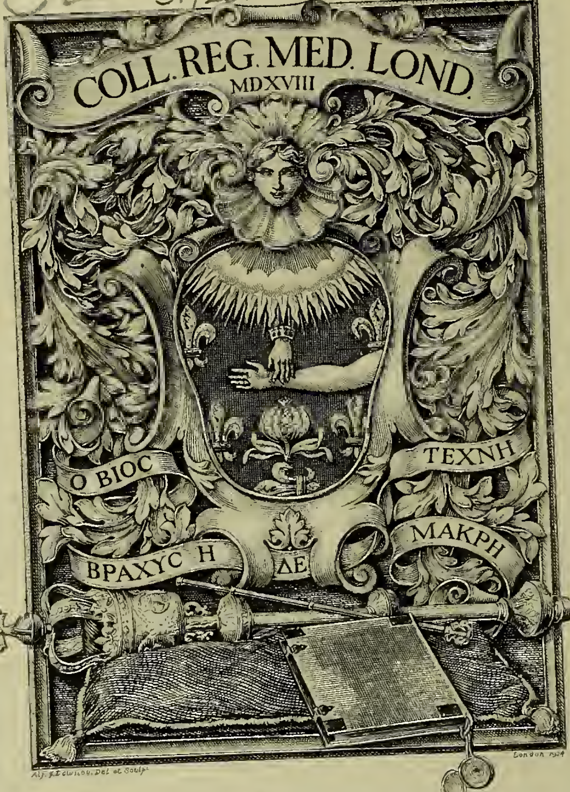
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OR,
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OF

Arts, Sciences, and Literature.

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CYCLOPÆDIA:

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ARTS and SCIENCES.

ELOCUTION.

ELOCUTION is a term which, according to the ftrictnefs of etymological definition, might be applied to fignify every thing that is included in the faculty and utterance of thought, by the means of language, whether oral or written; and fome writers, even in modern times, have applied it, with more attention apparently to derivation than to authorized precifion and neceffary contradiftinction, to written compofition as well as to actual fpeech. At the fame time, two other terms, oratory and eloquence, (which etymological refinement might undoubtedly reduce to the fame original fignification,) have admittance and current ufage in our language, and are occafionally ufed as fynonyms of elocution in our loofer converfation. But every copious fubject, when it comes to be treated in a didactic way, requires more terms of fettled diftinction than the fimplicity of rigid etymology can be expected to furnifh; and "many terms which, in the laxity of general converfation, are indifferently and indiftinctly ufed, in the precifion of fcientific difcuffion muft be carefully feparated and placed in contradiftinction: the very admiffion of fynonyms being perfectly inconfiftent with the progrefs and comprehenfion of fcientific truth."

Thefe three terms, therefore, in the very outfet of the prefent fubject, fhould be clearly and diftinctly defined, and the boundaries of fignification affignable to each, as terms of contradiftinction, be precifely marked. This has accordingly been done by a popular lecturer of the prefent day. "Eloquence," fays he, "may be defined, "the art of expreffing our thoughts and feelings with precifion, force, and elegance; and of heightening the impreffions of reafon by the colourings of imagination." It is applicable, therefore, to the whole faculty of verbal difcourfe, whether oral or written. It addreffes itfelf by the pen, to the eye, as well as by the living organs to the ear. Thus we fpeak (with admitted accuracy) of an eloquent book, as freely as of an eloquent oration; of the eloquent Buffon (alluding to his celebrated work upon natural hiftory); and of the eloquent writings, as well as the eloquent fpeeches of Edmund Burke. The Apoftrophe to the queen of France, is as genuine a piece of eloquence as if it had been fpoken in the houfe of commons.

Oratory, on the contrary, is precife and limited in its application: and, in this refpect, indeed, even popular ufage is pretty generally correct. It may be defined, "oral eloquence; or the art of communicating, by the immediate action of the vocal and expreffive organs, to popular, or to felect affemblies, the dictates of our reafon, or our will, and the workings of our paffions, our feelings, and our imaginations." Oratory, therefore, includes the idea of eloquence: for no man can be an orator who hath not an affluence of thought and language. But eloquence does not neceffarily include the idea of oratory; fince a man may be rich in all the ftores of language and of thought, without poffeffing the advantages of a graceful and impreffive delivery. It is, therefore, the name of a more complex idea; and includes, befides the general notion of eloquence, the practical part of elocution: which being our immediate object, muft be fpoken of more at large. "Elocution may be regarded either as a fcience, or as an act. In the former cafe it may be defined, "the fcience by which the rules for the juft delivery of eloquence are taught;" in the latter, "the happy combination and coincidence of vocal, enunciative, and gefticulative expreffion, by which oratorical excitement is fuperadded to the eloquence of thought and language." In other words: "Elocution is the art, or the act of fo delivering our own thoughts and fentiments, or the thoughts and fentiments of others, as not only to convey to thofe around us (with precifion, force, and harmony) the full

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purport and meaning of the words and fentences in which thofe thoughts are clothed; but, alfo, to excite and imprefs upon their minds, the feelings, the imaginations, and the paffions, by which thofe thoughts are dictated, or with which they fhould naturally be accompanied."

"Elocution, therefore, in its more ample and liberal fignification, is not confined to the mere exercife of the organs of fpeech. It embraces the whole theory and practice of the exterior demonftration of the inward workings of the mind." In fhort, "eloquence may be confidered as the foul, or animating principle of difcourfe; and is dependent on intellectual energy and intellectual attainments. Elocution is the embodying form, or reprefentative power; dependent on exterior accomplifhment, and cultivation of the organs. Oratory is the complicated and vital exiftence refulting from the perfect harmony and combination of the two."

The object, then, of the fcience of elocution is the improvement of oral language, as contradiftinguifhed from mere graphic compofition; and the cultivation of every external grace and accomplifhment with which the delivery of language fhould be accompanied, whether in reading, in recitation, or in fpontaneous utterance: an object, to the attainment of which the ancients devoted a very confiderable portion of attention; and for the due comprehenfion of which, it appears to be neceffary to go fomewhat deeper in our refearches into the phyfical and moral powers of man, than has been fufpected by the generality of modern profeffors; and inftead of calling in queftion, as fome recent cavillers have done, whether elocution is even to be regarded as an art, to eftablifh its doctrines on the fettled principles of fcience, and demonftrate the effential elements of that fcience as a branch of natural philofophy. To the want of this due confideration of the fubject, and to the incongruous maxims relative to it, are perhaps to be attributed not only the frequency of every fpecies of difgufting impediment in modern fpeech, but the lame and impotent ftate of public fpeaking among us, when compared in its effects with the fplendid and impreffive oratory of ancient times. "In thofe parts of oratory, indeed, which relate to the arrangements of thought, and the energies of expreffive language, there is no deficiency of exifting models; and, certainly, no paucity whatever of pedantic rules and treatifes. Cicero and Demofthenes ftill continue to fpeak to the eye, in all the eloquence of graphic words; and Quintilian and Blair (like two confpicuous luminaries, in the ancient and modern hemifpheres of oratorical criticifm) illumine the tracks of written language, and may help to inform us how orations fhould be compofed. In this part of oratory, the prefent and the preceding generation have, accordingly, fomething to boaft. But for the theory and practice of thofe impreffive exterior demonftrations with which the delivery of fuch orations fhould be accompanied, to what fyftems, or to what models can the Englifh ftudent appeal? In fhort, eloquence has been cultivated among us with confiderable diligence; but elocution has been fo much neglected, that the very nature of the fcience feems to be entirely forgotten; and the few fragments of antiquity that have defcended to us upon the fubject, are evidently mifunderftood by thofe who have pretended to comment upon them; and many of our moft learned critics have either ingenuoufly acknowledged, or unwarily betrayed, their total inability to comprehend fome of thofe very diftinctions moft indifpenfable to the expreffion and harmony of oratorical delivery: fuch, for example, as the mufical accents of fpeech, or inflections of the voice in the harmonic fcale; the proportions of refpondent founds and cadences, and the effential contradiftinctions of percuffion, accent, and quantity."

Such is the language of the lecturer already quoted; who, to refcue the elements of elocution from this ftate of neglect and chaos, and to facilitate the general attainment of an accomplifhment fo generally defirable, proceeds, in his "Introductory Difcourfe," thus curforily to ftate the extent and nature of the fubject.

"Elocution," fays he, "is, 1. Partly a fcience, founded on afcertainable principles, and fufceptible of palpable demonftrations; 2. Partly an art, attainable by imitative application and obfervance; and fubject to fuch laws as refult from comparifon of general principles with practical experience; and, 3. Partly an object of tafte and fentiment, dependent on acutenefs of perception, and delicacy and refinement of feeling.

1. "As a fcience its foundations are to be fought, 1ft. In phyfiology; that is to fay, in the anatomical ftructure of the elocutionary organs, and the laws of phyfical neceffity, by which their actions and reactions are directed and circumfcribed: fome knowledge of which feems to be indifpenfably requifite to the complete developement and exertion of their refpective powers; to the fupply of accidental and occafional deficiencies; and to the correction of thofe erroneous and defective modes of utterance, which, originating in negligent or vicious imitation, have ripened into habitual impediments. 2d. In mufic, the effential laws and accidents of which, with only one confpicuous exception;" the progrefs of the tune, in one inftance, being by flides or accentual inflections, "lifting the voice up and down in the mufical fcale;" and in the other, by afcertainable intervals and perceptible gradations; "are as applicable to elocution as to fong: all fluent and harmonious fpeech (even that of the moft eafy and familiar converfation) as neceffarily and as abfolutely falling into the rythmical divifion of mufical bars, and into the two generic meafures of common and of triple time, as the warblings of the moft fcientific finger on the ftage; while feveral of the impediments which moft ferioufly obftruct and deform the elocution of injudicious fpeakers, may be proved to originate in no other caufe than the violation of thefe mufical principles, and the confequent refiftance of thofe phyfical neceffities which limit the facilities of organic action, and with which the elementary principles of harmonic proportion fo admirably and fo myfterioufly conform. 3d. In philology, alfo, elocution hath a bafis, inafmuch as to the philofophy of the ftructure and compofition of language, and to the acute refearches of the etymologift, many of thofe difputed queftions of pronunciation, quantity, and percuffive accent, which have hitherto been furrendered to the arbitrary and fluctuating decifions of fafhion, ought, in reality, to be referred."

To which might have been added that the time of fpeech itfelf, is, or ought to be, a refult of philological perception: the quantities, emphafes, and inflections of fyllables, in all perfect fpeech, being dictated by the fenfe and import of fuch fyllables; either inherent in their original ftructure and individual fignification, or derivable from fentiment and affociation.

2. As an art, the laws of elocution are partly grammatical, as arifing out of the ftructure and arrangement of fentences, and the confequent degrees of connection and relationfhip between the different words and members and portions of the difcourfe to be pronounced; partly harmonic, as connected with the practical regulation of the variations and proportions of harmonic found, with which fuch difcourfe fhould be accompanied; and partly mechanical, or experimental,

mental, as relating to the motions and pofitions of the refpective organs, by which the varieties of vocal and enunciative expreffion are produced.

3. As a matter of tafte, elocution embraces the confideration of fuch peculiar habits of ftudy, deportment, and affociation, as are favourable to acutenefs and delicacy of fufceptibility, both in the intellectual and the organic fyftem, and give them their peculiar bias and direction. In this point of view, all the finer arts, and all the more intellectual accomplifhments conftitute effential parts of the ftudies of the finifhed elocutionift. He fhould have an *eye* for the glowing tints and flowing lines of picture, the proportions of architecture and the fymmetries of ftatuary; an *ear* for the ravifhing delights of mufic; a *perception* of the vital graces of look and attitude and motion, far beyond all that the dancing fchool and the opera houfe can teach; and a *foul* tremblingly alive to all the enthufiafm of poetry, and all the poignancy of fentiment and pathos.

In vindication of the claim of this fcience to fuch an ample field of illuftration and accomplifhment, an appeal may be made from modern maxims to the example of claffical antiquity, to the facts that ftand upon record, and the relics of ancient criticifm that yet remain: for although much in the outfet of the inquiry appeared to the lecturer in the light of original difcovery, further inveftigation, we are informed, "convinced him, that many of thofe doctrines, which he imagined to be new, are only "reftitutions of decayed intelligence:" and what has, in reality, been added to the treafures that well-directed labours might have redeemed from the overwhelmed ruins of claffical criticifm, is probably confined to the phyfiological parts of the fubject, and the connection attempted to be traced between the primary laws of phyfical action and re-action, and the elements of mufical proportion."

Thefe, however, conftitute a very effential portion of the fcience of elocution; and the ftudent of that fcience muft begin, in the firft inftance, by inveftigating the ftructure and offices of thofe organs upon which the functions of fpeech depend, which will be found to confift of two diftinct claffes, the feparate actions and attributes of which, it is highly important that the profeffor at leaft fhould accurately comprehend, left by miftaking the fource of the defects to be removed, he fhould neceffarily fail in the application of the remedy. Thefe are, 1, the vocal organs, or thofe portions of the organic fyftem employed by the human (or other animated) being in the production and variation of expreffive founds; and, 2, the enunciative organs, which, in the complication and perfection of their ftructure, are peculiar to man, and are employed in fuperadding to the founds of voice, certain other fpecific impulfes, conftituting thereby the elements and fyllables out of which are compofed the whole mechanifm of human language.

When, however, thefe two claffes of organs are faid to be diftinct, that word is not to be underftood in fo abfolute a fenfe, as to preclude the fuppofition of fome of them difcharging the two-fold office of modifying the tune and fuperadding the fpecific quality of literal element. The noftrils, for example, which conftitute a very effential part of the complicated organization that gives character to individual voices, are the chief implement employed in forming the elementary founds of *n*, *ng*, &c. while the teeth, and fome other parts of the mouth, principally employed in the formation of the characteriftic elements, have, alfo, a material operation in modifying the tone of the voice. The practical diftinction is, however, fufficiently evinced, by the feparate manifeftation of their effects: the tones and inflexions of voice being exhibited in the moft exquifite perfection by feveral fpecies of finging birds, who are deftitute of the organization requifite for fpeech, and fpeech itfelf being capable of proceeding, in the human fubject, in forcible whifpers, that is to fay, by the action of the enunciative organs on a mere ftream of breath, without accompaniment of any tone, or found of voice. Of this, however, more hereafter. See VOICE, ENUNCIATION, ORGANS of SPEECH, &c.

From the ftructure of the organs, the phyfiological enquirer is next conducted to a confideration of the laws of phyfical neceffity, under which the functions of thefe refpective organs are performed; and the mode of operation by which volition accommodates itfelf to the reftrictions inevitably impofed: an inveftigation which involves feveral topics of confiderable curiofity. From the fimple principle of pendulation (the primary and indifpenfible law of all reiterated action) are explained many of the effential phenomena of enunciative and vocal expreffion, as the trill of the R; the impracticability of *reiterating* identical elements, or pronouncing, in immediate fucceffion, certain elements clofely approximating in organic formation, without intervening paufes; the facilities of certain combinations of element, the difficulty of others, and, confequently, the phyfical caufes of euphony and cacophony; (fee EUPHONY, &c.) and, above all, the nature and caufes of thofe radical differences in the qualities of fucceffive fyllables fo well underftood (in practice, and effence at leaft, if not in caufe,) by the grammarians of Greece, and defignated by them under the terms *thefis* and *arfis*, but the total inapprehenfion of which has been the caufe of fo much confufion in the theories and embarraffment in the practical inftructions of modern profeffors. The leading dogmas of this fyftem are fo felf-evident, their application to organic as well as mechanic motion, and to the actions of the organs of fpeech in particular, fo demonftrable, and the coincidence of thefe actions with the phenomena of a certain alternate energy and remiffion in the procefs of verbal utterance fo apparent, that it is only aftonifhing how the principle itfelf fhould have remained fo long obfcured. But there is ftill room enough in the world of fcientific difcovery for other Columbufes to crack the heavy end of other eggs. But our bufinefs is an abftract, not a declamation. Thus then, it is contended, that action is of two kinds, continuous, or proceeding for a certain fpace of time, in a certain direction, from one original impulfe, as the flight of a dart by the impulfe of the bow, or of a ball from the explofion of a cannon, &c.; or reiterated and capable of unlimited continuity, from fucceffive impulfe, as in the pendulum of a clock, the motion of the legs in walking, &c. But fpeech is not a continuous action proceeding for a certain fpace in a certain direction from one original impulfe, like the flight of a dart, &c. but a feries of reiterated actions like thofe of the pendulum, or of walking, &c. though much more complicated and diverfified by variety of phenomena, and, for that end, by neceffary modification of impulfe. Still, however, fpeech is action, reiterated action, refulting from reiterated impulfe, and confequently fubject to the indifpenfible law of reiteration, namely, re-action, or alternation; for as the pendulum when it has made its full fwing in one direction muft re-act in the oppofite direction, before the primary action can be repeated; and as when one of the lower extremities has been advanced at full ftride before the body it muft either be drawn back again towards its former pofition, or, by a more complicated pendulation, the body muft advance upon the limb, and thus reftore the original poife to give the other extremity an opportunity of fimilar action, before the leg firft advanced can advance again; fo when the tongue, lip, or uvula have acted in any given direction for the formation of any given element, it muſt re-act ſilently or expreſſively either upon the primary, or in ſome new direction, before the ſame element can be repeated, or any other element, requiring a ſimilar line of action can be formed. And ſo, alſo, when the primary organ of cadential or ſyllabic impulſe (the cartilage that ſurrounds the larynx) has been once contracted for the impulſion of the more energetic note, a re-action of that organ, either ſilent or accompanied by another note of leſs energy, muſt take place before the contractile energy can be renewed. Hence are derivable all the phenomena that belong to, or are to be deſcribed under the denominations of *cadence*, *meaſure*, *rythmus*, *metrical feet*, and other diſtinctions ariſing out of thoſe radical and eſſential differences in the qualities of ſyllables, ſometimes deſcribed by the terms *accented* and *unaccented*, and ſometimes by the very ſame writers, in the very ſame page, denied the diſtinction of accentuation; and ſometimes, alſo, confounded with the *quantities*, and by the denominations, of *long* and *ſhort*, but with which moſt certainly, neither accent nor quantity have any thing whatever to do. (See ACCENT, MEASURE, RYTHMUS, PROSODY, METRICAL FEET, QUANTITY, &c. See, alſo, POISE, THESIS, and ARSIS, PULSATION, and REMISSION, &c.) Hence, alſo, will be found derivable (not from caprice, or taſte, or arbitrary invention, but from phyſical principles) the diſtribution of all vocal melodies (and thence by imitation of all other melodies) into the proportions and cadences of common and of triple time; (ſee TIME,) and hence ſome light perhaps may be thrown upon that curious and hitherto unfathomable queſtion, the cauſe of the excluſive ſatisfaction received by the human ear from ſounds that follow each other in thoſe definite and ſimple proportions.

Having laid theſe foundations of theory on the ſolid baſis of experiment, the elocutionary phyſiologiſt may proceed to practice, and the crown and pinnacle of his labours conſiſt in the expoſition of the nature and cauſes of the various impediments and imperfections of ſpeech; and in the application of the proper remedies applicable to thoſe defects, whether originating in organic deficiencies, or malconformations; or adopted from imitation, confirmed by the inveteracy of erroneous habit. (See IMPEDIMENT.) The practical part of elocution alſo neceſſarily includes all that relates to the education and management of the organs of ſpeech; the improvement of the expreſſive powers of voice and enunciation; the laws of inflection, proportion and harmony; and the graces and accompliſhments with which the delivery of ſpeech (whether original or imitative) ſhould naturally be accompanied; and by which its effects upon the heart, the judgment and the imagination may be heightened and confirmed. See PHYSIOGNOMICAL EXPRESSION, GESTICULATION, &c.

Such is the general outline of the ſcience of elocution, according to the only profeſſor of modern times, by whom the ſubject has ever been treated in a ſcientific point of view, and from the notes of whoſe public lectures this abſtract is principally furniſhed; a ſcience which, however neglected, deſerves (for its practical application at once to the nobleſt purpoſes of public exertion, and the moſt familiar gratifications of private life,) a conſiderable portion of the attention of thoſe who are entruſted with the education of youth. For if oratorical excellence be an object only to the few, yet that thoſe few ſhould have the means of cultivating thoſe parts of ſuch excellence which appear to be within reach of ſyſtematic tuition, is certainly highly deſirable; and (not to dwell upon the conſideration that it is not always practicable to foreſee, during the ſeaſon of early tuition, who ſhall, or who ſhall not, be among the number of that few to whom ſuch accompliſhment might be of primary importance) "ſome degree, at leaſt, of elocutionary accompliſhment is certainly deſirable by all. There are few, indeed, to whom it would not be advantageous (at leaſt in point of mental gratification) to be able to read, with emphaſis and harmony, the fine paſſages of our poets, or the inſtructive and elegant compoſitions of our hiſtorians, moraliſts, and amuſive writers:— There is, perhaps, ſcarcely any individual who has not, occaſionally, experienced the advantage of delivering what he had to ſay with correctneſs, eaſe, and impreſſiveneſs; or (lacking this accompliſhment) who has not felt the diſadvantages reſulting from ſuch defect. Even in the ſocial intercourſes of private life, how great are the benefits of this attainment! How does it multiply the ſources of innocent pleaſure! What a zeſt does it impart to the higheſt, though moſt familiar, of our intellectual gratifications!"

"Fortunately for mankind," continues Mr. Thelwall, "this accompliſhment, ſo univerſally to be deſired, needs never to be deſired in vain. With thoſe exceptions only, which reſult from deafneſs, or from mental imbecility, I ſhall, I think, demonſtrate, that (by no greater ſacrifice of time and effort than is uſually devoted to leſs important ſciences and much more frivolous accompliſhments) correct and impreſſive elocution is attainable by all." He admits, however, "that hitherto, at leaſt, the inſtances of ſuch attainment have been exceedingly rare; that few are the Engliſhmen who converſe with fluency and impreſſive grace; and fewer ſtill who can read with tolerable harmony and propriety. Even in our churches, the ſublimeſt paſſages loſe their impreſſiveneſs from the imperfect manner in which they are delivered; and thoſe very preachers who are moſt accompliſhed in every other particular, too frequently obſcure, by the wretchedneſs of their elocution, the eloquent diſcourſes they compoſe.

"But the cauſes of this it is not difficult to diſcover. We trace them, at once, in the almoſt univerſal neglect of this important branch of education. Even of the profeſſed teachers, in this department, where is the individual who has properly explored the extent, or the principles of the ſcience, or who has even ſuſpected that ſcience had any thing to do with the ſubject? It has almoſt been queſtioned whether elocution were even an art? Excellence has been regarded as the mere myſterious gift of nature or of fortune —as the original and unſolicited diſpenſation of a partial providence; which no education could ſecure, and which ſtudy and application were ſcarcely neceſſary to improve. With reſpect to the conſtituents of that excellence, mere taſte and preſentiment have been regarded as the only arbiters; the very laws of inflection and poportion have been denied all foundation and exiſtence in the utterance of modern ſpeech; and pronunciation, tone, and melody, and even the conſtituent requiſite of percuſſive accent, (upon which the individuality, the character and the force of ſpoken words eſſentially depend,) have been abandoned to the lawleſs rule of faſhion and caprice." Introductory Diſcourſe on the Nature and Objects of Elocutionary Science.

Elocution has by many been conſidered as contradiſtinguiſhable into three ſeveral kinds, reading, recitation, and ſpontaneous ſpeech; and ſome profeſſors have marked theſe diſtinctions ſo abſolutely, as to preſcribe different ſtyles of utterance, both in vocal and enunciative expreſſion, to the reader and the reciter, from thoſe which they regard as belonging to the unpremeditative ſpeaker. Mr. Cockin, in particular, in an ingenious diſſertation (publiſhed without his name, 1775) on "The Art of Delivering written Language," has maintained this hypotheſis; and has diſcuſſed the ſubject of theſe ſuppoſed differences under the reſpective five heads of accent, emphasis, modulation, expression, (of voice as well as gesture,) and pauses; for the latter four of which, see hereafter under their respective titles. This work, we are informed in the dedication, was altogether approved by Mr. Garrick, who assured the author "that the doctrine laid down in that essay agreed exactly with his own sentiments." The popular axiom, however, "read exactly as you would speak," (supposing it addressed to a good speaker,) seems, in its principle, to be a rule much more rational than any thing that even the ingenuity of Mr. Cockin, though applauded by Mr. Garrick, has been able to adduce. It is objectionable, indeed, on account of its impracticability; pointing out a degree of perfection that was never yet attained, nor ever will be, till perfection in other arts and accomplishments shall be attained also. But the principle is not, therefore, the less valuable; the models of perfection must not be discarded from our minds, because art could never yet completely realize them: and although there are impediments, perhaps insurmountable, in the way of giving either to reading or recitation all the ease, the grace, and the vitality of spontaneous speech, yet, in principle, they should assuredly be the same; for reading and recitation are only two different modes of imitating that nature, which spontaneous speaking exhibits in her original reality; and the imitation ought to be so much the more perfect and exact, as, in this instance, the artist has the exclusive advantage of operating not only on the model, but with the very materials which nature herself employs in her creations. Mr. C., however, contends, "that reading does not receive any of its beauties from the principles of imitation, being no copy, but only another kind of speech." That, generally speaking, it is so, cannot be denied: but it is so far from unquestionable that it ought to be so, that this may be perhaps assigned as the genuine reason why the *reading* even of those very persons produces only sleep, whose unpremeditated *speaking*, is the delight of all ears; and why lectures never interest the auditors, like spontaneous harangues.

There are, however, certain particulars of essential distinction in the practical facilities; and even capabilities of excellence, in reading, recitation, and original speech, which the student of elocution ought to understand, as thereby each may perhaps be brought somewhat nearer to perfection than can be expected without the due consideration of these circumstances. Thus, for example, spontaneous speech, springing immediately from the inspiration of feeling, with all the freshness and glow of original conception, is capable of a degree of warmth, ease, and flowing energy, which can belong only to first impressions and unpremeditated language. From this very circumstance, however, it is incapable of all the smoothness, proportion, and harmony, which a minute attention to euphony, construction, rythmus, and quantity, may enable the reader and reciter to accomplish. The reader, on the contrary, who finds the language ready polished to his hands, and sees it spread out before him, has leisure for full attention to all the minutiæ of rythmical cadence; and if his ear be good, his perceptions acute, and his notions of the principles of elocutionary harmony correct, he may certainly attain a degree of perfection of utterance, in what relates to mere proportion and melody, which none but the reader must expect. But then, on the other hand, the reader (especially he who reads at sight; and if he has previously studied, he becomes, in a certain degree, a *reciter*,) pronounces what he reads, not with the feelings of an originator, or imparter, but with the feelings of a recipient; his mind is passive while his organs only are active: hence, inevitably, a certain degree of coldness and unnatural restraint. The reciter partakes of the advantages and disadvantages of both; and he has both advantages and disadvantages peculiar to himself. If what he should repeat be completely in his memory, he makes it, to a certain degree, his own, and may *approximate* to the ease of the spontaneous speaker, and the smooth melody of the accomplished reader, though he can never completely attain the unsophisticated warmth and vitality of the former, or the complete rythmus and nicely measured pauses of the latter. At the same time, by repeated experiment, he may have adjusted his tones and attitudes, and the expressions of his countenance, more completely to the sentiment and passion of the passages he is to deliver than the reader could possibly have done, and have accommodated them more completely to the rules and principles of grace, than is practicable to the spontaneous speaker: but what he gains in force and propriety he is in danger of losing in simplicity; and the mere reciter, however excellent, is more likely to extort applause than to awaken the genuine sympathies of the soul. From this view of the subject, the lecturer already cited concludes, that though the principles of English elocution, fundamentally considered, are the same, to which soever of these three modes of utterance they may be applied, yet the practical excellencies and obvious difficulties of each being peculiar, the student of elocution, whatever department be his ultimate object, should practise in all three, since reader, reciter, and spontaneous speaker, have each something to learn, from the other two, for the full accomplishment of his own particular branch of the art.

Another and more rational division of the art of elocution may be made from a consideration of the subjects to which it is applied, or the circumstances under which it is exercised. According to this principle, elocution may be considered as distinguishable into the following kinds, 1. The conversational; 2. The narrative; 3. The didactic; 4. The authoritative or judicial; 5. The argumentative; 6. The persuasive; 7. The declamatory and impassioned; relative to each of which some general rules may be laid down both with respect to voice and enunciation: as that in the first, the enunciation should be easy and familiar the tone simple, the inflection limited, and the pitch of the voice but just so far beyond a whisper as to render it tuneable. In the second, the enunciation, though exceedingly simple, should be somewhat more precise and emphatic; the tone clear, unostentatious, and impressive; level, but not monotonous. In the third, both tone and enunciation should be strong, firm, and emphatic; which in the authoritative and judicial should swell to something like pomp, mingled with a degree of firmness that in effect should border on austerity, and with respect to modulation, almost on monotony. In the argumentative, clearness of voice and perspicuity of enunciation are the principal objects. In the persuasive, the tones should be mild, insinuative, and pathetic, the pronunciation remote alike from the affectation of sonorousness and of precision. In this, indeed, as in the seventh and last description of elocution, the enunciation should rather be subservient to the tone, (that is to say, to the feelings,) than the tone to the enunciation, as the object of the speaker is rather to be understood by the heart than by the understanding. In subjects and passages of strong passion and emotion, the enunciation should be occasionally accelerated and retarded; apparently wild and irregular, but obedient always to the changes of passion and sentiment; the modulation extensively varied, and the voice ranging through great varieties of softness, force, and vehemence, of acuteness and gravity, and the whole compass of expressive or reflective intonation.

The four great schools of elocution, or rather the four great

great theatres for the exhibition of that talent, are, the bar, the pulpit, the fenate, and the ftage; and before we take leave of the fubject, fomething ought to be faid on each of thefe. We fhall confider them, therefore, in their alphabetic order.

Elocution of the Bar.—The ftyle of elocution adapted to this profeffion, will beft be underftood by confidering the objects to which the eloquence of the bar is principally to be directed. Thefe are, 1. To demonftrate, by the elucidation of evidence, difputed facts; 2. To convince, by arguments, the doubtful judgment; 3. To influence by perfuafion, or controul by declamation, the paffions, the fympathies and moral feelings of thofe upon whom the decifion of a caufe may depend. For the firft of thefe, we require an elocution diftinguifhed by impreffive diftinctnefs, an unaffected deliberation, and collected coolnefs; an enunciation precife without formality, at once terfe and familiar; a deportment candid, firm, and unaffuming. For the fecond, we demand an emphatic perfpicuity; an air of decifive, but modeft confidence; an ardour not impetuous, but chaftened and reftrained, by all the decorums of circumftance and fituation. For the laft, the nobleft, and moft arduous of all the exertions of forenfic eloquence, are required, a range of elocutionary expreffion, as various as the paffions and emotions to be commanded; an infinuating mildnefs, a melting or a kindling pathos; the tone, the look, the whole manner, gefticulation and deportment, fhould occafionally affume the entire range of expreffive variety, from the moft conciliating fympathy to the deepeft folemnity, and even, perhaps, on fome occafions to intimidating boldnefs. The occafions, indeed, on which all that is here demanded can with propriety be exerted by the forenfic orator, may but rarely occur; but when they do occur, the opportunities are decifive, and the reputation of the pleader, who is fully qualified to avail himfelf of them, is ftamped for ever.

Elocution of the Pulpit.—The objects of clerical eloquence have been oratorically thus enumerated, "to inform the underftanding even of the inapprehenfive; to aroufe the flumbering confcience; to regulate the moral feelings; to reftore the focial fympathies, which the difparities of fortune have but too much tendency to fufpend; to reftrain the fury of ambition, and check the mad career of voluptuous prodigality; to unlock the iron grafp of avarice, and expand the liberal palm to deeds of charity; to humble the towering infolence of pride, and difarm the uplifted hand of oppreffion and revenge; to infufe the fpirit of benevolence into the heart of unfeeling obduracy; to breathe the facred love of peace into the bofoms of the turbulent, and the mild fpirit of forbearance and toleration into the foul of perfecuting bigotry and prejudice." How far all thefe objects are, practically, in the contemplation of every orator of the pulpit, this is no place to difcufs; but if fuch be, in reality, among the proper objects of pulpit eloquence, it is obvious that all, and more than all, that we have demanded for the elocution of the bar, is requifite in this fpecies of elocution alfo. Among the indifpenfible requifites of fuch elocution, are a familiar fimplicity, infinuative and endearing; an impreffive energy, ftimulative and aroufing; a pathos varied, characteriftic, and defcriptive; and a fublimity awful, elevating, and commanding. A mingled folemnity and enthufiafm fhould occafionally give an air of infpiration to the preacher, and his pronunciation, and all the particulars of utterance properly included in the term enunciation, fhould be full, fonorous, and oratorical, rather than loofe and colloquial. At the fame time, nothing is more to be avoided than any overmarked peculiarity or affectation, or than the vulgar vehemence, the bawling and vociferation, which are fometimes miftaken for energy and oratorical animation.

The modes of elocution in this profeffion, are thofe of reading, as applied to portions of the fcriptures, or to fet forms of worfhip; of fermon, which may be either read, (according to the general cuftom of the church of England,) recited, (as is ufual among the preachers of the church of Scotland,) or delivered fpontaneoufly, (that is to fay, from notes or reflections previoufly digefted, without actual compofition,) as has been recommended by bifhop Burnet, and as is practifed by fome of our feparatifts, and even by a very fmall number of our regular clergy; and of prayer. Of the firft of thefe, it is only neceffary to fay, that the only circumftance in which it fhould differ from any other fpecies of reading, feems to be, that it fhould be rather more folemn, and deliberate, from refpect to the place and the occafion to which it is accommodated. In all kinds of reading, the ftyle of elocution fhould accord with the fubject, the tone and manner fhould harmonize with the language and fentiment; and as the fubjects of fcriptural and devotional reading are fo exceedingly diverfified, it follows as a confequence, that the ftyle of the reader fhould be diverfified as widely; and that nothing can be more inconfiftent with the objects of clerical elocution than monotony. With refpect to the three modes of delivering a fermon, this is not the place for difcuffing their refpective claims of preference; and what has been already faid of the application of the fame common principles to reading, recitation, and fpontaneous fpeech, and the different kinds of excellence moft attainable in each, precludes the neceffity of particular rules for them refpectively. In prayer, a folemn proftration of manner, with a confiderable mixture of enthufiafm, feems particularly required; and an efpecial avoidance of all thofe odd tricks and peculiarities, into which minifters are fo apt to fall. But the further confideration of this fubject belongs, properly, to the title Gesture.

Elocution of the Senate.—As the eloquence of the fenate is partly deliberative, partly controverfial, and partly declamatory, it requires an elocution uniting almoft all the principal requifites enumerated under the two preceding heads; and it admits, and even occafionally demands, a more impetuous warmth, a more rapid and vehement emotion, than in either of the former inftances could be at all decorous. The fermons of Maffillon might require, or, at leaft, their effect might be heightened by a denunciative feverity, an awful aufterity of manner, that fhould imprefs his audience with all the ideas and feelings of a fupernatural agency; and under fuch circumftances the oratory of the pulpit might feem to have been carried, even above the heights, and beyond the force of fenatorial and popular oratory; but it is in the fenate alone, and the popular affemblies of the nation, that the orator is to hurry away the impetuous paffions, and tranfport the hearer into abfolute action; and there only are, of courfe, required the full thunders of elocutionary energy. But it is not only in the fervid tones of an impetuous declamation, that the fenatorial elocutionift fhould excel; in the calm dignity of a well modulated cadence, and the polifhed grace and propriety of enunciation, he fhould alfo furpafs; and in the eafy urbanity of tone and euphony (when the ftronger exertions of eloquence are not required) he fhould manifeft, at once, the dignity of the ftatefman, and the elegance and refinement of the polite fcholar. How little thefe circumftances, (almoft all of them within the reach of a well directed education,) are attended to, is but too generally known; and in the humble ftate of modern oratory (as judged by its effects) the confequences may but too well be difcovered.

Elocution of the Stage.—The critical object of theatrical reprefentation is *imitation.* Its excellence is *verifimilitude.* It is a moving picture, that exhibits founds as well as objects,

jects, and a part of whose pigments are the tones of the human voice. Its elocution, therefore, should be that of Nature—Nature in her highest perfection. Ideal nature, if you please; superior, in perfection, to any thing that individual nature ever exhibited, but in principle nothing deviating from unsophisticated reality. The harmony may be more perfect, the intonation something more diversified, the inflection and range of the voice rather more extensive, the utterance a little more emphatic, and some other graces and observances may be carried a degree further than ever was observable (or perhaps practicable) in spontaneous speech and real life; but still that spontaneity and reality must be the models; and the elocution, in all essential particulars, that would be unfit for the bar, the pulpit, or the popular assembly (so far as the difference does not arise out of the different sentiments to be expressed and passions to be indulged or excited) is unfit for the stage also. It should be remembered, however, that the drama deals in the *extremes* of passion and emotion; that its moral requires that it should exhibit those passions bursting all bonds of decorum, and triumphing over the restraints of reason. The player has frequently to exhibit the judgment under the domination of passions; and is even to represent the full malignity of the worst, as well as the imprudent excesses of the best passions of our nature; while the passions of the orator are always, in reality, (though not always in appearance,) to be under the controul of his judgment; and all the malignant and evil passions are to be suppressed, or kept out of sight, any otherwise than as they may be *mentioned*, or alluded to, in moral reprehension. Hence even the simplicity and truth of principle may, and must produce, occasionally, much apparent difference of effect; and the same exercise of judgment (for the judgment of the player must, in reality, still be paramount over his passion, though he be exhibiting the very reverse) that leads the orator, to temper and qualify, may induce the actor, to exaggerate the passion. It is in these exaggerations, however, that the art and mastery of the performer are most severely tried, and taste and judgment are alike imperiously requisite. They are necessary undoubtedly to the perfection of his art; yet the instant the exaggeration is apparent, disgust begins;—the instant the vulgar feeling of wonder is excited, the tragedian sinks to a level with the rope dancer; and many a time ought he to be overwhelmed with confusion, by those very plaudits to the attainment of which he has sacrificed all the finer touches of nature that might have secured the genuine applause of sympathy and emotion. But fully to attain, or even distinctly to comprehend, the higher excellencies of theatrical elocution, requires a very different course of preparation and study from what generally falls to the destiny, or enters into the apprehensions of the professors of this art. It is not in the science of the green room, the library of the prompter, and the technical knowledge of stage trick, to make a finished actor. To deliver language well, it is necessary fully to comprehend it, not loosely and colloquially merely, but grammatically, etymologically, and sympathetically; to detect the nicest shades of allusion and discrimination, and enter into the sentiment of the author; to realize the passion, where passion is, and the character, where the composition is characteristic. To excel in any species of elocution, therefore, demands some knowledge of general literature; to be a master of that elocution that should illustrate the fine passages of Shakespeare, will require a knowledge of our language which, fully possessed, would entitle the elocutionist to the rare and valuable character of an *English scholar*. But the sources of human passion must be studied also; human nature must be known, in the general, and in the particular, in all ranks and conditions, and under all circumstances and associations. The perceptions must be diligently cultivated; the discriminative powers must be well exercised; feeling, keen, vigorous, varied feeling, must be cherished; and the imagination must be perpetually at work. For the developement of the flexible powers of the voice, no pains well directed can be too elaborate, and the mind should comprehend, and the ear should perceive the delicacies and varieties of rythmus, with all the subtile nicety of a poet. The actor so qualified will discard from his elocution all the pedantries alike of the convent and of the green room; all professional affections and prescriptive peculiarities; he will copy nature in such a style, that nature in her turn will copy him; and like the great actors of Greece and Rome, he will be worthy to give, while he receives, instructions to another Cicero or Demosthenes.

ELODES, in *Botany*, Adanson 444. (Elodea; Juss. 255.) A genus formed by Adanson of the *Hypericum Ægyptiacum* of Linnæus, on account of an oblong scale or appendage to the claw of each petal, considered by Linnæus as a sort of nectary, to which opinion he was probably led by the analogy of the nectariferous glands in his own *Hypericum Elodes*. We see no reason to separate the above plant from *Hypericum*, nor does Jussieu more than hint at the measure. See HYPERICUM.

ELODES is also used among the ancient writers in *Medicine*, for a species of fever, attended with profuse sweats.

ELOGIUM, ELOGE, a praise, or panegyric, bestowed on any person or thing, in consideration of its merit.

The word is Latin, but formed of the Greek ευλογια, *commendation;* which is compounded of ευ, *well*, and λεγω, *to say*, or *speak*.

The secretary of the Royal Academy of Sciences at Paris formerly composed the eloges of such members as died; and delivered them at the next public meeting of the company. Funeral orations are eloges of eminent persons deceased.

Extravagant and improbable eloges are of the greatest dis-service to their own design; and do, in effect, diminish the person whom they pretend to magnify, and degrade him whom they profess to exalt. Any worthy man may pass through the world, unquestioned and safe, with a moderate recommendation: but when he is set off and bedaubed with rhetoric, and embroidered so thick, that you cannot discern the ground, it awakens naturally (and not altogether unjustly) interest, curiosity, and envy; for all men pretend a share in reputation, and love not to see it engrossed, or monopolized; and are therefore apt to enquire (as of great estates suddenly got) whether the person so commended, came honestly by it, and of what credit the person is that tells the story.

ELOHA, in *Scripture*, the singular of Elohi, one of the names of God. See ELOHI.

ELOHI, ELOI, or ELOHIM, one of the names of God. But it is to be observed, that angels, princes, great men, judges, and even false gods, are sometimes called by this name. The connection of the discourse assists us in judging rightly concerning the true meaning of this word. It is the same as Eloha; one is the singular, the other the plural. Nevertheless, Elohim is often construed in the singular number, particularly when the true God is spoken of; but when false gods are spoken of, it is construed rather in the plural. Calmet, Diction. Bibl. See JEHOVAH.

ELOI. See ELOHI.

ELOIGNED, in *Law*. See ELONGATA and ELONGATUS.

ELOINE, signifies to remove, or send a great way off. Thus it is said, if such as be within age be eloined, so that they cannot come to sue personally, their next friends shall be admitted to sue for them. Stat. 13 Ed. I. cap. 15.

ELOME, a name given by ſome authors to orpiment.

ELON, in *Ancient Geography*, a town of Paleſtine, in the tribe of Dan. Joſh. xix. 43.

ELONGATA, in *Law*, is a return of the ſheriff, that cattle are not to be found, or removed, ſo that he cannot make deliverance in replevin. 2 Lil.-Abr. 454. 458.

ELONGATION, in *Aſtronomy*, The angle, under which we ſee the diſtance of a planet from the ſun, reduced to the ecliptic.

Let S T (*Plate* XII. *Aſtronomy, fig.* 104.) be the diſtance of the ſun from the earth, S L the curtate diſtance of the planet from the ſun, the angle T S L equal to the difference of longitude of the planet P and earth T ſeen from the ſun, called the commutation; the reſolution of the triangle T S L, in which the two ſides and contained angle are given, will give the angle at the earth S T L, called the elongation, and this being taken from the longitude of the ſun, if the planet is to the eaſt, or right of the ſun, will give the geocentric longitude of the planet.

The triangle S L T may be reſolved by the following rule: the leaſt ſide is to the greateſt as radius is to the tangent of an angle, from which 45° muſt be taken. The tangent of the remainder, multiplied by the tangent of half the ſum of the unknown angles, gives the tangent of half their difference, which muſt be added to or ſubtracted from the half ſum to trace the angle of elongation. This angle is the leaſt of the unknown angles in the caſe of an inferior planet when the half difference muſt be ſubtracted; it is the greateſt for a ſuperior planet when it muſt be added.

It is ſometimes uſeful to recollect the following proportions.

The ſine of the commutation is to the ſine of the elongation as the tangent of the heliocentric latitude is to the tangent of the geocentric latitude.

The ſine of the elongation is to the ſine of the commutation as the curtate diſtance of the planet from the ſun is to the curtate diſtance of the planet from the earth.

It is at the time of the greateſt elongations of the inferior planets Mercury and Venus, that they are uſually ſeen to the greateſt advantage. The greateſt elongation of Venus was, according to Ptolemy, from 45° 25″ to 47° 35′, and that of Mercury between 16° 8′ and 28° 37′. According to our modern tables theſe numbers are, for Venus 44° 57′ to 47° 48′, and for Mercury 17° 36′ to 28° 20′.

Elongation is alſo uſed, by ſome authors, for the difference in motion, between the ſwifteſt and the sloweſt of two planets; or the quantity of ſpace, whereby the one has overgone the other; called alſo *ſuperation*.

The ſwifteſt motion of the moon, with regard to the ſun, is called the elongation of the moon from the ſun. We alſo ſay diurnal elongation, horary elongation, &c.

Elongation, as it relates to *Fortification*, is a term uſed to expreſs that deviation from the immediately regular conſtruction, which is derived from a polygon formed upon a circle, to one formed upon an ellipſis, or oval: when this happens, only two of the faces retain that conſtruction and proportion which would appertain to the reſpective circles of which they would each form a part. In this we conſider the ellipſis in queſtion to be drawn upon two circles, and having a line paſſing through both their centres, as well as through the centres of the two retained faces; which neceſſarily are parallel. The two ſides, or *elongated* arcs of the ellipſis, may be divided into any number of faces, according to the extent of the area incloſed; they are uſually on the ſcale of the *greater* ſyſtem, while the ends are on the ſcale of the mean ſyſtem. Sometimes the elongation muſt be made ſo as to occupy a great extent of front; in which caſe it may become expedient to throw forth a crown-work from the centre of the *elongated* arc, or line, in order to prevent the enemy from occupying any part of the eſplanade ſufficiently near to batter thoſe works which may be rather weak for want of a flanking fire ſufficiently powerful to impede the beſiegers. Theſe crown-works anſwer much the ſame purpoſe as advanced redoubts in front of a line of entrenchments, and ſcour the whole advance ſo completely, enfilading the aſſailants, as to render it peremptorily neceſſary to become maſters of them before the lines can be carried. This will ſhew not only their ability, but the abſolute neceſſity for conſtructing all ſuch advanced defences, in that ſcientific manner which may render them untenable by the enemy, after being poſſeſſed by them, as well as perfectly incompetent to make any impreſſion on the intrenchments, which would command them *in reverſe*, that is, in their rear, and compel the enemy to quit. Crown-works being on a more important ſcale, require that every attention ſhould be paid that their batteries ſhould not bear upon any of the main defences.

The foregoing relates to regular works: for the irregular we have ſcarcely any thing like a defined rule; but it muſt always be held in mind, that the more the defences are elongated, the more they will require additional ſupport, either from various lines of fortification one within the other, or from detached works, ſo ſituated as to defend the weaker parts. This neceſſity ariſes chiefly from the ſaliant angles being rarely allowed to fall within 90°, leſt they ſhould plonge upon ſome other parts of the defences; whereas in all works formed upon a pentagon, hexagon, heptagon, or even an octagon, the angles of the baſtions may be conſiderably reduced, and the ravelines equally ſo; it is owing to this that fortreſſes, on a large ſcale, not only admit, but require, numerous additional defences to fill up the ſeveral intervals between the exterior ſaliant angles, or extremes of the defences, but to prevent the enemy from occupying poſitions favourable to their views.

We do not term works conſtructed in an irregular manner along the ſhores of a bay, or around a peninſula, *elongated*; they may be carried for miles without coming under that deſignation; it is only when a line of defence, and particularly fortifications, forming a figure either perfectly regular, or nearly ſo, are in every particular part extended, for the purpoſe of embracing more ſpace, or conforming to any particular local circumſtance, that we conſider the term *elongation* to be applicable.

In *Tactics*, the term implies ſuch an extenſion of the front as is produced artificially, without the aid of reinforcements. Thus, we draw up troops only two, inſtead of three, deep, for the purpoſe of elongating our front; which conſequently thus becomes extended to half as much more as it formerly occupied in length. This is often neceſſary, but it certainly weakens the fire and the reſiſtance throughout; beſides, it prevents the caſualties in the front from being ſo readily filled up, and is apt to leave gaps, or openings, through which the enemy's cavalry may make a charge.

Where it is abſolutely neceſſary to retain a very firm front, yet to extend it ſo far as local means may allow, eſpecially where it is principally intended to repel the enemy's horſe, thoſe parts of the line which may be moſt expoſed by the evenneſs of the ground, &c. ought to be blocked by *abbatis*, that is, timber felled and laid in ſuch a manner as ſhould obſtruct the paſſage of cavalry; behind theſe a few men ſhould be diſperſed to prick off any of the aſſailants who ſhould attempt to cut an opening, or to drag away the trees, ſo as to obtain admiſſion. Frequently trees can be cut down, but cannot be drawn away to any chofen fpot: in fuch cafe, their trunks and principal branches may be left, while their leffer boughs may be cut into ftakes and palifades for the defence of other parts. The line will of courfe be elongated by fuch devices, while the more expofed parts may retain their effective ftrength. Where a convoy is in queftion, and that the attack upon it can be made only upon one long front, which cannot be entirely covered by the waggons, &c. then, placing the artillery in the moft commanding fituations, the infantry muft be ranged in fuch manner as may *elongate* the defences, and keep the enemy in check. This will be peculiarly neceffary where a neighbouring height muft be cut off from the enemy's poffeffion, though it could not be occupied by the defenders of the convoy without weakening and dividing them.

The elongation of an attack, is where only a fmall front is fhewn at firft, but is gradually extended fo as to embrace a greater portion of the defences: thus, when after opening a battery upon a baftion only, other batteries are made to bear upon the curtain almoft parallel thereto; in fuch cafe, we fuppofe only a bridge-head, or a *fleche* to exift, but no raveline. Likewife, when a column of infantry bearing down upon, and menacing only one particular point, fuddenly deploys, and acts upon a greater extent of line, the attack is faid to be *elongated*. But, in either cafe, the term does not apply to any additional force brought to act on the fame point; it relates to extenfion merely.

Elongation, in *Surgery*, is an imperfect luxation; when the ligament of any joint is fo extended, or relaxed, as to lengthen the limb, but yet not to let the bone go quite out of its place. See Luxation.

ELONGATUS, Eloigned, a return of the fheriff that a perfon is conveyed out of his jurifdiction. See writ *de* Homine Replegiando.

ELOPEMENT, in *Law*, is when a married woman, of her own accord, departs from her hufband, and dwells with an adulterer; for which, without voluntary reconcilement to the hufband, fhe fhall lofe her dowry; nor fhall the hufband, in fuch cafe, be compelled to allow her any alimony. Stat. Weftm. 2. 13 Edw. I. c. 34. See Divorce and Dower.

"Sponte virum mulier fugiens, & adultera facta,
Dote fua careat, nifi fponfo fponte retracta."

The word is formed from the Belgic, *Ee*, matrimony, and *loopen*, to run away.

However, mere advertifing a wife in the Gazette, or other public papers, is not a legal notice to perfons in general not to truft her; though a perfonal notice given by the hufband to particular perfons is faid to be good. An action lies, and large damages are ufually given, againft a perfon for carrying away, and detaining another man's wife. See Forcible *Abduction* and Ravishment.

ELOPS, in *Ichthyology*, a genus of abdominal fifhes, the character of which, according to the Linnæan fyftem, confifts in having the head fmooth; edges of the jaws and palate rough with teeth; gill-membrane with thirty rays, and armed on the outfide in the middle with five teeth.

The genus elops is defined by Bloch as having the gill-membrane furnifhed with more than thirty rays, (fpecimens he examined exhibiting thirty-four,) and Bofc admits there fhould not be lefs than thirty to conftitute the genus. Bloch confiders the bony fhield or plate beneath the chin, and the dorfal fin being placed oppofite the ventral, as effential characters of the genus.

The only fpecies of this genus at prefent known is the Linnæan elops faurus; le lézard of the French writers. Perhaps the earlieft defcriber of this fifh is fir Hans Sloane, who, in the fecond volume of his hiftory of Jamaica, gives a figure and detailed defcription. He fpeaks of it under the name of faurus maximus, and acquaints us that it is called in Jamaica the fein-fifh, or fea gally-wafp. "This fifh (he obferves) was about fourteen inches long, in the middle five inches round, and tapering to both ends; the mouth in both jaws had one row of fmall fharp teeth, and on the upper two more within, parallel to them, and a row of the fame on the upper part of the cartilaginous tongue; three quarters of an inch from the end of the fnout were the eyes, round, and grey; there were two *pinnæ poft branchias*, two under the belly, one on the middle of the back, *poft anum* another, and a forked tail; it was all over fcaly, the back of a dark brown, and the belly of a white colour." The fpecies is found in various parts of the American feas; it was met with by Dr. Garden about Carolina, and communicated by him to Linnæus. The ftrong fpine at each fide of the tail is confidered as a fpecifical diftinction of elops faurus by Linnæus, Gmelin, and others, but this muft obvioufly remain a very doubtful character till another fpecies at leaft of the fame genus be difcovered in order to afcertain whether fuch fpines be not characteriftic of the genus inftead of the fpecies.

It has been obferved by writers that elops faurus bears fome refemblance to a pike, or rather to a falmon; with the former it has no kind of affinity whatever, but on the contrary it is fo clofely allied to the falmo tribe that were it not from being deftitute of the flefhy raylefs fin, fo uniformly obfervable on the lower part of the back in the falmon kind, we fhould be almoft induced to refer it to that genus.

The head of elops faurus is without fcales. The lower jaw rather longer than the upper. Both jaws, together with the tongue and palate, are armed with a vaft number of fmall teeth. The eyes nearly vertical; the irides double, the inner one yellow, exterior red, and the pupil black; and the eyes partly covered with the fkin of the head. The body of this fifh is flender, and the fcales large; the head yellowifh, back blueifh, fides filvery. The lateral line is ftraight. All the fins brownifh; the exterior half of the pectoral fin, anterior part of the dorfal fin, and extremity of the tail blueifh. The tail is much furcated, and divided in the middle by a diftinct longitudinal ftripe of black.

Elops, Ελοψ, in *Zoology*, the name of a ferpent, otherwife called elaps.

ELOQUENCE, the art of fpeaking or writing well, fo as to move and perfuade. The term, however, in its greateft latitude, denotes that art or talent, by which the difcourfe is adapted to its end; "Dicere fecundum virtutem orationis. Scientia bene dicendi." Quintilian. In common converfation, however, the word eloquence is feldom ufed in fuch a comprehenfive fenfe. But this definition exactly correfponds to Tully's idea of a perfect orator; "Optimus eft orator qui dicendo animos audientium et docet, et delectat, et permovet." Accordingly all the ends of fpeaking are reducible to four; every difcourfe or fpeech being intended to enlighten the underftanding, to pleafe the imagination, to move the paffions, or to influence the will. When a fpeaker addreffes himfelf to the underftanding his aim is to inform, and to convince, for the former of which purpofes the predominant quality is perfpicuity, and for the attainment of the latter, argument. By the firft we are made to know, and by the fecond to believe. The imagination is addreffed, by exhibiting to it a lively and beautiful reprefentation of a fuitable object. As in this exhibition, the tafk of the orator may be faid to refemble that of the painter, which confifts in imitation, the merit of the performance refults entirely from the two following fources, *viz.* dignity, as well in the fubject, or thing imitated, as in the manner of imitation, and refemblance, in the portrait or performance. This addrefs attains the fummit of perfection in the *fublime*, (which fee,) or thofe great and noble images, which, prefented to the mind in fuitable colouring, expand, as it were, the imagination with fome vaft conception, and quite ravifh the foul. The characteriftic of the third fpecies of difcourfe, or that which is addreffed to the paffions, is the *pathetic.* (See Passions and Pathos.) But the moft complex and moft important of all the kinds of eloquence is that which is calculated to influence the will and to perfuade to a certain courfe of conduct. This is an artful mixture, of that which propofes to convince the judgment, and of that which interefts the paffions; and its diftinguifhing excellence refults from thefe two, the argumentative and the pathetic duly blended. Thefe, combining their force and acting in concert, conftitute that *vehemence* of addrefs, which is admirably fitted for perfuafion, and has always been regarded as the fupreme qualification in an orator. This animated reafoning was by the Greek rhetoricians termed δεινότης, and from fignifying the principal excellency in an orator was ufed at length to denote oratory itfelf. Hence, as vehemence and eloquence became fynonymous, the latter, in conformity to this mode of thinking, was fometimes defined "the art of perfuafion." In order to perfuade, which, though not the only object of eloquence, is the moft important and for many reafons the moft difficult, the moft effential requifites are folid argument, clear method, a character of probity appearing in the fpeaker, joined with fuch graces of ftyle and utterance as fhall command attention to what he fays. Hearers who exercife their underftanding cannot be perfuaded, without being convinced; but conviction and perfuafion, though they are fometimes confounded, ought to be diftinguifhed from each other. Conviction affects the underftanding only; perfuafion, the will and the practice. It is the bufinefs of the philofopher to convince a perfon of the truth; but it is the bufinefs of the orator to perfuade him to act agreeably to it, by engaging the affections of the hearer. Conviction and perfuafion ought always to accompany each other, but this is not univerfally the cafe; becaufe the inclinations do not regularly follow the dictates of the underftanding. The inclination may revolt, though the underftanding be fatisfied; the paffions may prevail againft the judgment. Conviction, however, is one avenue to the inclination, or heart; and it is that which an orator fhould firft endeavour by his utmoft efforts to gain; for no perfuafion is likely to be ftable, which is not founded on conviction. But in order to perfuade, the orator muft do more than produce mere conviction; he muft duly confider the nature of man, and endeavour to act upon the different fprings by which he is moved. He muft addrefs himfelf to the paffions; he muft paint to the fancy, and touch the heart; and hence, befides folid argument and clear method, all the conciliating and interefting arts, both of compofition and pronunciation, enter into the idea of eloquence.

"We may diftinguifh," fays Dr. Blair, (Lectures, vol. ii.) "three kinds, or degrees, of eloquence. The firft, and loweft, is that which aims only at pleafing the hearer. Such, generally, is the eloquence of panegyrics, inaugural orations, addreffes to great men, and other harangues of this fort. This ornamental fort of compofition is not altogether to be rejected. It may innocently amufe and entertain the mind; and it may be mixed, at the fame time, with very ufeful fentiments. But it muft be confeffed, that where the fpeaker has no farther aim than merely to fhine and to pleafe, there is great danger of art being ftrained into oftentation, and of the compofition becoming tirefome and languid.

"A fecond and a higher degree of eloquence is when the fpeaker aims not merely to pleafe, but alfo to inform, to inftruct, to convince; when his art is exerted in removing prejudices againft himfelf and his caufe, in chufing the moft proper arguments, ftating them with the greateft force, arranging them in the beft order, expreffing and delivering them with propriety and beauty, and thereby difpofing us to pafs that judgment, or embrace that fide of the caufe, to which he feeks to bring us. Within this compafs, chiefly, is employed the eloquence of the bar.

"But there is a third and ftill higher degree of eloquence, wherein a greater power is exerted over the human mind; by which we are not only convinced, but are interefted, agitated, and carried along with the fpeaker; our paffions are made to rife together with his; we enter into all his emotions, we love, we deteft, we refent, according as he infpires us; and are prompted to refolve or to act, with vigour and warmth. Debate, in popular affemblies, opens the moft illuftrious field to this fpecies of eloquence; and the pulpit alfo admits it." See farther on the different fpecies of eloquence under the article Elocution. For the hiftory of eloquence, and an account of the moft diftinguifhed orators; fee Oratory and Orator. Thofe who diftinguifh between eloquence and rhetoric reprefent the latter as propofing and explaining the theory, and the former as the practice of the art; but they are generally ufed indifcriminately for each other. See Elocution and Rhetoric. On the fubject of this article, fee Campbell's Philofophy of Rhetoric, Blair's Lectures, vol.ii. and Cambray's Dialogues on Eloquence.

ELORA, or Ellora, in *Geography*, a town of Hindooftan, in the vicinity of Dowlatabad, famous for its numerous pagodas, moft of which are cut out of the natural rock. M. Thevenot, who has particularly defcribed them, fays, that for two leagues together nothing is to be feen but pagodas, in which are fome thoufands of figures. The fculpture of them he does not much commend; and we may apprehend, fays major Rennell, that they are of early Hindoo origin. It fhould be recollected, that Deoghire, which ftood in this neighbourhood, was the greateft and richeft principality in the Deccan; and that the fame of its riches incited Alla to attack it in 1293; and thefe elaborate monuments of fuperftition were probably, as Rennell fuggefts, the offspring of that abundant wealth, under a government purely Hindoo. Sir C. W. Malet has given a particular account of thefe wonderful excavations, illuftrated with drawings, in the fixth volume of the "Afiatic Refearches." As to their origin or date no inquiry which he had been able to make afforded him fatisfaction. He has no doubt, however, that they are the works of people, whofe religion and mythology were purely Hindoo; and he adds, that moft of the excavations carry ftrong marks of dedication to "Mahdew," as the prefiding deity. Neverthelefs he fuggefts, that the moft northerly caves of Ellora, occupied by naked fitting and ftanding figures, are the works of the "Sewras" or "Juttees," who by the Brahmens are efteemed fchifmatics, and whofe fect, called "Srawuk," is very numerous in Guzerat. The tenets, obfervances, and habits of the "Sewras" are peculiar, and in many points very different from other Hindus. Their adoration of the deity is conveyed through the mediation of "Adnaut" and "Parifnaut," the vifible objects of their worfhip, perfonified as a naked man fitting or ftanding. This fect is fuppofed to be of a comparatively modern origin; and if this be the cafe, and the hypothefis of the dedication of the temples to their idol be

 admitted,

admitted, the limit of their poffible antiquity will be affigned; but without afcertaining, or affecting, that of the others. As to the antiquity of thefe aftonifhing works, this writer has detailed two different accounts; one given by an intelligent Mahometan and another by a Hindu. The account of the firft is faid to have been derived from a perfon of acknowledged erudition. The fecond was deduced from a book, entitled "Sewa Lye Mahat," or the grandeur of the manfion of Sewa, *i. e.* Mahdew. The Mahometan reported, that "the town of Ellora was built by rajah Eel, who alfo excavated the temples, and being pleafed with them, formed the fortrefs of Deoghire (Dowlatabad,) which is a curious compound of excavation, fcarping, and building, by which the mountains were converted into a fort, refembling, as fome fay, the infulated temple in the area of the "Indur Subba" (one of the pagodas.) Eel rajah was contemporary with Shah Momin Araf, who lived 900 years ago." The Brahmen, on the other hand, faid, "that the excavations of Ellora are 7894 years old, formed by Eeloo rajah, the fon of Pefhpout of Elichpore, when 3000 years of the Dwarpa Youg were unaccomplifhed, which, added to 4894 of the prefent Kal Youg, makes 7894." Our author inclines to the former opinion. He farther informs us, that the "Koond," or ciftern, mentioned by the Brahmens, is ftill in excellent prefervation, juft without the town of Ellora; and the holinefs of its water is even now in fuch high eftimation as to render it a "Teerut" (pilgrimage) of great reputation and refort, under the appellation of "Sewalla Teerut," or "Kond." There are many other excavations in a femicircular mountain, that commands a view of the fine valley of Ellora. In order to account for thefe extraordinary works, and the fituation in which they were conftructed, it fhould be confidered, that the ancient Brahmens avoided the contamination of cities, and affected the purity and fimplicity of rural retirement. In fituations remote from obfervation, the imagination of their difciples probably enhanced the merits of their fanctity. Accordingly, to alleviate aufterities, and to gratify the devout propenfities of thefe holy men, became objects of pious emulation. Under the influence of this principle, the munificence of princes may have engaged to provide them retreats, which, fanctified by the fymbols of their adoration, were at once fuited, in fimplicity and feclufion, to thofe for whom they were intended, and in grandeur to the magnificence of their founders. Thus power and wealth may have been combined, under the guidance of enthufiafm, to produce monuments, fcarcely lefs extraordinary or lefs permanent, though lefs confpicuous and lefs known, than the pyramids of Egypt. Although fome of thefe excavations are of very ancient origin, there are others, and particularly two, in a hill near a garden in the neighbourhood of Aurungabad, formed, as it is confidently afferted, by rajah Paur Sing, one of the Rajpoot Ameers of Aurungzebe's court, as a place of retirement, during his attendance on that monarch in his excurfions to the neighbouring garden.

ELOTZ, a town of Ruffia, in the diftrict of Orlof; 112 miles E.N.E. of Orel. N. lat. 53° 20′. E. long. 39° 14′.

ELOVKA, a town of Ruffia, in the government of Tobolfk; 16 miles W. N. W. of Tomfk.

ELOY, Nicholas Francis Joseph, in *Biography*, was born at Mons, in the province of Hainault, on the 20th of September 1714, and died on the 10th of March 1788, having exercifed his profeffion as a phyfician with great ability and difinterefted humanity. He was a man of extenfive learning, and great modefty, and much addicted to ftudy; whence, notwithftanding his profeffional avocations, he was enabled to write upon a variety of topics, and his publications are numerous. His firft work, which was publifhed in 1750, was a fmall treatife, entitled "Reflexions fur l'Ufage du Thé." His next publication was an attempt at a hiftory of medicine, arranged in the form of a dictionary, and entitled "Effai du Dictionnaire Hiftorique de la Medicine Ancienne et Moderne," in two volumes octavo, which appeared in the year 1755; this work was afterwards greatly enlarged, by extending the different articles which it contained, and was publifhed in 1778, in four volumes quarto, with the title of "Dictionnaire Hiftorique de la Medicine Ancienne et Moderne;" to which, as our readers will have obferved, we have been much indebted for information relative to the different medical characters, of whom we have already given a biographical account. Eloy likewife publifhed, in 1755, a fmall volume, entitled "Cours Elementaire des Accouchemens;" and, a few years previous to his death, *viz.* in the years 1780 and 1781, he committed to the prefs two other effays, the firft of which was entitled "Memoire fur la Marche, la Nature, les Caufes, et le Traitement de la Dyfenterie;" and the other, "Queftion Medico-politique; fi l'Ufage du café eft avantageux à la fanté, et s'il peut fe concilier avec le bien de l'état dans les Provinces Belgiques?" As a flight reward for the patriotic zeal manifefted in this tract, the eftates of Hainault prefented him with a fuperb fnuff-box, with this infcription, "Ex Dono Patriæ;" *the Gift of his Country.* He held the honourable office of phyfician to prince Charles of Lorraine. Nouveau Dict. Hiftor. &c. Lyon, 1804.

ELPHIN, in *Geography*, a poft town of the county of Rofcommon, province of Munfter, Ireland, 75 Irifh miles W. by N. from Dublin, and 7 miles S. from Carrick, on Shannon.

Elphin, a bifhopric in Ireland, in the archi-epifcopal province of Tuam. It dates its origin from St. Patrick, in the middle of the 5th century. It comprizes the greater part of the county of Rofcommon, a large fcope in Sligo and Galway, and a very little in Mayo; and is reckoned one of the moft valuable of the Irifh bifhoprics. There are 75 parifhes, which are formed into 29 benefices, and of thefe 26 have churches, which are the only ones in a tract of 420,150 Irifh acres! The cathedral is a poor parifh church, but the bifhop's palace is a very good modern houfe, in the midft of an excellent demefne, and adjoining the fmall town of Elphin. Beaufort.

ELPHINSTON, William, in *Biography*, a Scotch prelate and ftatefman, was born at Glafgow about the year 1431. He was educated at the Univerfity of his native place, and became diftinguifhed for his proficiency in the learning of the times. He afterwards went to Paris, where he ftudied the civil and canon law, and likewife delivered lectures with great reputation for feveral years. Upon his return to Scotland he was promoted to church livings, and admitted a member of the king's council. He was, foon after this, appointed a joint commiffioner with the bifhop of Dunkeld and the earl of Buchan, in fettling fome difputes between the courts of Scotland and France. As a reward for the prudence and eloquence which Mr. Elphinfton difplayed on this occafion, he was, on his return, nominated to the bifhopric of Rofs; whence, about the year 1484, he was tranflated to the fee of Aberdeen, and appointed, at the fame time, to the chancellorfhip of the kingdom, an office which he held fome time with the higheft reputation; but when the troubles which took place between the king, James III., and his difcontented nobility, had involved the kingdom in a civil war, he abandoned public ftate affairs, and confined himfelf wholly to the duties of his bifhopric. But, on the acceffion of James IV. his talents as a ftatefman were again called into exercife, and from this time his fovereign undertook no affairs of moment without his advice and concurrence. He died in 1514, at the advanced age of eighty-three, leaving behind him an excellent character; he was the patron of learning and learned men, and it is fuppofed, that by his influence the bull was obtained from the pope, for eftablifhing a univerfity at Aberdeen, with as ample privileges as were enjoyed by the moft favoured feats of learning; and to his perfonal exertions and fuperintendence, it was chiefly owing that the building of King's college was undertaken and completed. To that foundation he proved himfelf a munificent benefactor during the remainder of his life; and, at his death, when he bequeathed large fums of money for its fupport. Gen. Biog.

ELPISTICI, Ελπιστικοι, among the Greeks, a fect of philofophers, who made hope the ruling paffion of mankind.

ELRICH, in *Geography*, a town of Germany, in the circle of Upper Saxony, and county of Klettenburg; formerly the capital of the county; in which are fome confiderable manufactures; 6 miles N. W. of Nordhaufen.

ELRICK, or EGELRIC ROAD, in *Antiquity*, was an ancient artificial road, made with great labour and expence through the fens, ten miles from Spalding to Deeping, by Egelric, abbot of Crowland, in the county of Lincoln, and afterwards bifhop of Durham; who, as Ingulphus relates in his hiftory of that monaftery, raifed, by means of wood and gravel, a caufeway, or caufey, for travellers, through the centre of a wild foreft and deep marfhes, called, after him, Egelric; or, by abbreviation, Elric-road. A part of it is ftill vifible, lined with willows, between the river Welland, and the marfhes north of Crowland. Gough's Tranflation of Ingulphus's Hiftory of Crowland.

ELS, in *Geography*, a town of Moravia, in the circle of Brunn, 32 miles W. of Olmutz, and 24 N. N. W. of Brunn.

ELSA, a river of Tufcany, which runs into the Arno, about a mile W. from Empoli.

ELSE, a river of Silefia, which runs into the Oder, near Oderburg.

ELSEN, a fmall town of France, in the department of the Roer, chief place of a canton in the diftrict of Cologne, with a population of 304 individuals. But the canton contains 36 communes, and 12,239 inhabitants.

ELSEN, a town of Germany, in the kingdom of Weftphalia, and bifhopric of Paderborn; 2 miles W. N. W. of Paderborn.

ELSFLETH, a fmall town of Germany, in the duchy of Oldenburg, fituated on the river Wefer, where the duke of Oldenburg exacts a confiderable toll from all veffels failing up the river towards Bremen. At the peace of Luneville, the duke was offered an indemnity for this toll, with the view to favour the commerce of Bremen; but its produce is fo important, that the duke would not confent to its abolition.

ELSGAU, a bailliage of Switzerland, being part of the bifhopric of Bafle, lying between the mountains and the Larg, and comprehending the town and bailiwick of Porentru, and 20 parifhes.

ELSHEIMER, ADAM, in *Biography*, a painter of very extraordinary talents, ftanding quite alone in the peculiar province of the lift he adopted, *viz.* fmall pictures of landfcapes with figures, and of fmall figures with landfcape back-grounds. The figures being in fome the principal object, and occupying the largeft portion of the fpace of the picture; and, in others, the landfcapes being the moft important. He was born at Franckfort; at what period, thofe who have written his life, differ much in ftating; but the beft authorities determine it to have been in 1574, and his death to have happened in 1620, fo that he lived only 46 years.

He was at firft a difciple of Philip Uffenbach, whom he foon excelled, and then determined to go to Rome, where alone he could acquire that high tafte to which he afpired.

After fome time fpent in ftudy of the fine works there expofed to his view, and an intimacy with many eminent painters, he fixed upon that ftyle of art which has been mentioned as decidedly his own; in which no one had ever before exerted himfelf; and in which no one has ever fince fo highly excelled as Elfheimer.

That which renders his pictures fo interefting is, the grandeur of ftyle in which they are executed. Many of his figures partake fo much of Raphael's beft manner of character, of action, and difpofition of the draperies, that if they were magnified, they would appear to be of that great mafter's own hand; and they have fuperadded a colour which is of a fuperior clafs; in the production of which, indeed, the fmallnefs of their fize was of confiderable affiftance to him; for it is by no means fo eafy to extend a full body of colour over a large furface, with equally pleafing variety of tone, and freedom of execution; and in it to feparate and form the diftinct parts as in a fmaller one; and though it requires more neatnefs in the execution of the latter, it does not demand fo free and fo ready a hand to unite, to blend, and foften the various parts, and to give expreffion its full force, as in the former.

His pictures exhibit great attention to nature; particularly his perfpective is very perfect, in lines, at leaft; and he not unfrequently chofe very difficult things to manage: fuch as working with a fhort perfpective diftance, and fometimes placing his figures on the top of a hill, and fuddenly lofing the ground, till it is recovered again in a deep valley. His landfcapes have, in general, the air of real views, and are finifhed with wonderful attention to general form, and beautiful fcenery. Their colour is not always exactly that of nature, but as feen under a peculiar illumination, like the tone which Titian has adopted in his St. Peter Martyr; giving it an air of grandeur not to be obtained, perhaps, by the brighter hues of nature.

From the extreme care and excellence with which his works are finifhed, they were not, of courfe, in his fhort life, very numerous; and are rarely to be met with. The richeft collection of them in this country is at the earl of Egremont's, at Petworth, in Suffex. There are ten pictures by him, eight of which are of one fize, *viz.* about four inches high, by two and a half wide, or perhaps a little more. The fubjects are, a St. Peter, St. Paul, St. John Baptift, Tobit and the Angel with a Fifh, an old Woman and a Girl, an old Man with a Boy, and a Capuchin Friar, with a model of a convent in his hand. The figures in all thefe are about three inches high, yet their characters and expreffions are juft and excellent; and the drawing of their figures, and the draperies, in the beft ftyle of art. Another picture reprefents the interior of a brothel by fire and candle light, in which there are ten or more figures gaming, and indulging in the licentioufnefs of fuch a place, all exquifitely wrought; with fome expreffions that have never been furpaffed, although the figures are not more than two inches and a half high. The laft is Nicodemus's vifit to Chrift; but it is not of fo good a quality as the others.

The

The subjects he chose were generally moon light or candle light pieces, which he painted with great lightness, spirit, and delicacy of touch, and with great knowledge of the chiaro-scuro, and excellent colour; and with such finish, that every part will bear the minutest inspection.

While he lived his pictures bore high prices, and they of course were greatly enhanced on his death; one of them is mentioned by Houbraken, representing Pomona, as having sold for 800 German florins. There are engravings from many of Elsheimer's pictures by his friend and benefactor, count Gaud; but they are in general too heavy and black, and have a flatness of effect, particularly in the trees, very unlike the originals; among them is one from his most famed picture, the Flight into Egypt, a moonlight. It is now, with two others of different subjects, in the National Museum at Paris.

Elsheimer, though thus endowed with taste and skill, was not the favourite of fortune. Notwithstanding he obtained great prices for what he did, yet his care in the execution of them, and the time they cost him to finish, were not so recompensed as to enable him to live and maintain a large family with comfort. As what he earned by his paintings would not find sustenance for himself and them, he fell into debt, and was cast into prison; the disgrace of which, though he was not suffered to remain long confined, is said to have preyed on his spirits, and hastened his dissolution. He was greatly regretted, and his works eagerly bought up, even by the Italians. The grand duke of Tuscany had several of them, and the world justly lamented the severe fortune of so extraordinary a genius, who deserved far more felicity than he was permitted to enjoy.

Elsheimer is highly celebrated, says another writer, for his careful pencil and extraordinary effects of light. Most of his landscapes are illumined by fire, or by moon, or torch light; and in them he has introduced small historical figures, which are highly appropriate to the scenes, and most exquisitely painted: yet his Aurora, of which there is an excellent print by count Gaudt, shews that bright and sudden light was not absolutely necessary to the display of his powers, and that he dipped his pencil in early dawn, with equal felicity.

The accuracy of his observation, and the retention of his memory were great, and the skill was scarcely less with which he introduced into his compositions, such picturesque incidents as he had once seen. Pilkington says that "it is impossible to conceive any thing more exquisite in painting than the productions of the pencil of Elsheimer; for whether we consider the fine taste of his design; the neatness and correctness of the drawing of his figures; the admirable management and distribution of his lights and shades; the lightness, the spirit, and the delicacy of his touch; or the excellence of colouring; we are astonished to observe such combined perfections in one artist; in whose works even the minutest parts will bear the most critical inspection, and the whole together is inexpressibly beautiful. He understood the principles of chiaro-scuro to the utmost perfection; and shewed the solidity of his judgment in the management of his subjects, which for the most part were night-pieces, by candle, or torch light," &c.

With these high claims to contemporary patronage, it was the fate of Elsheimer to fall a martyr to his own merits. Not affluence, nor even comfort, attended him in his professional pursuits. His family was numerous, and the great care with which his sensibility to the minuter beauties of nature prompted him to finish his pictures, occupied so much time, that he was gradually overwhelmed with debts, and cast into prison. Being much respected, he was soon released; probably by his friend Gaudt, the engraver: but returned, spirit-broken, to his art, and survived not long. Posterity will reverence his professional merits, and regret his misfortunes.

Of artists of transcendant talent, it has been the frequent lot to receive from their contemporaries but a trifling earnest, either of the value of their works, or the extent of their fame: so blind is taste, with all its lofty pretensions, or so reluctant is human nature to recognise the claims of living excellence.

Among the most celebrated of his works, which are known through Europe, by the diffusion of count Gaudt's excellent engravings after them, may be mentioned his "Flight into Egypt," wherein he has contrasted the effects of fire and moonlight; two landscapes, in each of which he has introduced "Tobit and the Angel;" a "Cottage Door by Candle-light, with Ceres drinking from a Pitcher;" the story of "Baucis and Philemon;" the "Decollation of John the Baptist;" "Latona and her Sons, with the Lycian Peasants metamorphosed into Frogs;" and the "Death of Procris:" the two latter subjects were engraven in England by Magdalen Pass. Some of his most valued performances were late in the gallery of the grand duke of Tuscany. L.

ELSHOLTZIA, in *Botany*, so named by professor Willdenow in memory of a Prussian botanist, John Sigismund Elsholtz, who lived in the middle of the 17th century, and published a *Flora Marchica*, or catalogue of plants cultivated in the principal gardens of Brandenburg, printed at Berlin in 1663, in small 8vo. Willdenow mentions also a manuscript work on Horticulture by the same writer in his native tongue, preserved in the royal library of Berlin.—Willden. in Römer Usteris Magazine, fasc. 11. 1. t. 1. Sp. Pl. v. 3. 59. Class and order, *Didynamia Gymnospermia*. Nat. Ord. *Labiatæ*, *sect.* 3. Juss.

Gen. Ch. *Cal.* Perianth of one leaf, bell-shaped, with ten furrows, and five oblong acute teeth; the orifice closed with hairs. *Cor.* of one petal, ringent: tube cylindrical, short, the length of the calyx: upper lip shortest, obtuse, concave, four-toothed, clothed externally with long white hairs; lower obtuse, straight, sharply crenate, externally clothed with hairs. *Stam.* Filaments four; the two uppermost shortest, lodged in the upper lip; the two lowermost in the under one: anthers roundish. *Pist.* Germens four, roundish, superior: style thread-shaped: stigma cloven. *Peric.* none. *Seeds* four, naked, brownish, in the bottom of the calyx. Willdenow.

Ess. Ch. Calyx tubular, five-cleft. Corolla ringent: upper lip four-toothed; lower longest, undivided, finely crenate. Stamens distant.

1. E. *cristata*. Willd. as above. (Hyssopus ocymifolius; Lamarck Encycl. v. 3. 187.) "Spikes solitary, erect." Native of Siberia, about the lake Baikal. *Root* annual, fibrous. *Herb* with the habit of an *ocymum*, and a very fragrant scent, especially when rubbed after drying, compared by some to roses, but in our opinion more resembling the muscat grape. *Stem* a foot or more in height, square, leafy, with opposite branches. *Leaves* stalked, opposite, ovate, acute, serrated, light green, smooth. *Spikes* terminal, solitary, stalked, unilateral, consisting on one side of a double row of obovate, pointed, imbricated bracteas, and on the other of three or four dense rows of pale lilac-coloured flowers. This plant is propagated by seed, with little trouble, in our gardens, but has more singularity than beauty in its aspect. The scent indeed renders it desirable.

2. E.

2. E. *paniculata.* Willd. Sp. Pl. v. 3. 59. (Hyſſopus criſtatus; Lamarck Encycl. v. 3. 187. Manám-podám; Rheede Hort. Mal. v. 10. 129. t. 65.) "Spikes panicled, reflexed." Native of moiſt places on the coaſt of Malabar. Lamarck, who had in his poſſeſſion fine ſpecimens of this plant from Sonnerat, aſſures us that the leaves are not alternate, as drawn in the *Hortus Malabaricus*, but oppoſite as in the preceding ſpecies, with which he rightly perceived its generic affinity. The chief ſpecific difference ſeems to be in the inflorefcence, which in the plant we are deſcribing is panicled, each branch of the panicle conſiſting of a numerous ſeries of reflexed ſpikes, ſhorter than in the former, with more oblique, unequally cordate, bracteas. Every part of this herb is ſaid to exhale an agreeable aromatic odour. The root ſeems to be annual.

ELSIMBURG, in *Geography.* See HELSINBURG.

ELSINEUR, in Daniſh *Helſingoer*, a handſome town of Denmark, in the iſland of Zealand, at the entrance of the Baltic, oppoſite the Swediſh coaſt, 20 miles N. of Copenhagen. E. long. 12° 34′. N. lat. 55° 58′. The population amounts to between 6 and 7000 individuals. It derives its name from the Helſingers, an ancient Gothic colony, and is ſituated on the declivity of a hill, almoſt directly over-againſt Helſinburg, in the Swediſh province of Scania. The paſſage is not above 4 Engliſh miles. The narrow arm of the ſea, which joins the North ſea and the Baltic, is called the Oereſund, or *Sound*, and is protected by the caſtle of *Cronenburg*, which ſee.

Till the year 1425, when king Erick of Pomerania beſtowed on it the privileges of a city, Elſineur was but a ſmall inſignificant place. It has two churches, a grammar-ſchool, ſeveral handſome private buildings, and a ſugar-houſe. In 1753, a harbour was attempted, but the execution of the project was found impracticable. The road-ſtead, however, is excellent.

The principal trade of Elſineur is in wine and ſpirituous liquors; but it derives all its importance from the Sound dues, which, in times of peace, are paid at Elſineur by all veſſels paſſing through the Sound from either the Baltic or the North ſea. The cuſtom-houſe, where theſe duties are paid, is a very fine building, and it is on account of this toll, that all nations trading in the Baltic keep a conſul at Elſineur. The Sound dues are in proportion to the ſize of the ſhip and to the value of the cargo. They were originally a mere contribution to the expence of keeping light-houſes on the coaſt.

The number of veſſels of different nations that ſailed through the Sound and paid the dues at Elſineur, was in

1768 - - - -	6930 veſſels.
1778 - - - - -	8476
1788 - - - - -	9224
1792 - - - - -	12,114
1798 - - - - -	9508
1802 - - - - -	12,130
1803 - - - - -	11,631
1804 - - - - -	10,579
1805 - - - - -	11,587
1806 - - - - -	7140
And in the firſt three months of	
1807 - - - - -	342

From which ſtatement it appears, that the Baltic trade has been moſt conſiderable in the years 1792 and 1802, which both preceded the two late ruptures between England and France. See SOUND.

ELSNABBAN, a ſea-port town of Sweden, in the province of Sudermania, on the coaſt of the Baltic; 32 miles E.N.E. of Nikioping.

ELSNER, JAMES, in *Biography*, a doctor of theology, was born, in 1692, at Saalfield, in Pruſſia, and was deſtined by his father for trade, to which, however, he felt ſo ſtrong a diſinclination, that nothing could overcome it. He was accordingly ſent to the univerſity of Konigſberg, where he became private tutor to ſome young noblemen, and was afterwards appointed chaplain in the garriſon to field-marſhal count Alexander Von Dohm. He next went to Utrecht and Leyden, where he formed an intimacy with the moſt eminent literary characters of thoſe cities. In the year 1719, he publiſhed a work on the delivery of the law on Mount Sinai, and ſhortly after the firſt volume of his "Sacred Obſervations on the New Teſtament." In the following year he left Holland, at the invitation of his Pruſſian majeſty, by whom he was appointed profeſſor of theology and the oriental languages at Lingen, having firſt taken his degree of doctor at Utrecht. From this place he was called to Berlin to reſtore the reputation of Joachim's ſchool, which had fallen into much diſrepute for want of proper diſcipline. Elſner performed all that was required of him, and attained a high degree of reſpect, by the dignity and firmneſs of his manners In the autumn of 1722, he pronounced an inaugural diſcourſe on the obligation of uniting piety to learning; and immediately after this, he was choſen a member of the Royal Academy of Sciences. Other preferments were conferred upon him, and he was always very fully employed either as a preacher or an author; and, in 1742, he was appointed director of the claſs of the belles-lettres in the Royal Academy; and when the ſociety was renewed in 1744, he retained the ſame office, and maintained the character which he had heretofore ſupported, as well by his attention to his academical duties, as by the learned diſſertations with which he enriched the memoirs of the inſtitution. He died of a fever on the eighth of October, 1750. His works are very numerous, and on various topics, but chiefly in theology. He publiſhed alſo, "A new deſcription of the ſtate of the Greek Chriſtians in Turkey," in which he received very important aſſiſtance from Athanaſius Doroſtamos, who came to Berlin to collect money for the Chriſtian ſlaves in England.

ELSTER, originally *Halſtrow*, in *Geography*, a ſmall town of the kingdom of Saxony, in Upper Luſatia, on a river called the *Black Elſter*, remarkable for its manufacture of knitted ſtockings.

ELSTERBERG, a ſmall town of the kingdom of Saxony, in the circle of Voigtland, between ſome high hills on the river Elſter, with an old ruined caſtle. It has a grammar-ſchool, about 2000 inhabitants, and a flouriſhing manufacture of ſtuffs and woollen cloth.

ELSTERWERDA, a ſmall town of the kingdom of Saxony, in the circle of Meiſſen, on the river Elſter, with a fine hunting caſtle and a beautiful park. It has only 700 inhabitants; but is remarkable for a canal which was dug here in 1740, and by means of which it has a conſiderable timber trade to Meiſſen and Dreſden.

ELSTOB, WILLIAM, in *Biography*, was born at Newcaſtle-upon-Tyne, in the year 1673. He was educated at Eton and Cambridge, but the latter place not being congenial to his health, he removed to Queen's college Oxford, where he was choſen fellow and tutor. In the year 1697, he took his degree of M. A., and in 1702 was appointed rector of the united pariſhes of St. Swithin and St. Mary Bothaw in London. He died in 1714, when he was only forty-one years of age. He publiſhed ſeveral works, and had collected materials for a hiſtory of Newcaſtle. He had likewiſe projected many literary deſigns, of which the moſt important,

important, was an edition of the Saxon laws, with great additions, together with notes of various learned men, and a prefatory hiftory of the origin and progrefs of the Englifh laws, down to the Conqueror and to Magna Charta. This great work was completed in 1721 by Dr. Wilkins, who deplores the lofs which the literary world had fuftained in the early death of Mr. Elftob. He intended alfo a tranflation, with notes, of Alfred's Paraphraftic Verfion of Orofius, of which his collections came into the poffeffion of the late Dr. Tegge. This work was afterwards publifhed by the Hon. Daines Barrington, with an Englifh tranflation, who made ufe of Mr. Elftob's tranfcript. Biog. Brit.

Elstob, Elizabeth, fifter of the preceding, was attached to the fame kind of purfuits, and was born at Newcaftle in 1683. From a very early period fhe fhewed a ftrong predilection for literary purfuits. She refided at Oxford during her brother's continuance at that univerfity, and is defcribed as having been the *indefeffa comes* of his ftudies. She probably accompanied him to London, and affifted him in his antiquarian purfuits. To one of his publications, *viz.* the Homily on St. Gregory's day, fhe gave an Englifh tranflation, and a preface in vindication of female learning. By the encouragement of Dr. Hickes, fhe undertook a Saxon Homiliarium with an Englifh tranflation, notes, and various readings, but only a few of the homilies were printed at Oxford in folio. In the year 1715, fhe publifhed a "Saxon Grammar," the types for which had been cut at the expence of lord chief juftice Parker, afterwards earl of Macclesfield. After the death of her brother, her circumftances were fo very low, that fhe was reduced to the neceffity of keeping a fchool at Evefham, in Worcefterfhire. By the interceffion of fome friends, queen Caroline allowed her a penfion of twenty guineas, which was paid very regularly till the death of that princefs, when fhe was again reduced to great difficulties, and had recourfe to education as a refuge from poverty. In 1739, fhe was received into the family of the duchefs of Portland, where fhe continued till her death in the year 1756. Biog. Brit.

ELSYNGE, Henry, was born at Batterfea in 1598, and received his education at Weftminfter-fchool, and Chrift-church college, Oxford. From the univerfity he went to the continent, and fpent feven years in foreign travel. Upon his return he was, through the intereft of archbifhop Laud, elected clerk of the houfe of commons, the duties of which office he performed with fingular ability, and much credit. He acquired the efteem of all parties in the midft of much difcord and faction, and kept his poft under the long parliament till December 1648, when he chofe to retire rather than take a part in the trial of the king. After this, he declined public bufinefs till his death in 1654. As an author his chief publication was entitled "The ancient Method and Manner of holding Parliaments in England." This was firft printed in 1663. Anthony Wood fuppofed that it was chiefly tranfcribed from a MS. of the author's father, who was clerk of the houfe of lords, but there is no doubt it received many valuable additions from our author's own parliamentary experience. Mr. Elfynge left a tract concerning proceedings in parliament, never publifhed; and alfo other tracts and memorials. Biog. Brit.

ELTEN, in *Geography*, a fmall town of Germany, in the new kingdom of Weftphalia, formerly a free imperial abbey, which was fecularized at the peace of Luneville, and given as an indemnity to the king of Pruffia, who loft it again at the peace of Tilfit in July, 1807.

ELTERLEIN, a fmall town of the kingdom of Saxony, in the circle of the Ertzgebirge, fituated between Annaberg and Grunhayn, with about 1000 inhabitants. It is chiefly remarkable for the adjacent mines, which yield excellent magnefia and a very fine potters' clay for china. There is likewife a good manufacture of thread lace at Elterlein.

ELTHAM, a large village in the hundred of Blackheath and lathe of Sutton, in the county of Kent, England, confifts of 256 houfes, which are occupied by 1627 inhabitants. Its ancient name was Eald-ham, the old manfion or dwelling. John de Vefei, lord of Eltham, procured a grant of a market for this manor; and two other grants relating to it are extant among the records in the Tower. The market appears to have been difcontinued in the time of James I., when the royal palace, the remains of which ftand about two furlongs fouthward from the village, ceafed to be vifited by our kings.

Eltham palace was for feveral centuries a favourite retreat of the Englifh fovereigns, to which, probably, its vicinity to the metropolis contributed, as well as the pleafantnefs of its fituation. When it was originally built is unknown, yet it muft have been prior to the year 1270, when Henry III. kept a grand public chriftmas here, accompanied by his queen and all the great men of the realm. In the next reign, Anthony Bec, the warlike bifhop of Durham, obtained poffeffion of it, and confiderably improved it: he died here in 1311. Edward II. frequently refided here; and in the year 1315, his queen was delivered of a fon in the palace, who was called John of Eltham, from the place of his birth. Edward III. held a parliament here in 1329, and another in 1375, when the Commons petitioned him to make his grandfon, Richard de Bourdeaux, prince of Wales. Edward IV. was at a great expence in repairing the palace, where, in 1482, he kept his chriftmas in a very magnificent and coftly manner, two thoufand perfons being daily fed at his charge. Moft of the fucceeding monarchs, to the time of Henry VIII., refided much in this palace; but on the rife of Greenwich it was gradually deferted. The change which it has undergone is exceedingly ftriking: formerly the abode of fovereigns, and the birth-place of princes, it is now a farm; and the beautiful great hall, where parliaments were held, and entertainments given in all the pomp of feudal grandeur, is now ufed as a barn for the houfing and threfhing of corn. The area, in which the buildings ftand, is furrounded by a high ftone wall, that has been partially repaired and ftrengthened by arches, &c. of brick, and a broad and deep moat, over which are two bridges, nearly oppofite to each other, on the north and fouth fides. The hall is a moft noble remain, meafuring 100 feet in length, by 56 broad, and about 60 high. The windows have been extremely elegant, but are now bricked up. The roof is of timber, curioufly wrought in the manner of that of Weftminfter-hall, and richly ornamented with finely carved pendants. Three parks, well provided with deer, were formerly connected with this palace: in the largeft, which includes an area of two miles in circumference, ftands a refpectable manfion, called Eltham lodge. Hafted's Hiftory of Kent.

ELTMAN, a town of Germany, in the circle of Franconia, and bifhopric of Wurzburg; 8 miles W.N.W. of Bamberg, and 40 E.N.E. of Wurzburg.

ELVAS, formerly *Jelves*, a town and bifhop's fee of Portugal, in the province of Alentejo, containing three parifh churches, feven convents, two hofpitals, and 12,500 inhabitants, including the diftrict, in an open and fruitful territory, 18 leagues N.E. of Evora, and fix W. of Badajoz, in Spain. It has a caftle on an eminence, and is commanded by Fort la Lippe, a new and ftrong fortification on the top of a hill. Here is a remarkable aqueduct, fupported

ported in fome places by three arches one over the other; the ftreets are narrow, irregular, and dirty; and the houfes are indifferently built. At fome diftance from the town the country is bleak and barren. N. lat. 38° 44′. W. long. 7°.

ELVÆ. See ELFS.

ELUDING, the act of evading, or rendering a thing vain, and of no effect: a dextrous getting clear, or efcaping out of an affair, difficulty, embarraffment, or the like.

We fay, to elude a propofition, &c. The defign of chicanery is, to elude the force of the laws; this doctor has not refolved the difficulty, but eluded it. Alexander, fays the hiftorian, in cutting the Gordian knot, either eluded the oracle, or fulfilled it: "Ille nequicquam luctatus cum latentibus nodis, Nihil, inquit, intereft, quomodo folvatur; gladioque ruptis omnibus loris, oraculi fortem, vel eludit vel implevit." Q. Curt. 13.

ELVEN, in *Geography*, a fmall town of France, in the department of Morbihan, chief place of a canton in the diftrict of Vannes, with a population of 3829 individuals. The canton contains five communes and 9136 inhabitants, upon a territorial extent of 220 kiliometres.

ELVERDINGHE, a fmall town of France, in the department of the Lys, chief place of a canton in the diftrict of Ypres, with 2729 inhabitants. Its canton has a population of 9057 individuals difperfed in 9 communes, on a territorial extent of 112½ kiliometres.

ELVERS, in *Ichthyology*, an Englifh name for a fmall fort of eels, caught in fome parts of the kingdom, particularly about Gloucefter and Tewkfbury. Thefe are, in reality, young congers, or fea-eels. They get up into rivers while very fmall, and as they precede the fhads, it is conjectured that they fupply them with food. They are taken in prodigious numbers in the rivers, in dark nights, by a kind of fieve made of hair-cloth, fixed to a long pole, and are efteemed a very delicate food. Willughby.

EL-VISO, in *Geography*, a well built town of Spain, in the province of New-Caftile, and diftrict of La Manche, containing a parifh church, a convent, a palace of the marquis D'El-Vifo, and 3500 inhabitants, about 20 leagues S.W. of Alcaraz; and 13 S.S.E. of Ciudad Real, fituated in a fertile plain, producing corn, wine, and fruits.

ELVIUS, PETER, in *Biography*, was born at Upfal in 1710, and applied himfelf in early life to the ftudy of mechanics, under able mafters. In the year 1738, the royal college of Mines entrufted him with the care of its collection of machines. His own knowledge enabled him to conftruct a fulling mill on new principles. In 1743 he undertook, with M. O. Hamren, a tour through the kingdom of Sweden, to examine where the beft fituations could be obtained for works to be driven by water; and on this occafion he drew plans of thofe places which feemed moft convenient for the purpofe. For this fervice he obtained a place in the academy of Upfal, and applied himfelf to the calculation of chances and probabilities, which led him to confider the exifting bills of mortality, and the means for rendering them more accurate and ufeful. He was a diligent obferver of the heavens, and on the ifland of Huen fearched out the ruins of the refidence of Tycho Brahe, and made fome celeftial obfervations amidft the remains of Uranienburg. He died at the early age of 38, on the 27th of Sept. 1749, and the Academy of Sciences, to which he had been the fecretary, caufed a medal to be ftruck in honour of his memory. Gen. Biog.

ELUL, in *Chronology*, one of the Hebrew months, anfwering partly to our Auguft and September. There are but nine and twenty days in it. It is the twelfth month of the civil year, and the fixth of the ecclefiaftical. Upon the feventh or ninth day of this month the Jews faft, in memory of what happened after the return of thofe who went to view the promifed land. Numbers, xiii. xiv.

Upon the twenty-fecond of this month, the feftival of the xylophori was obferved, when wood was carried to the temple. Selden fays, that it was celebrated on the eighteenth day of the month Ab. On the twenty-fixth of the fame month, the dedication of the walls of Jerufalem by Nehemiah was commemorated. Jofeph. lib. ii. cap. 17. p. 811. Nehem. xii. 27, &c. Calmet, Diction. Bibl.

ELVO, in *Geography*, a river of Italy, which runs into the Sefia, 2 miles N. of Vercelle.

ELUSA, in *Ancient Geography*, a town of Paleftine, in Idumæa, W. of Jordan, according to Ptolemy. This town was once an epifcopal city, and it is placed by P. Hardouin in the third Paleftine.

ELUSA, called alfo *Elufæ*, and *Civitas Elufatium*, a town of Gaul, was formerly the metropolis of Novempopulania, and maintained that rank till the eighth century. But upon its deftruction by the Normans, the fee of Auch was advanced to the rank of Metropolitan. Some remains of this place retain the name of Ciutat near Eufe.

ELUSATES, the inhabitants of Elufa, who occupied the N.W. diftrict of Armagnac. Cæfar mentions them, and places them between the Tarufates and the Garites.

ELUTRIATION, or *wafhing over*, is a method of feparating fubftances of different fpecific gravities from each other by means of water. For this purpofe the mixture is ftirred about brifkly in a veffel full of water, and when the heavier particles have again fallen to the bottom, the water, ftill turbid with the lighter ones that are as yet fufpended, is poured off into another veffel, to the bottom of which they, in a fhort time, fubfide. By this fimple method a fkilful perfon will feparate from each other three or four fubftances with great exactnefs.

ELUVIES, in *Geology*, is a term ufed by Mr. Parkinfon, (Organic Remains, i. 275.) and fome other writers, to exprefs the fuppofed ruins of the antediluvian earth, effected by the Noachic deluge, but which it is prefumed by others, from the Mofaic account of that miracle, did not deftroy the exifting vegetable productions or the fifh, and much lefs therefore could it have effected the univerfal difintegration of mineral fubftances, on which Dr. Woodward's and fome other theories are built. Befides, the animal and vegetable fubftances, which are found imbedded in the fuppofed poft-diluvian ftrata, are none of them of the fpecies, which, by the eftablifhed modes of generation, have been handed down to us, immediately from thofe individuals of each fpecies which Noah preferved in the ark, when the reft were drowned by the flood.

ELUXATIO, (from *eluxo*, to put out of joint,) a diflocation.

ELWAD-AD, in *Geography*, a town of Arabia, in the country of Yemen; about 40 miles nearly W. of Chamir. N. lat. 16° 16′. E. long. 42° 30′.

ELWALL, EDWARD, in *Biography*, was born at Sedgley, near Wolverhampton, in Staffordfhire. At Wolverhampton he fettled in bufinefs, and acquired the reputation of honefty and great integrity in his dealings. As a politician, he was diftinguifhed as the zealous affertor of the civil and religious rights of the people, and as a vigorous fupporter of the Hanoverian fucceffion. He was of a ferious and inquifitive turn of mind, and never hefitated to proclaim his fentiments on any fubject that he deemed important. He confidered the fourth commandment as binding on all generations, and not only wrote in defence of the opinion, but while in businefs, conftantly fhut up his fhop on the feventh day, and opened it on the firft day of the week; hence he was ftigmatized as a Jew. About the year 1714 he became diftinguifhed as an Unitarian, and publifhed "A true Teftimony for God and his facred Law, being a Defence of the firft Commandment of God, againft all Trinitarians under Heaven." This drew on him the refentment of the neighbouring clergy, who ceafed not to purfue him with their enmity, till they procured an indictment againft him for herefy and blafphemy; on which he was tried, without having had a copy of his indictment, before judge Denton about the year 1726, at Stafford affizes. He pleaded his own caufe, and vindicated the principles which he had embraced with a firmnefs and prefence of mind, faid to have been rarely equalled in modern times, and with complete fuccefs, for a refpectable and honeft jury, under the direction of an upright judge, acquitted him. Mr. Elwall was not daunted by the obloquy and profecution which his firft piece had drawn on him from defending with freedom the fentiments for which he had fuffered, but publifhed feveral other tracts, having the fame tendency. After his trial he removed to London, and became a member of the feventh-day Baptift church at Mill-yard, Goodman's fields. In the latter part of his life he frequently attended the religious affemblies of the quakers, and was fometimes admitted to fpeak among them. He died in London at an advanced age, with an unfullied reputation, about the year 1745. He had not enjoyed the advantages of a learned education; but his natural abilities, and good judgment, were fuch as rendered his converfation agreeable to perfons in the higher ranks of fociety, by whom he was known, and refpected, on account of his ardent attachment to the houfe of Hanover. Speaking of himfelf, his principles, and conduct, he fays, "I have been a fturdy and ftrenuous friend to my royal friend George thefe forty years and upwards, ever fince the nation happily fettled the crown in his illuftrious family; and many a ftately Jacobite and Tory have I filenced by dint of argument, and brought to the ground by dint of fift, yet generally in felf-defence, and not to convince his judgment." He was a man of inflexible integrity and of extenfive charity, as well as of fervent piety.

ELWANGEN, in *Geography*, a fmall town of the kingdom of Wurtemberg, 18 miles S.E. of Halle, in Suabia, and 30 S.W. of Anfpach. It was formerly a rich abbey of the German empire, whofe prelate ranked as a prince, and voted in the college of princes. At the peace of Luneville it was given to Wurtemberg as an indemnity for the territory which its fovereign was forced to cede to France on the weftern fhore of the Rhine.

ELWY, Britain, the name of two rivers in Wales, one rifing near Gwythrin, in the weft part of Denbighfhire, in North Wales, runs eaftward for fome miles, then fuddenly turning northward above St. Afaph, paffes by that city, and falls into the Clwyd, about three miles below it. Another river of the fame name rifes in the mountains to the northward of Capelton Ybedyddier, in Glamorganfhire, South Wales; and running in a fouth-eafterly direction paffes Henfall park, St. Fagan's, &c. and meeting the Taf, at the Embochure, near Penarth-point, forms Penarth harbour.

ELXAI, in *Biography*. See Elcesaites.

ELY, Isle *of*, in *Geography*, a tract of land fo called, is fituated in the northern part of Cambridgefhire, England, and was formerly furrounded by waters; but, in confequence of the vaft improvements made by draining the fens, &c. it is now merely known by the name of an ifland. The whole diftrict, called the ifle of Ely, extends from the bridge at Tyd on the north, to Upwere on the fouth, 28 miles in length; and from Abbot's or Bifhop's Delf on the eaft, to the river Nene, near Peterborough, on the weft, 25 miles in breadth: and includes feveral confiderable towns and villages, of thefe the principal place is

Ely, which, though far from populous, claims, as being the fee of a bifhop, the appellation of a city. It is fituated on a fmall eminence near the river Oufe, and owes its origin to the eftablifhment of a monaftery here, A.D. 673, by Etheldreda, daughter of Anna, king of Eaft-Anglia. After her death, in 679, the government of the abbey fucceffively devolved on her fifter Sexburga, queen of Kent; Ermenilda, queen of Mercia, daughter of Sexburga, and the princefs Werburga, her grand-daughter, all of whom were, with the foundrefs, for many centuries confidered as faints. A town gradually arofe about the monaftery; and both remained in peace and fecurity till the year 870, when this place of monaftic retirement was difcovered by the Danes, who invaded the ifle, and, though at firft repulfed by the bravery of the inhabitants, returned in greater numbers, and overcame every defenfive effort. They put the religious to the fword, fet fire to the church and other buildings, and departed, loaded with the fpoil, not only of the town and monaftery, but alfo of all the neighbouring places, whofe inhabitants had depofited their valuables here for better fecurity. Some of the inmates of the monaftery, who had efcaped the maffacre by flight, returned a few years afterwards, and commenced a college for fecular clergy, which continued till 970, when the monaftery was reftored to its former eftablifhment by Ethelwold, bifhop of Winchefter, under the patronage of king Edgar, who, in confideration of a large fum paid by the bifhop, gave up to the convent the jurifdiction of the ifle, which after the Danifh maffacre had been annexed to the crown. Bifhop Ethelwold beftowed large benefactions on the abbey, which now confifted of regular monks of the order of St. Auguftine. Brithnoth, the firft abbot, exerted himfelf to complete the repairs of the church. The abbey continued to profper till the conqueft: its privileges being previoufly augmented and confirmed by Canute, and again by Edward the Confeffor, the latter of whom had received his education within its walls. During the confufion which enfued on the Norman invafion, the abbey was deprived of many eftates; and Thurftan the abbot, fearing that its whole poffeffions would be feized by the Conqueror, refolved to fupport the intereft of Edgar Atheling, in which he was joined by feveral Englifh nobles, who were determined to defend their country from the dominion of William, whom they regarded as an ufurper. A vigorous, and, for fome time, effectual refiftance was made; but at length, the abbot having feceded from the confederacy, the fuperior prowefs of the Norman foldiers prevailed. Great numbers of the Englifh were flain in battle; and many of thofe, who were made prifoners, were cruelly mutilated; fome having their eyes put out, and others their hands and feet cut off, that they might remain living monuments of the Conqueror's vengeance, and become a terror to fuch as difputed his authority.

A bifhop's fee was eftablifhed here in 1107, and Henry, bifhop of Bangor, was appointed the firft diocefan. This prelate procured many gifts and privileges for his bifhopric, and a grant of a fair for the city, to continue for feven days. The king granted a mandate to make an equal divifion of the abbey eftates, between the prelate and the abbot, but the former contrived to retain a full third of the poffeffions more than he was entitled to. On the furrender of the monaftery to Henry VIII. that monarch granted his letter-patent, dated September 10, 1541, to convert the conventual

tual church into a cathedral, by the title of the Cathedral Church of the Undivided Trinity; the eftablifhment for the performance of divine fervice to confift of a dean, a prieft, and eight prebendaries, with other minifters; the dean and prebendaries to form a body corporate. The bifhop of Ely poffeffes the rights of a lord of a county palatine, and is fovereign within the ifle, where all caufes are heard and determined by a judge of his appointing, who holds affizes, gaol delivery, and quarter feffions.

The cathedral is the workmanfhip of very different periods, and difplays a fingular admixture of the Saxon, Norman, and Englifh ftyles of architecture; yet, notwithftanding the diffimilarity of its parts, it muft, when confidered as a whole, be regarded as a very magnificent ftructure. The north and fouth tranfepts, which are the oldeft parts, were erected in the reigns of William Rufus and Henry I. Here the arches are femi-circular, as well as in the nave, which was begun in the reign of the latter monarch, and completed before 1174. Between this period and the year 1189, bifhop Rydel erected the great tower at the weft end, which was anciently flanked on the north fide by a building of the fame kind as that on the fouth: but this either fell or was taken down, and another building begun in its place. This was never carried higher than 12 or 14 feet. The interior view of this tower is particularly beautiful, it being decorated with fmall columns and arches running round in feveral ftories, and lighted by 27 windows. The lower part was repaired, and new cafed with ftone, in the middle of the 15th century. The handfome veftibule at the entrance, formerly called the Galilee, was built about the year 1200, by bifhop Euftachius. The foundation of the elegant ftructure which was originally the prefbytery, but now forms the choir, was laid by Hugh Northwold, the eighth bifhop, in the year 1234, and finifhed in 1250. The three moft weftern arches were deftroyed by the fall of the lofty central tower, in the night of the 12th of February, 1322. To prevent the recurrence of a like accident, Alan de Walfingham, fub-prior of the convent, and facrift of the church, a perfon eminently fkilled in architecture, defigned and erected the prefent magnificent octagon, which is fupported on eight pillars, and terminated by a lantern. The capitals of the pillars are ornamented with hiftorical carvings, reprefenting the principal events in the life of Etheldreda. This octagon is probably unequalled by any of the kind: the ftone work was completed in fix years, and the wood work raifed thereon, and covered with lead, in about 15 years. The whole was perfected in the year 1342, at the expence of 2406*l.* 4*s.* 11*d.* The three arches eaftward of the octagon were rebuilt about the fame period, by bifhop Hotham, and are very much embellifhed. At the eaft end of the north aifle is a fumptuous chapel, erected by bifhop Alcock, who died at his caftle at Wifbech, in 1500. His tomb, with his effigy lying thereon, but much defaced, is placed under an arch of ftone on the north fide. In the fouth aifle, and in fome refpects correfponding with the former, but much fuperior in its embellifhments, is another chapel, which was erected by bifhop Weft, about the year 1530, and is highly enriched with ornaments and elegant tracery, &c. Both thefe chapels were greatly dilapidated by the enthufiaftic reformers who fprung up during the civil wars, and feem to have had an invincible antipathy to every religious edifice that difplayed tafte and elegance.

The extreme extent of the cathedral, from eaft to weft, is 535 feet; but the interior length is only 517. The length of the tranfept is 190 feet, the height of the lantern over, 170. The extreme height of the weftern tower 270, and the tower on the fouth wing of the latter 120. The length of the nave is 203 feet, and the height of the roof over it 104. The height of the eaftern front to the top of the crofs is 112 feet. Near the eaft end of the cathedral, on the north fide, is St. Mary's chapel, now Trinity church; it having been affigned to the ufe of the inhabitants of that parifh foon after the Reftoration, by the dean and chapter. This elegant ftructure was commenced in the reign of Edward II. and is one of the moft perfect buildings of that age. The fhape is an oblong fquare; the interior length being 200 feet, the breadth 46, and the height of the vaulted roof 60. This building has neither pillars nor fide aifles, but is fupported by ftrong buttreffes, furmounted with pinnacles. The fpaces over the eaft and weft windows were formerly decorated with ftatues, and a variety of well-executed fculpture: and the interior was embellifhed with niches highly carved, and enriched with ftatues, ornamental foliage, and flower-work. This edifice was built at the charge of the convent by John de Wifbech, one of the monks, and Alan de Walfingham, who erected the octagon. The firft ftone was laid by the latter on Lady-day, 1321. The cloifters, and other buildings belonging to the monaftery, have been long fince demolifhed, with the exception of the refectory, which has been converted into the deanery; and an elegant little chapel built by prior Crauden, now ufed as a granary, adjoining to it.

The principal charitable benefaction for the ufe of the poor of Ely is vefted in the churchwardens, and arifes from eftates in the neighbourhood, bequeathed by —— Parfon, about the year 1425. Here is alfo a free-fchool, fupported by the dean and chapter; and a charity-fchool for twenty-four boys, who are educated and cloathed by the income of an eftate bequeathed by Mrs. Needham about 1740. The police of Ely is regulated by the magiftrates, who are appointed by the bifhop, and are juftices of the peace within the ifle. Thefe meet for the difpatch of bufinefs every market-day, which was altered in 1802 from Saturday to Thurfday. This city is the only one in England not reprefented in parliament. Many of the houfes are of ftone, and fome of them have an ancient appearance. The ftreets are irregular, and, with the exception of the principal one, neither lighted nor paved. The population, as afcertained under the late act, was 3713; the number of houfes about 700. The chief employment of the inhabitants is gardening, which is carried on in this neighbourhood to a great extent. Cambridge, St. Ives, and even London, receive confiderable fupplies of vegetables from this place. Great quantities of ftrawberries are alfo reared here, and fome other fruits; but thefe are chiefly conveyed in barges to Lynn, and carried thence by the veffels employed in the coal trade to Newcaftle-upon-Tyne, and other places in the north of England.

The Rev. James Bentham, author of "The Hiftory and Antiquities of the conventual and cathedral church of Ely," was a native of this city. Some account of this gentleman has already appeared in this work. (See Bentham.) An interefting and well written account of Ely cathedral has recently been publifhed by the Rev. Mr. Miller, of this place. See alfo Lyfons's Magna Britannia, vol. ii.

About one mile from Ely is Tatterfall-hall, which derived its name from the late Mr. Tatterfall, of fporting memory, and is now poffeffed by his fon.

Ely, *Elie*, or *Ellie*, a parifh of Fifefhire, in Scotland, within which is an ancient royal borough of the fame name. This is fituated clofe to the fea, on the fouthern fhore of the Frith of Forth, where there is an excellent harbour, much reforted to by "wind-bound veffels." Seven

fquare-ſquare-rigged veſſels, carrying 1000 or 1100 tons, belong to it, and are employed in foreign trade. Veſſels of large ſize are built here; and in the town are ſome manufactories for checks, bed-ticks, and ropes. Near the ſhore rubies have been diſcovered. Contiguous to the town, in the face of Kincraig rocks, is the cave of Mac-Duff, in which it is related that Mac-Duff retreated from Macbeth and his followers. Malcolm granted many privileges to this town. Sinclair's ſtatiſtical Account of Scotland.

ELYMAIS, in *Ancient Geography*, or, as it is called by Strabo, *Elymatis*, a province of Perſia, lying between the rivers Eulæus and Oroates, and extending from the confines of Media to the Erythræan ſea, or Perſian gulf. It was formerly divided into three great diſtricts, *viz.* Meſabatene, Gabene or Gabiene, and Carbiana, and containing the following cities, *viz.* Seleucia or Soluce, on the banks of the Hedypos or Hedypnus, which Strabo calls a great city, Safirate, at a ſmall diſtance from mount Caſyrus, Badaca, on the Eulæus, and Elymais, the metropolis of the province, famous for a rich temple conſecrated to Diana, which Antiochus Epiphanes attempted to plunder, but he was obliged by the inhabitants to retire in diſgrace to Media. This temple was afterwards plundered by one of the Parthian kings, who found in it, as we are informed by Strabo, 10,000 talents. In this country there was alſo a very rich temple conſecrated to Jupiter Belus, which Antiochus the Great attempted to plunder, but loſt his life in the attempt. The country of Elymais was inhabited, according to Pliny, by the following nations, *viz.* the Oxii, or Uxii, Mizæi, Parthuſi, Mardi, Saitæ, Hyi, Coſſæi, Parætaceni, and Meſſabatæ. The Elymæans were a powerful people, inured to the toils of war, ſkilful bowmen, and never ſubdued either by the Syro-Macedonian, or Parthian kings, but governed by their own princes. If we may depend upon the authority of Strabo, the riſe of this kingdom may be dated from the downfall of the Perſian monarchy, for the ancients are agreed that the Elymæans were ſubject to the kings of Perſia; and if they never ſubmitted to the Syrian yoke, they muſt have been firſt governed by their own princes, either in Alexander's life-time, or ſoon after his death. Nothing is known of their kings, but that they aſſiſted Antiochus the Great in his wars with Rome, but afterwards cut him off in defence of their temple. They afterwards engaged, under the conduct of their king, in a war againſt the Babylonians and Suſians, in which they were aſſiſted by the Coſſæans with 13,000 archers.

Elymais is alſo a name given by ſome writers to the city of Perſepolis.

ELYMI, or Helymi, a people who inhabited the N.W. part of Sicily, about the river Crimiſa, where were ſituated the towns of Ægeſta or Aceſta, Erice and Entella.

ELYMIA, a town of Greece, in the Peloponneſus, placed by Xenophon towards the towns of Mantinæa and Orchémene.

ELYMIOTÆ, a people of Macedonia, who occupied a plain almoſt ſurrounded by mountains, towards the ſource of the river Aliacmen, according to Ptolemy. They had to the N.W. the country of the Lynceſtes, to the N.E. Emathia, to the S.E. the Pelaſgiotide, and to the S.W. Pelagonia.

ELYMNIUM, one of the names of the iſland of Eubœa.—Alſo, a town of Macedonia, on mount Athos.

ELYMUS, in *Agriculture*, a term ſignifying lime-graſs, a genus of graſſes which are of but little uſe to the farmer, except in protecting the looſe ſandy banks on the ſea-ſhores, in different parts of the iſland; and for which purpoſe the following ſort is the moſt uſeful.

Elymus *Arenarius*, ſea lime-graſs, which is a kind of graſs that, with the ſea-reed, helps very much, according to the opinion of Mr. Sole, to ſuſtain and keep up the looſe ſand-banks on the borders of the ſea, from the deſtructive effects of the tides.

Elymus, in *Botany*, ελυμος of Dioſcorides, from ελυω, *to fold up*, alluding to the ſheath which incloſes the ſpike or ear of ſome ſpecies. This etymology applies at leaſt to the Millet or Panick, ſuppoſed to be the ancient ελυμος, but Linnæus has adopted the name for a new genus of his own, akin to *Hordeum* and *Triticum*, to which it is leſs ſuitable. Linn. Gen. 39. Schreb. 54. Willd. Sp. Pl. v. 1. 467. Juſſ. 31. Sm. Fl. Brit. 152. Mart. Mill. Dict. v. 2. Claſs and order, *Triandria Digynia*. Nat. Ord. *Gramina*.

Gen. Ch. *Cal.* Common receptacle elongated into a ſpike. Perianth lateral, aggregate, conſiſting of two lanceolate glumes to each ſpikelet. *Cor.* of two valves; the outer one largeſt, pointed, awned; the inner concave, emarginate, finely fringed. Nectary a pair of oblong, acute, fringed ſcales. *Stam.* Filaments three, capillary, very ſhort; anthers oblong, cloven at the baſe. *Piſt.* Germen turbinate; ſtyles two, divaricated, ſhort; ſtigmas feathery. *Peric.* none, except the permanent corolla. *Seed* ſolitary, linear, convex at the back, concealed by the glumes.

Eſſ. Ch. Calyx lateral, aggregate, of two valves, containining many florets.

A genus of large coarſe rigid graſſes, for the moſt part perennial, with long creeping roots. This laſt quality renders the *E. arenarius*, Linn. Sp. Pl. 122. Sm. Engl. Bot. t. 1672. Knapp. t. 108, particularly valuable, as forming a natural barrier, in the looſe blowing ſand of many ſea ſhores, to the encroachments of the ocean, being indeed one of the principal means by which the induſtrious Hollanders have gained a part of their territories from the ſea. It is in England comprehended with *Arundo arenaria* and *Carex arenaria*, (ſee thoſe articles,) under the name of Marram, and acts of parliament have been made for their preſervation. The roots and leaves of ſuch graſſes being very durable, retain the blowing ſand, of which they accumulate more and more as they extend in growth upward, and thus gradually form a natural and very firm bank. In a clay ſoil they are of no avail. Of the economy of the American or Siberian ſpecies of *Elymus*, we have no information. Two annual European ſpecies, *E. Caput-Meduſæ* and *E. Hyſtrix*, are furniſhed with very long rough capillary awns, by which their ſeeds are not only wafted to a diſtance, but detained by the accumulation of blowing ſand, when they have once alighted, till they can fix themſelves by roots.

ELYOT, *Sir* Thomas, in *Biography*, a gentleman eminent in various branches of learning, and a patron and friend of moſt of the learned men in the reign of Henry VIII., was deſcended of a good family in the county of Suffolk, and ſon of ſir Richard Elyot. He was educated at St. Mary's Hall, in Oxford, where he made a great progreſs in logic and philoſophy; but the year in which he entered (like the year of his birth) is not certainly known; it is, however, ſuppoſed to have been about the year 1514. After he had ſpent ſome years at the univerſity, he travelled into foreign countries, and, on his return, was introduced at court. His uncommon genius and extenſive learning recommending him to the favour of Henry VIII. who was a great patron of men of letters, his majeſty conferred upon him the honour of knighthood, and employed him in ſeveral embaſſies. He ſent him, particularly, to Rome in the year 1532, on the ſubject of the divorce of queen Catharine, and afterwards to the emperor Charles V. in the year 1536. Elyot was, as Wood obferves (fee his Athen. Oxon.) an excellent grammarian, poet, rhetorician, philofopher, phyfician, cofmographer, and hiftorian; and was diftinguifhed as much for his candour, and for the innocence and integrity of his life, as for his accomplifhments. He was admired and beloved by all the men of learning who were his contemporaries, and his memory is celebrated by them in their refpective works, particularly by Leland, in his "Encomia Eruditorum Virorum." He was buried on the 25th of March 1546, in the church of Carleton, in Cambridgefhire, of which county he had been fheriff; and a monument was foon after erected over his grave. He poffeffed feveral manors in Cambridgefhire, and one or more in Hampfhire.

He wrote and tranflated feveral works. 1. "The Caftell of Health," which is faid to have been firft publifhed in 1541; but Dr. Aikin obferves, that his edition of that year is afferted to be "corrected, and in fome places augmented, by the firft author thereof." It was reprinted in 1572, 1580, and 1595. The reading of the author, as it appears from his *proheme*, or preface, was unufually great, confidering that he did not follow the profeffion of phyfic, having extended to the works of all the Greek, Arabian, and Roman writers of credit. This book was greatly efteemed, not only by the public in general, but by fome of the faculty in his time, and is, indeed, fully as worthy of notice as moft of the medical pieces of that age. His rules for diet and regimen, when not drawn from Galenical theory, are on the whole founded upon plain good fenfe; and he uniformly inculcates temperance of every kind. This he carries to a degree, with regard to certain enjoyments, that would no doubt be generally thought fomewhat too rigorous, except by fuch a bridegroom as the old gentleman in La Fontaine, who would be pleafed with our knight's authority to add all the months, from April to October, to the red letter days of his calendar.

We learn from the work in queftion, that the difeafe now called *a cold*, began to be common in England in the time of Elyot. "At this prefent time," he fays, "in this realme of England, there is not any one more annoyance to the health of man's body, than diftillations from the head, called rheums." The caufe of their being fo much more frequent than they ufed to be forty years before, he fuppofes to be "banquettings after fupper, and drinking much, efpecially wine, a little after fleep;" and alfo covering up the head too hot, a practice which prevailed to fuch a degree, that he tells us, "now a days, if a boy of feven years of age, or a young man of twenty years, have not two caps on his head, he and his friends will think that he may not continue in health; and yet if the inner cap be not of velvet or fatin, a ferving man feareth to lofe his credence."

The other works publifhed by fir Thomas Elyot, were, 2. "The Governor," in three books, 1544, 8vo.; 3. "Of the Education of Children;" 4. "Banquet of Sapience;" 5. "Prefervative againft the Fear of Death;" 6. "De rebus memorabilibus Angliæ;" 7. "An Apology for Good Women;" 8. "Bibliotheca Eliotæ, or Elyot's Library or Dictionary," 1541, folio; which work was afterwards augmented and improved by Cooper. He tranflated alfo from the Greek into Englifh, "The Image of Governance, compiled of the Arts and Sciences, by the Emperor Alexander Severus," 1556, 8vo.; and from the Latin into Englifh, "St. Cyprian's Sermons of the Mortality of Man," 1534, 8vo.; and, "The Rule of a Chriftian Life," written by Picus, earl of Mirandula, printed in the fame year. (Gen. Biog. Dict. Aikin's Biog. Memoirs of Med. in Great Britain.)

ELYRUS, in *Ancient Geography*, a town of the ifland of Crete, which, according to Paufanias, was fituated in the mountains.

ELYS BAY, in *Geography*, a bay of the ifland of Antigua, on the N. coaft, a little to the fouth of Beggar's Point.

ELYSII, in *Ancient Geography*, a people who inhabited the eaftern part of Germany.

ELYSIUM, Ελυσιος, in the *Ancient Theology*, or rather *Mythology*, a place in the inferi, *i. e.* in the lower world, or, as we fometimes render it, in hell; furnifhed with fields, meads, agreeable woods, groves, fhades, rivers, &c. whither the fouls of good people were fuppofed to go after this life.

Orpheus, Hercules, and Æneas, are fuppofed to have defcended into elyfium, in their life-time, and to have returned again. Virgil. lib. vi. ver. 638, &c. Tibullus, lib. i. eleg. 3. gives us fine defcriptions of the elyfian fields.

Virgil oppofes elyfium to tartara; which was the place where the wicked underwent their punifhment.

"Heic locus eft, partes ubi fe via findit in ambas:
Dextera, quæ Ditis magni fub mœnia tendit:
Hac iter elyfium nobis: at læva malorum
Exercet pœnas, et ad impia tartara mittit."

He affigns elyfium to thofe who died for their country, to thofe of pure lives, to truly infpired poets, to the inventors of arts, and to all who have done good to mankind.

Some authors take the fable of elyfium to have been borrowed from the Phœnicians; as imagining the name elyfium formed from the Phœnician עלז, *alaz*, or עלצ, *alats*, or עלס, *alas*, *to rejoice*, or *to be in joy*; the letter *a* being only changed into *e*, as we find done in many other names; as in *Enakim*, for *Anakim*, &c. On which footing, elyfian fields fhould fignify the fame thing as a place of pleafure; or,

"—— Locos lætos, & amœna vireta
Fortunatorum nemorum, fedefque beatas." Virg.

Others derive the word from the Greek λυω, *folvo*, *I deliver*, *I let loofe*, or *difengage*, becaufe here men's fouls are freed, or difencumbered from the fetters of the body. Beroaldus and Hornius, Hift. Philofoph. lib. iii. cap. 2. take the place to have derived its name from Eliza, one of the firft perfons who came into Greece after the deluge, and the author and father of the Ætolians. According to Diodorus Siculus (l. 1. c. 36.) the whole fable of the infernal regions was borrowed from the funeral rites of the Egyptians, and introduced into Greece by Orpheus. Hence Homer is faid to have borrowed his ideas and defcriptions, which occur in various parts of the Odyffey. Accordingly in the fourth book he gives the following account of elyfium in the addrefs of Proteus to Menelaus:

"Elyfium fhall be thine; the blifsful plains
Of utmoft earth, where Rhadamanthus reigns.
Joys ever young, unmix'd with pain or fear,
Fill the whole circle of th' eternal year:
Stern winter fmiles on that aufpicious clime:
The fields are florid with unfading prime:
From the bleak pole no winds inclement blow,
Mold the round hail, or flake the fleecy fnow.
But from the breezy deep, the bleft inhale,
The fragrant murmurs of the weftern gale."
Pope's Od. b. iv. v. 765, &c.

The other poets as well as the philoſophers ſeem to have copied their notions of hell and of the elyſian fields from Homer. Plato, in his account of the ſtate of departed ſpirits, repreſents the ſoul of the deceaſed as paſſing into a place, which he calls divine, and as being there judged. If his life was conformable to the right of reaſon, he is advanced to a higher apartment, where he enjoys pleaſure and proſperity in the ſociety of the gods; whilſt the ſouls of bad men ſink into a noiſome abyſs, there to dwell in thick darkneſs, and to endure every kind of miſery. Socrates alſo adopted ſimilar ideas. This philoſopher diſtinguiſhed a threefold ſtate of ſouls departed. Thoſe who had neither ſingular merit nor enormous vices, inhabited the confines of Acheruſia, where, being purified by the waters of the lake, they received the rewards of the few virtues they had practiſed. The ſouls of the wicked wandered about their tombs, where they were tormented in different ways. After which, having drank the water of Lethe, they entered into new bodies, more or leſs honourable, according to their merit. The ſouls of the good went immediately into the elyſian fields. Pythagoras maintained, that the ſoul, upon its immediate ſeparation from the body, was conducted by Mercury into a place of the pureſt air, in which were the elyſian fields, called by Virgil the "aerial regions," *aerios campos*. The ſouls of the philoſophers, which were the beſt of all, became like to the gods, while thoſe of the wicked were tormented by the furies without intermiſſion. Both the one and the other, after a certain period of purification, returned to the earth to animate new bodies. Thus did this philoſopher inculcate, firſt in Europe, the doctrine of the metempſychoſis, or tranſmigration of ſouls, which he is ſaid to have borrowed from the Egyptians, and which had been taught before by Orpheus and Homer, who had borrowed it from the ſame people. Accordingly we learn from Herodotus, that the Egyptian prieſts maintained, that the ſoul does not die with the body, but is received into Amenthes, which was a place under ground, reſembling the hell of the Greek poets. Plutarch ſays, that this word denotes "that which gives, and that which receives," and adds, that it was a place in the centre of the earth, the common receptacle of departed ſouls. Hence, after a certain period, they were releaſed, and united to new bodies. The poets have delivered ſentiments ſimilar to thoſe of the philoſophers concerning the ſtate of ſouls after death, and whilſt each had his peculiar notions, all agreed, that the ſoul goes either to Elyſium or Tartarus; though they are far from being unanimous as to the ſituation of theſe two manſions. Some place the elyſian fields in the middle region of the air; ſome in the moon; others in the ſun; and others again in the centre of the earth adjoining to Tartarus. The moſt common opinion is, that they lay in one of the iſles of the ocean, called the "Fortunate iſlands," which are reckoned to be the Canaries. According to Ol. Rudbecks the elyſian fields were ſituated in Sweden. In the opinion of many of the ancients, the manſion of the bleſſed was in the charming country of Betica (the preſent Andaluſia in the extremity of Spain towards Cadiz,) whither the Phœnicians had travelled from the earlieſt times, and which was repreſented as a delicious country, poſſeſſing a fertile ſoil, abounding with enchanted groves, enriched by mines of gold and ſilver, and watered with rivers, ſtreams, and fountains. According to Homer, the infernal regions were in the country of the Cimmerians, who are ſaid to have inhabited the weſtern coaſts of Italy, near Baiæ and Puteoli, where Ulyſſes arrives on the ſame day that he takes his leave of Circe. Virgil has adopted Homer's notion, and places the mouth of hell upon the ſame coaſt, near the lake Avernus. Others, however, of the poets, place the entrance of hell at the promontory of Tenarus, where was the cave from which Hercules dragged Cerberus when he went down to hell. Others ſeek for it in Theſprotia, and Lucan refers it to the banks of the Euphrates. The ancients differ in opinion with reſpect to the time, during which departed ſouls continued in the infernal regions. Some ſuppoſe that ſouls doomed to Tartarus continued there a thouſand years, before the period of their tranſmigration commenced. Pindar fixed the reſidence of the bleſſed in the elyſian fields for ever; whence, according to Virgil and the other poets, they were to depart after a certain period of time, having drank the water of oblivion; and this period was uſually limited to a thouſand years. (See Tartarus.) The poets, Homer, Virgil, Pindar, Claudian, Catullus, &c. deſcribe the regions of bliſs under a variety of pleaſing images, ſuch as green bowers, gliding ſtreams, murmuring ſprings, charming meadows, ſerene air, perpetual ſprings, warbling birds, &c. Tibullus, whoſe imagination was voluptuous, repreſents it as abounding with mirth and all ſenſual pleaſures. Virgil admits merely chaſte and innocent enjoyments, and in this reſpect he has copied Homer.

ELYTROCELE, (from ἐλυτρον, the *vagina*, and κηλη, a *tumour*,) in *Surgery*, a hernia in the vagina.

ELYTROID, in *Anatomy*, from ἐλυτρον, a *ſheath*, and ειδος, *form*, is a name applied to one of the coverings of the teſticle. See Generation, *Organs of*.

ELYTRON, properly a covering of any ſort, and for any ſubſtance. Hippocrates has appropriated the word to ſignify the membranes which involve the ſpinal marrow.

ELZEVIRS, in *Biography*, celebrated printers at Amſterdam and Leyden, lay claim to a ſhort notice in this work, on account of the many valuable books which were printed at their preſſes, and of the perfection to which they carried their art at a comparatively early period. The firſt of the family was Lewis, who was diſtinguiſhed for his editions from the year 1595. He was ſucceeded by Bonaventure, Abraham, and Daniel, of whom the laſt died about the year 1680. The ſmall types of theſe famous printers have a clearneſs and elegance which have rarely been equalled. Virgil, Terence, and the Greek Teſtament, printed in 1633, diſtinguiſhed by characters in red ink, are reckoned maſter-pieces; and the beſt of their claſſics ſtill maintain a high value. Moreri.

ELZT, or Eltz, in *Geography*, a town of Germany, in the country of Lower Saxony, and biſhopric of Hildeſheim on the Saale; 9 miles S.W. of Hildeſheim.

EM, or Embak, a river of Ruſſia, in the government of Riga or Livonia, which iſſues from the lake Wyrtz, and falls into the Peipus.

EMANATION, formed of the Latin *e*, out of, and *manare*, to flow or ſtream, the act of flowing, or proceeding, from ſome ſource or origin. Such is the emanation of light from the ſun; or that of effluvia from odorous, &c. bodies; of wiſdom from God, &c.

The principle of emanation was adopted from the moſt remote times by the oriental philoſophers, and by means of emanation from an eternal fountain of being, they endeavoured to explain the nature and origin of things. Zoroaſter, at an early period, maintained this ſyſtem, alleging, that various orders of ſpiritual beings, gods or dæmons, have proceeded from the deity, which are more or leſs perfect, as they are at a greater or leſs diſtance, in the courſe of emanation, from the eternal fountain of intelligence; among which, the human ſoul is a particle of divine light which will return to its ſource, and partake of its immortality; and matter is the laſt or moſt diſtant emanation from

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the firſt ſource of being, which, on account of its diſtance from the fountain of light, becomes opake and inert, and whilſt it remains in this ſtate is the cauſe of evil: but, being gradually refined, it will at length return to the fountain whence it flowed. This doctrine of emanation afterwards produced many fanciful opinions in theology. It was adopted by the ancient Indians, and taught under various modifications by the Brachmans. The ſame ſyſtem was likewiſe received among the Egyptians, taught by Orpheus and Pythagoras, and communicated to the Greeks either from Egypt or from the Eaſt. Wherever it originated, it was taught for many ſucceſſive ages in the more civilized regions of Aſia and Africa, and both before and after the commencement of the Chriſtian era, it gradually ſpread through the Alexandrian, Jewiſh, and Chriſtian ſchools. It was a diſtinguiſhing tenet of the Jewiſh Cabbala, of Simon Magus, and of the Gnoſtics and modern Platoniſts. This ſyſtem, as it was taught by the oriental, Alexandrian, and Cabbaliſtic philoſophers, comprehended the following tenets. All things are derived, by emanation, from one principle; which principle is God. From him a ſubſtantial power immediately proceeds, which is the image of God, and the ſource of all ſubſequent emanations. This ſecond principle ſends forth, by the energy of emanation, other natures, which are more or leſs perfect, according to their different degrees of diſtance, in the ſcale of emanation, from the firſt ſource of exiſtence, and which conſtitute different worlds, or orders of being, all united to the eternal power from which they proceed. Matter is nothing more than the moſt remote effect of the emanative energy of the Deity. The material world receives its form from the immediate agency of powers far beneath the firſt ſource of being, and is the neceſſary effect of the imperfections of matter. Human ſouls are diſtant emanations from Deity; and, after they are liberated from their material vehicles, will return, through various ſtages of purification, to the fountain whence they firſt proceeded. Nothing can be more fanciful than the numerous fictions which are blended in this ſyſtem, and which have been grafted upon it by enthuſiaſts of different deſcriptions, both philoſophical and theological; inſomuch that it has been the ſoul of enthuſiaſm and fanaticiſm. (See THEOSOPHISTS.) Some of the modern Eclectic philoſophers attempted to unite the atomic and emanative ſyſtems; and Jordano Bruno, in particular, founded his doctrine on the ancient ſyſtem of emanation. See BRUNO.

EMANATION is alſo uſed for the thing that proceeds, as well as the act of proceeding. The power given a judge is an emanation from the regal power; the reaſonable ſoul is an emanation from the divinity.

EMANATION is alſo uſed among the ſchoolmen, for the production of a leſſer thing, in order to the production of a greater, by virtue of ſome natural connection, or dependence between them.

Hence that is called an emanative cauſe (in contradiſtinction to an efficient cauſe) which produces an effect by its mere preſence, without the intervention of any action; as a roſe doth a ſmell, &c. Others, and with good reaſon, deny that there is any ſuch thing as an emanative cauſe, to produce an effect without any action. See CAUSE.

EMANCIPATION, formed from the Latin *ex*, of, and *mancipium*, a ſlave, in the *Roman Law*, was the act of ſetting a ſon free from the power and ſubjection of his father.

Emancipation differs from manumiſſion, as the latter was the act of a maſter in favour of a ſlave, the former that of a father in favour of his ſon.

The effect of emancipation was, that the goods, and moveable effects, which the ſon ſhould thenceforth acquire, ſhould be his ſole property, and not the property of his father, as they were before emancipation. Beſides, emancipation put the ſon in a capacity of managing his own affairs, and of marrying without his father's conſent, though a minor, or pupil, and under twenty-five years of age.

There were two kinds of emancipation; the one *tacit*, which was by the ſon's being promoted to ſome dignity, or by his coming of age, or by marriage; in all which caſes, the ſon became his own maſter of courſe.

The other *expreſs*, where the father declared before the judge, that he emancipated his ſon. This was not performed without ſome formality: the father was firſt to ſell his ſon imaginarily to another man, whom the lawyers call *pater fiduciarius*, *father in truſt*; of whom being bought back again by the natural father, he manumitted, or ſet him free, by a declaration before the judge. This imaginary ſale was called mancipatio; and the manumiſſion conſequent thereon, emancipatio.

Emancipation obtained in France, chiefly with regard to minors, or pupils, who were hereby ſet at liberty to manage their effects, without the advice, or direction, of their fathers or tutors. It muſt be obſerved, however, that emancipation only extended to the ſelling of moveables, and letting of leaſes, &c. of immoveables; not to the ſelling or mortgaging of immoveables; which were only done with the conſent of a curator, ordinarily a perſon appointed, when emancipated.

Formerly emancipation was performed in the ordinary courts of juſtice, when deſired by the child; but if he were a minor, the king's letter was alſo required. Though there were other ways of emancipation, as by marriage; arriving at the age of twenty years; and in ſome provinces by the death of the mother, becauſe the children were there under the power of the father and mother conjointly; ſo that the death of either of them emancipated the child.

Emancipation by marriage, in France, gave a power of marrying again, without the father's conſent though under age; but among the Romans, Cujas tells us, a widow, under twenty-five years of age, though emancipated by her former marriage, returned into the power of the father, and might not marry a ſecond time, without his conſent.

Du-Cange obſerves, that the word emancipation was alſo uſed in the monaſteries, in ſpeaking of monks promoted to any dignity, or removed from under the power of their ſuperiors; as alſo in ſpeaking of monaſteries, chapels, &c. themſelves, when exempted by the pope, from the juriſdiction of the ordinary.

EMANUEL, in *Biography*, king of Portugal, ſon of the infant Don Ferdinand, duke of Viſco, ſucceeded his couſin John II. in 1495. He was then in his twenty-ſixth year, and highly eſteemed for the excellent qualities of his mind. He began his reign by reſtoring the nobility to that conſequence in the ſtate of which it had been the policy of his predeceſſor to deprive them. He ſhewed an inclination to favour the Jews, who had been enſlaved in the former reign; but by the violence of his adviſers, he did not dare to follow the bent of his own mind, and demanded of theſe unhappy people, as the terms of their liberty, that they ſhould inſtantly profeſs themſelves Chriſtians, in name, though a period of twenty years ſhould be allowed them for their converſion. Moſt of them complied with the required condition; but others, and thoſe not a few, voluntarily put an end to their lives, rather than ſubmit to a dereliction of principle. Some of them were ſo indignant at the requiſition that they firſt murdered their own children, and then

then committed the raſh deed upon themſelves; thinking death in any form better than an abandonment of the religion of their fathers. In 1496 he married Donna Iſabella, daughter of Ferdinand and Iſabella of Spain, who died the next year, having firſt given him a ſon and heir. This was the period in which the new paſſage to the Indies was diſcovered by Vaſco de Gama, a circumſtance which proved the ſource of great riches to Portugal., and contributed to fix the epithet of *fortunate* upon this prince. In 1499 he married the younger ſiſter of his late wife; and in 1501, under his auſpices, the Brazils were diſcovered, which have proved a more laſting benefit to Portugal than her Indian poſſeſſions, and which has at length become an aſylum to the exiſting monarch, driven by Bonaparte from his European poſſeſſions. Emanuel, in gratitude for the important diſcoveries made in his reign, founded the famous monaſtery of Bethlehem, near Liſbon. He now adopted the plan of making conqueſts in Africa, in which he was not very ſucceſsful, but by the talents of Albuquerque he formed a very uſeful alliance with the king of Congo. Although proſperous in a high degree, he met with mortifications ſufficient to lead him to declare his purpoſe of reſigning his crown into the hands of his ſon. The eagerneſs which the young man ſhewed for power, and the marked attention which the courtiers paid him, cauſed the monarch to change his purpoſe. He died in 1521, in the 53d year of his age, at a time when he was regarded as one of the moſt powerful and ſplendid princes in Europe. Emanuel, when religion was out of the queſtion, was capable of liberal and generous conduct. He treated with great favour Don George, natural ſon of the late king, for whom his father had endeavoured to procure the ſucceſſion to the crown; and he reſtored to their titles and eſtates the Braganza family, who had ſuffered attainder and confiſcation in the late reign. In the hiſtory of his country, Emanuel ſtands very high for piety, humanity, munificence, and thoſe other good qualities that do honour to an enlightened ſovereign. Univer. Hiſt.

Emanuel-Philibert, duke of Savoy, ſon of duke Charles III., was born in 1528, and though deſtined for the church, yet by the early death of two elder brothers, he was brought up as heir to the ſovereignty. He viſited the court of the emperor Charles V., by whom he was created knight of the Golden Fleece. He accompanied Philip II. into England, and was afterwards entruſted by him with the command of his armies. He was general at the ſiege of Metz, and at the battle of St. Quintin, in 1557, in which the French ſuſtained a ſignal defeat. He married Margaret, daughter of Francis I. of France, and by that alliance regained all the dominions which his father had loſt. At the perſuaſion of ſome bigots he attempted the extirpation of the Vaudois, proteſtants of Savoy, but was defeated in his projects, and by the influence of the ducheſs, who was well diſpoſed towards the reformation, he willingly allowed them the exerciſe of their religion. He died reſpected and beloved in 1580, after a reign of 27 years. Univer. Hiſt. Moreri.

EMARGINATUM Folium, in *Botany*. (See Leaf.) The term applies only to the extremity or apex of a leaf, and expreſſes a notch in that part, apparently cauſed by a greater tightneſs or contraction in the nerve, than in the ſofter more dilatable parts adjacent, which are therefore extended beyond it. The petals of flowers, however, are very often emarginate in their original conformation, as in many ſpecies of Chickweed or Sandwort.

EMASCULATION, the act of taking from a male thoſe parts which are characteriſtic of his ſex. See Castration.

EMAUX *de l'Eſcu*, in *Heraldry*, the metals and colours of a ſhield, or ſcutcheon.

EMBA, or Yemba, in *Geography*, a river of Ruſſia, which takes its riſe in the ſouthernmoſt part of the Ural mountains, and conſtitutes the border between the Uſimſkoi government and the country of the Kirchiſtzi, though the forts are much more to the weſt, namely, on the river Ural. The Emba takes up only one river of note, the Sagiſs, has a ſtrong current, but is at the ſame time very ſhallow. It is the moſt eaſterly of all the rivers that fall into the Caſpian.

EMBABE', a village of Egypt, oppoſite to Boulac, near Cairo, upon the weſt bank of the Nile, famous for the excellent quality of its butter, and for a variety of lupins, which grow in its vicinity, and called embaben. Theſe are ſold ready dreſſed in the ſtreets and markets, and they ſupply Lower Egypt. Their general appellation in the country is "termeſs." The Chriſtians of the Eaſt eat lupins as a ſtimulus for drinking brandy. Flour is made of them, which is uſed for cleaning the hands and ſoftening the ſkin. The ſtalk, reduced to aſhes, is preferred to other charcoal in the compoſition of gun-powder.

EMBALMING, the opening of a dead body, taking out the inteſtines, and filling their place with odoriferous and deſiccative drugs and ſpices, to prevent its putrefying.

The word is formed from *balm*, which was a principal ingredient in the embalmings of the ancient Egyptians.

Dr. Grew, in his Muſeum Regalis Societatis, is of opinion, that the Egyptians boiled their bodies in a large cauldron, with a certain kind of liquid balſam. His reaſon is, that in the mummies preſerved in the collection of the Royal Society, the balm has penetrated not only the fleſhy and ſoft parts, but even the very bones; ſo that they are all as black as if they had been burnt.

The Peruvians had an effectual method of preſerving the bodies of their incas, or kings, embalmed.

The mode of embalming dead bodies among the Egyptians was as follows: when a man died, his body was carried to the artificers, whoſe trade it was to make coffins; they took the meaſure of the body, and made a coffin for it, proportioned to its ſtature, the dead perſon's quality, and the price that people were willing to give. The upper part of the coffin repreſented the perſon who was to be ſhut up in it, whether man or woman. If it was a man of condition, this was diſtinguiſhed by the figure which was repreſented on the cover of the coffin; there were generally added paintings and embelliſhments, ſuitable to the quality of the perſon. Vide Caſſian Collat. 15. cap. 3. & Cicero, Tuſc. Quæſt. lib. i. Herodot. lib. ii. cap. 86. Diodor. lib. ii. cap. 5.

When the body was brought home again, they agreed with the embalmers at what rate particularly they would have it embalmed, for the prices were different; the higheſt was a talent of ſilver, eſtimated at about 258*l.* 6*s.* 8*d.* or, as others ſay, about 300*l.*: twenty minæ was a moderate one, and the loweſt price was a very ſmall ſum. They immediately ſent for a deſigner, who marked the body, as it lay extended, at the place where it ſhould be opened, on the left ſide, and the length of the inciſion. A diſſector, with a very ſharp Ethiopian ſtone, made the inciſion, and hurried away as faſt as he could, becauſe the relations of the perſon deceaſed, who were preſent, took up ſtones, and purſued him as a wicked wretch, with an intention to ſtone him.

This operation being finiſhed, the embalmers, who were looked upon as ſacred perſons, entered to perform their office,

office. They drew all the brains of the dead perſon through his noſtrils, with a hooked piece of iron, provided particularly for this purpoſe, and filled the ſkull with aſtringent drugs; they likewiſe drew all the bowels, except the heart and kidneys, through the aperture which they had made in the ſide. The inteſtines were waſhed in wine from the palm-tree, and in other ſtrong and binding drugs. The whole body was anointed with oil of cedar, after having been filled with myrrh, cinnamon, and other ſpices, for about thirty days, ſo that it was preſerved entire, not only without putrefaction, but had a good ſcent with it. Αιγυπτιοι δε τα εντερα εξελοντες ταριχευσιν αυτους. And the Perſians, as the ſame author, Sextus Empiricus, obſerves, were uſed νιτρω ταριχευειν. Sext. Empir. Pyrrhon. Hypoth. lib. ii. cap. 24.

Bodies thus preſerved are called *mummies*, from the Arabic word *mam*, which ſignifies wax, this being an ingredient in the preparation.

After this the body was put into ſalt for about forty days; wherefore when Moſes ſays, that forty days were employed in embalming Jacob, we are to underſtand him as meaning the forty days of his continuing in the ſalt of nitre, without including the thirty days paſt in performing the other ceremonies above-mentioned, ſo that, in the whole, they mourned ſeventy days in Egypt, as Moſes likewiſe obſerves.

Afterwards the body was taken out of the ſalt, waſhed, wrapt up in linen ſwaddling-bands, dipped in myrrh, and rubbed with a certain gum, which the Egyptians uſed inſtead of glue. Then the body was reſtored to the relations, who put it in a coffin, and kept it in their houſes, or in tombs made particularly for this purpoſe. There are ſome found, at this day, in Egypt, in chambers, or ſubterraneous vaults, which fully juſtify the truth of what is here ſaid.

They who were not rich enough to bear this expence, contented themſelves with infuſing, by a ſyringe, through the fundament, a certain liquor extracted from the cedar, and leaving it there, wrapt up the body in ſalt of nitre. This oil preyed upon the inteſtines, ſo that when they took it out, the inteſtines came along with it dried, and not in the leaſt putrefied. The body being incloſed in nitre, grew dry, and nothing remained beſides the ſkin glued upon the bones. They who were too poor to be at any conſiderable expence, did no more than cleanſe the inſide, by ſyringing a liquor into it; this done, they put the body, without farther ceremony, into nitre for ſeventy days, in order to dry it. Calmet, Diction. Bibl. Pococke's Deſcription of the Eaſt, vol. i. p. 230, &c.

The preſent method of embalming in Egypt differs very much from the ancient. Mallet informs us, that it is now the cuſtom to waſh the body ſeveral times in roſe-water; then to perfume it with incenſe, aloes, and other odours, in great abundance; the body is afterwards wrapped up in a winding-ſheet, made partly of ſilk, and partly of cotton, moiſtened probably with ſome liquid perfume; this is again covered with another cloth of unmixed cotton, to which is added one of the richeſt ſuits of clothes of the deceaſed. Letter X. p. 88.

The art of embalming, ſays Sonnini, is now unknown to the Egyptians. As ſoon as a perſon is dead, they preſs the different parts of the body, in order to make it diſcharge all its impurities; they repeatedly waſh it, ſhave it, pluck out all the hair, and ſtop all the apertures cloſely with cotton; they then pour upon them odoriferous waters, and the perfumes of Arabia penetrate into all their pores. The inanimate remains are then committed to the earth; and upon the ſpot where the head of the deceaſed lies, they erect a ſmall ſtone pillar, crowned with a turban. Every Friday they reſort to the foot of this ſepulchral monument, and renew their mournful adieus.

Dr. Ward, in his Diſſertations on this ſubject, ſuppoſes that the Jewiſh method of embalming was very different from the Egyptian, and that this appears from ſeveral paſſages in the New Teſtament. Both, as he conceives, ſwathed up their dead; but inſtead of the Egyptian *embowelling*, he ſuppoſes the Jews contented themſelves with an *external unction*; and that inſtead of myrrh and caſſia, they uſed myrrh and aloes. To this account he alſo adds the ſuppoſition, that St. John might mention the circumſtance of our Lord's embalming, in order the better to obviate the falſe report which then prevailed among the Jews, that the body of our Lord had been ſtolen away in the night by his diſciples; for the linen, he ſuppoſes, could not have been taken from the body and head, in the manner in which it was found in the ſepulchre, on account of its clinging ſo faſt from the viſcous nature of theſe drugs, if they had been ſo fooliſh as to attempt it. It is certain that the modern Egyptian mode of embalming, if it may be ſo called, differs very much from the ancient; but it is not eaſy to determine how far the Jewiſh method, in the time of our Lord, differed from that of the Egyptians. It does not appear indeed to be certain, that the Jews were not accuſtomed to embowel their dead in embalming. As all other nations ſeem to have embalmed exactly according to the Egyptian manner, the ſame cauſes that induced them to do ſo, probably occaſioned the Jews not to vary from them in this reſpect. It does not, however, follow from hence, that our Lord was embowelled, though St. John ſays (ch. xix. 40.), that he was buried with ſpices, "as the manner of the Jews was to bury;" for theſe words do not neceſſarily ſignify, that all was done that was wont to be done in thoſe caſes among the Jews. Indeed, the contrary appears to have been the fact, from the farther preparations made by the women, who probably were not acquainted with what had been done, though Dr. Ward ſuppoſes the contrary; ſince St. Luke expreſsly tells us (ch. xxiii. 55.), that "the women, which came with him from Galilee, followed after, and beheld the ſepulchre, and how his body was laid." Admitting this ſtatement, Ward's thought concerning the difficulty of taking off the bandages, beſmeared with very glutinous drugs, muſt appear to be unfounded; for in that caſe, the women could have done nothing more as to the embalming of him. Beſides, aloes and myrrh do not appear to poſſeſs that very glutinous quality which Dr. Ward aſcribes to them; and it is more reaſonable to ſuppoſe that St. John mentions this circumſtance, concerning which the other evangeliſts are ſilent, becauſe he publiſhed his hiſtory for the uſe of perſons leſs acquainted with the cuſtoms of the Eaſt, than thoſe for whoſe information the others wrote. This reaſon induced him to ſay to thoſe who were wont to *burn* their dead, that our Lord was *buried with ſpices*, which was *in general* the Jewiſh method of diſpoſing of their dead; and this he might very well do, though the ſhortneſs of the time occaſioned ſome deviation from what they commonly practiſed. This ſhortneſs of time prevented them alſo from ſwathing him with that accuracy and length of bandage, which they would otherwiſe have uſed; in conformity to the cuſtom obſerved among the Egyptians, and probably alſo among the Jews: for we are informed, that the Egyptians have uſed above a thouſand ells of filletting about a body, beſides what

what was wrapped about the head. Such, indeed, was the hurry of the difciples, that our Lord's head was fimply bound about with a napkin; a practice ufed by the Mahometans at this time. What was done by Jofeph and Nicodemus with the mixture of myrrh and aloes, which they provided, doth not appear. Dr. Lardner fuppofes, they might have formed a bed of fpices. A modern Jew, cited by bifhop Kidder, objects to the hiftory of the New Teftament; alleging that the quantity was fufficient for 200 dead bodies, that is, allowing half-a-pound for each body. But this quantity falls far fhort of that which modern furgeons ufe in embalming. It appears from what Jofephus (Antiq. lib. 15.) fays of the funeral of Ariftobulus, the laft of the high priefts of the family of the Maccabees, that the larger the quantity of fpices ufed in their interments, the greater honour was thought to be done to the dead; and therefore we may eafily account for the quantity brought by Nicodemus, though we may not be able to tell precifely how he difpofed of it. Might not large quantities of precious perfumes be ftrewed, or defigned to be ftrewed, about the body of our Lord? Harmer's Obf. vol. ii.

It is no wonder that we find human bodies preferved without corrupting for many ages, by means of fpices, and other ingredients, proper to refift putrefaction, applied with the niceft care; but it is ftrange that there fhould be a fort of embalming performed by nature, in fome places, where bodies are preferved merely by the virtues of the foil in which they lie; yet this is evidently the cafe in fome inftances. We have, in the Philofophical Tranfactions, an account of a man and a woman who were loft in the great fnows on the moors of Hope, near the woodlands in Derbyfhire, on the 14th of January, 1674. Thefe perfons were not found till the 3d of the May following, at which time they fmelt fo ftrong, that the coroner prudently ordered them to be buried on the fpot. Thefe bodies lay buried in the peat-mofs 28 years before they were looked at again; when fome people of the country, who had heard of the ftrange virtues of the foil thereabouts in preferving dead bodies, opened the ground, and found them no way altered, the colour of the fkin being fair and natural, and the flefh as foft as that of perfons newly dead. Phil. Tranf. N° 434, p. 415.

After this the place was remarked where they lay, and they were fhewn for a fight for 20 years, though they were much changed by having been fo often uncovered in that time.

EMBANKMENT, in *Rural Economy*, a large body, mound, or bank of earth, conftructed and thrown up in different ways, according to circumftances, with the view of guarding, protecting, and defending lands on the borders of the fea, rivers, and lakes, from being inundated and injured by them.

They are of different kinds and forms, according to the nature of the fituations and the materials of which they are conftituted. In embanking againft the fea and large rivers, where the flopes next them are naturally gentle and eafy, they are moftly of the earthy defcription, being well put together, and covered on the furface with turf cut from the tough fward of the land in the neighbourhood; but, in cafes where the banks, borders, and fhores, are more fteep and bold, they are ufually of a more hard and folid nature: being often made with ftone, brick, gravel, fand, fhells, and other fimilar fubftances, laid clofely in fome fort of tenacious material, fuch as clay, mortar, and other matters of the fame quality. Wood is likewife, in fome inftances, employed in their conftruction.

In works of this fort, very much depends upon the form in which they are conftructed, and the nature and management of the materials which are made ufe of in the bufinefs. In refpect to the firft, it may be remarked, that banks of thefe kinds are commonly conftructed with too narrow bafes for the heights which are given them: from which circumftance, the fides which are oppofed to the effects of the water become too fteep and upright; confequently, in cafes of high tides or floods, they are utterly incapable of refifting their weight, which has equally a lateral and downright preffure. Befides this, there is another difadvantage attending this method of forming them, which is, that the floods, as well as the tides, in ebbing and flowing, have a more continued action on one part than would be the cafe, if the flopes were more gentle and gradual; confequently, they have a much greater tendency to break down and deftroy the fuperficial parts of the banks. With fome variations in the forms, moft of the embankments in this country are, however, made in this way. They may fucceed in fome particular inftances; but in general it is found, that breaches are frequently taking place in them, from the effects of the fea or floods, which are not capable of being filled up or repaired, without confiderable difficulty and trouble; and which, if fuffered to continue even for a fhort fpace of time, endanger the whole embankment.

The common form of embankment is fhewn at *fig.* 1, *Plate* X. *Agriculture*, and the improved form pointed out at *fig.* 2, in the fame plate.

The angles or flopes of thefe forts of works are made very different in different cafes; but that fhewn in the above figure feems in general well calculated for the purpofe of refifting the impreffion of heavy tides, or the waters of floods. The greater breadth they have in proportion to their height, the more effectual they muft be in refifting the power of the waters which come upon them.

In regulating the heights of embankments, it is neceffary to afcertain the greateft depth of water at the higheft tides or floods; making the fummits of them about two feet higher than the points to which they rife at fuch times. By fome, a lefs height than this above the higheft mark of the tides or floods has, however, been confidered fufficient; but it is always proper to be on the fafe fide, as the confequences of an overflow are very ferious.

In forming embankments with ftones, or other fimilar materials, which, as has been feen, is effential in bold fteep banks or fhores, it is neceffary that they be laid in proper materials, and be clofely jointed next the fea, or the rivers, fo as to be fully capable of refifting the entrance of water; as, unlefs this be the cafe, they will by no means be complete: for the water, infinuating itfelf between the openings, finks down among the ftones, foftens and loofens the clayey or earthy matters underneath, by which portions of them are continually forced out and wafhed away; hollows being formed in that way below, and the ftones naturally finking down; in confequence of which, the waters rufh into the cavities with confiderable impetuofity, and quickly difplace others, and the whole embankment is foon deftroyed. This very frequently takes place with the heads thrown acrofs rivers, and fuch paved or caufewayed banks as are formed with the view of protecting and preferving thofe bold and open fhores, which are liable to be undermined and carried away by the wafhing operation of the waters which come againft them. In order to render the embankments perfectly fecure in fuch cafes, they fhould be laid with good mortar, and be pointed with a ftrong cement. A good coat of gravel, in fome cafes of this kind, is even found far fuperior to paving with ftones.

In conſtructing embankments of the quay, or other ſimilar kinds, a mortar formed from powdered unburnt lime-ſtone and coarſe ſharp ſand is employed; the whole being pointed with puzzolana earth, by which they become as ſolid as rock, and fully reſiſt the effects of water. The lime of particular ſorts of lime-ſtone is found more proper for forming this ſort of mortar cements than that of others: thus, that found at Dorking in Surrey is ſuppoſed to conſtitute the moſt durable ſubſtance of this kind of any in the kingdom; and has been employed in forming the new docks in the river, near London. And an excellent ſort of lime-ſtone for the ſame purpoſe has likewiſe been diſcovered near Worſley, in Lancaſhire, which is there termed Sutton lime.

It has been ſuggeſted by a late writer, that an excellent mortar cement for this uſe, which hardens under water, may be compoſed by having four parts of blue clay, ſix of the black oxyd of mangáneſe, and nine of carbonate of lime, ſubmitted to a white heat, and then well incorporated with ſixty parts of ſand, and as much water as may be neceſſary to form it into a mortar.

It is invariably found, in examining the ſhores of the ſea, and the banks of rivers, that ſuch as have eaſy and gently declining ſlopes from their beds to their borders or banks; and thoſe which are formed in a ſteep upright manner, of rocky materials, ſuch as are ſhewn at *figs*. 3, and 4, are the leaſt expoſed to injury from the effects of their waters: the two former being the moſt ſecure, when ſpread over or coated with good coverings of ſand or gravel, or uniformly turfed over quite down to the water-ſide with the ſward of a tough old paſture. The ſtrength and firmneſs of their banks are in proportion to the extent of the ſlope; and their durability depends on that of their being made uniform on their ſurfaces, both in reſpect to hardneſs and ſmoothneſs: as, in the former caſe, from the great length of ſlope, the flows and decreaſes of the waters act more momentarily on their different parts, and their greater weight renders their banks more firm; while, in the latter caſe, by the equality of their ſurfaces, the power of the waters is rendered the ſame on one part as another, and no obſtacles are left for the producing of eddies, or other means of forming holes or breaks in them.

In the latter, or thoſe of the bold, upright, rocky kind of banks, their ſtrength chiefly depends on the reſiſtance of the large quantity of materials by which they are backed, and not on the manner in which they are diſpoſed, as in the former caſe; and their durability, on that of the uniform compactneſs of texture in the parts oppoſed to the effects of the waters: as, where theſe have fiſſures in them, or are ſofter in ſome parts than others, the waters are liable to enter and break down the banks in time, according to the particular nature of the caſes. A ſtriking example of this kind lately occurred in the Iſle of Wight.

It is, therefore, of importance that the modes and forms of embankment, which are thus naturally preſented, ſhould be improved upon by art. It is evident, that if a cut was formed behind the embankment, as in *fig*. 5, at the letter *x*, the ſhores or banks, though, in this caſe, as it were, detached from the land, would be found equally ſtrong and capable of reſiſting the preſſure of the waters, as in their original ſtate. Hence, if a mound or bank was formed, and placed out at the diſtance of one, two, or three miles from the ſhore or other embankment, within the bed of the ſea or other waters, as at *y* in the ſame figure, it would be equally capable of reſiſting them as in the former inſtance, and not more liable to be broken down by their preſſure than in its former ſtation; and would alſo defend them as completely from the intermediate ſpace of land, as it did before from the narrow trench. Conſequently, on this principle, vaſt tracts of land may, in different parts of the kingdom, be obtained by judicious embankments.

Though the ſhores of bold ſteep coaſts may not afford examples equally capable of being followed with advantage as the above, they nevertheleſs ſuggeſt uſeful hints for the purpoſe of defence, in caſes of bold, abrupt, broken ſhores, conſtituted of earth, or of that material and rocky ſubſtances intermixed. It readily preſents itſelf to the mind, that the raiſing a good perpendicular ſtone-wall againſt ſuch banks, renders them nearly as ſtrong and laſting as thoſe formed by nature of ſteep, ſolid, rocky bodies. This ſort of walled bank is exhibited at *fig*. 6. But though this method may be practiſed, in caſes of the above kind, with great advantage, it is not by any means applicable in general to rivers; as, with them, the water, during the periods of floods, ſtands in need of room to ſpread, which is the great uſe of giving their banks a ſloping form; while, in this way, by being confined, it would have the effect of doing more injury than was the caſe before. Inſtances may, however, happen in which it may be had recourſe to with propriety, in defending a part of the bank of a river, without giving it a ſloping direction, or for protecting one part of a bank at the riſk of that which is oppoſite to it; but well-conſtructed piers, in ſuch caſes, are frequently more perfect, and conſtantly attended with leſs expence. But inſtead of theſe, art may ſuggeſt one that may anſwer in ſome reſpects more perfectly; as in place of bringing together ſuch a maſs of earthy or other ſubſtances, as may be proper for conſtructing ſuch banks as are ſhewn at *figs*. 1, and 7, it may be more advantageous to have one formed, ſuch as is ſhewn at *fig*. 8, the ſide of which next the water forms with the baſe an angle of about 45 degrees. This will be capable of bearing all the weight or preſſure of water that can poſſibly be brought upon it, equally well with that of *fig*. 1, except that the operation of the tides would break the ſuperficial part of the ſide next the ſea, unleſs prevented by coating it with ſome durable ſubſtance, ſuch as paving ſtones, bricks, or other ſimilar materials.

But various different ones may be invented between this and the firſt natural kind, which differ only in the degree of inclination which they have towards the ſea; that which ſlopes in the higheſt degree, as *fig*. 1, having the ſurface covered over with ſand or gravel; and that which has the leaſt ſlope, as *fig*. 8, may be covered with pavement; the different intermediate ſlopes being protected by materials which have a quality between the two, ſuch as coarſe gravel, chalk-ſtones, brick, and ſand, as ſhewn in *fig*. 9. This embankment is wholly conſtructed of a ſandy loam, being depoſited upon a ſoil of the ſame quality; but as it would not, for ſome time after being formed, be ſufficiently impervious to water, a column of clay is carried upright in the middle, from the clayey ſubſtratum of the ſoil underneath, as ſhewn at *x x* in the ſection.

In caſes where the ſhores are of a very ſandy nature, it is frequently neceſſary to form the embankments wholly of a ſort of wicker-work. In ſuch circumſtances, three or four rows of pailing may be put down, of different heights; and the vacant ſpaces between them be well filled, by forcing in furze, bruſh-wood, or even ſtraw, as repreſented at *fig*. 10. Theſe ſubſtances, by detaining the mud and ſand, as the tide paſſes through them, or during high floods, ſoon form a ſort of embankment, ſuch as that ſhewn in the above repreſentation. It ſhould afterwards be covered with ſome plant, which is capable of binding and giving it ſolidity, ſuch as the *elymus arenarius*. This embankment would continue,

continue, during extraordinary tides, to retain ftill larger quantities of the fandy materials, until ultimately raifed higher than they could reach, by which a fafe bank would be formed. It is fuggefted by Mr. Loudon, in his ufeful "Treatife on forming Country Refidences," from which many of the above hints have been drawn, that from twenty to thirty thoufand acres of land might be gained in this way, in a very few years, in different parts of the rivers Severn, Humber, Frith, &c.

In all cafes of embankment, however they may be formed, tunnels and fluices of a proper kind, with valves towards the fea or rivers, muft be occafionally placed, according to circumftances, fo as to permit the water that may be collected within to pafs away, and that of the fea or rivers to flow up, with different intentions in the view of improving the land.

The utility of projecting points is very confiderable, in different cafes, on the fea-coafts and rivers, in defending the bays and inlets of the former, as well as guarding the banks of the latter, by diverting their ftreams or currents to the oppofite fides. Hence arifes the formation of piers, which become highly beneficial in defending embankments, as well as the borders of rivers and brooks. In the firft of thefe cafes, they may generally be conftituted and coated over with the fame fort of material as that of which the embankment is formed; while, in the latter, they fhould be formed of fome fort of ftony matter, being conftructed in fuch a way as to decreafe in every direction as they advance outwards, as reprefented in *fig.* 11. In each of thefe cafes, they are, however, capable of being conftituted of brufhwood, fecured by means of ftakes, often with more perfect fuccefs. And it frequently happens that a fimple rude wicker-work fence, of not more than three or four yards in length, may be fully fufficient for the purpofe. Embankments formed of ftone, unlefs conftructed in the manner reprefented at the above figure, are apt to caufe eddies below them; while thofe formed of brufh-wood cannot have this effect.

It is obvious that confiderable attention muft be required in deciding the moft proper fituations for conftructing thefe forts of projections in, and the diftances to which they fhould extend into the rivers: as a too extended projection may be highly dangerous to the oppofite bank, and of courfe do harm inftead of being beneficial; while not carrying them out fufficiently may prevent the effect which is wanted. In cafes where piers are to be formed of ftone, as in rivers where the bottoms are of a rocky nature, the plan reprefented at *fig.* 11. is probably the moft proper, as it will fcarcely caufe any eddy, and be nearly equally mild with that of wicker-work in the effect which it produces. Different works of thefe feveral kinds have been conftructed in the northern parts of the ifland with much fuccefs.

Proper Materials for Embankments.—There cannot be any doubt, but that different forts of materials may be made ufe of in different fituations and kinds of works of this nature, with more advantage than others, both in fo far as duration and expence are concerned.

Thofe fteep upright embankments which are conftructed with the view of protecting bold fhores, or coafts, and the banks of particular rivers, may probably be beft formed of good brick, rubble, or afhler work in the manner of a wall, as feen at *fig.* 6. in the plate, the materials being laid in the ftrongeft fort of mortar that can be made. But where this is not the cafe, they may be built in the common way, and pointed with puzzolana earth, or what is termed the Roman cement, prepared by Meffrs. Parker and Co. London.

The different kinds of floped embankments may be formed either with common earthy materials, clay, mud, or a mixture of thefe feveral different fubftances: and any other matters which are capable of uniting into a folid, firm, compact mafs, may be had recourfe to for the fame purpofe. Where the fides next the fea or other waters form angles of from twenty to thirty or even thirty-five degrees, with their bafes, they may be coated with fand, the fhells from the fea, or coarfe gravel from the borders of the fhores. And ftones, broken down to uniform fizes of a few pounds in weight, may be employed in a fimilar manner. But where none of thefe fubftances are capable of being procured in fufficient abundance, a method practifed in Holland, of covering them with fuch perifhable materials as mats, reeds, ftraw, bark, and others of the fame nature, may be had recourfe to; but thefe are obvioufly difadvantageous, as requiring very frequent renewal. They might likewife be protected by a low fence of brufh-wood, fixed in an erect manner all along at the bottom of the bank, of an equal height, as tending to break off the violence of the waves. Another method might alfo be employed, which is, that of covering the whole front of the bank with brufh-wood, either made into bundles or in the manner of wicker-work, or fixed down in a neat manner by means of long poles and ftrong hooked ftakes. And further, they may be laid in the form of caufeway with ftones in mofs, or covered with wicker-work applied upon the moffy material when fpread out over the bank. And there are ftill many other modes which may be adopted under particular circumftances.

In all cafes where the fides and flopes towards the fea conftitute angles of from thirty-five to forty-five degrees, with their bafes, as in *fig.* 8, recourfe may be had to ftones of the flag kind as coverings, which fhould be jointed with cement mortars formed in fome of the manners mentioned above. And where thefe forts of ftones cannot be provided, if clay can be found, proper kinds of bricks may be made, and ufed in the fame way as the ftones. But where the flopes or inclined planes are from forty to forty-five degrees, it is frequently more cheap and economical to have them covered with ftones of about fix or eight pounds in weight, applied to the thicknefs of a foot and a half or nearly two feet; or thefe may be ufed on a bed of common mofs of three inches, or of peat-mofs of the flow kind, of fix inches in thicknefs, fpread upon the banks, only to the thicknefs of fix or eight inches. Stones of thefe kinds may likewife be formed into a fort of caufeway, or be laid in ftrong clay, and their furfaces be jointed with lime or a ftrong cement mortar, which has the property of quickly hardening, and of enduring the operation of the air and tides, which alternately act upon it.

There may likewife be cafes in which it may be the moft advantageous practice to have the fides next the fea or rivers protected by coverings of wood only, in which cafes, larch may be the moft proper, or fuch others as are durable, having their furfaces covered over with pitch and fome fort of fharp fand. And old fail cloth, or oil cloth pitched and coated over with fand in the fame manner; or even thin plates of metals have been fuggefted as ufeful in particular inftances.

Expence of forming Embankments.—This muft obvioufly be very different in different fituations and circumftances, according to materials and the price of labour, but though in general pretty confiderable, it is feldom fo high as is commonly fuppofed. It is probable that in cheap diftricts, and where the materials are plentiful, the expence of forming an earth bank covered with fand or gravel, fuch as that fhewn at *fig.* 1, could not be lefs than from four-pence or fix-pence, to ten-pence or a fhilling the cubic yard. And fuch as have more fteep and bold flopes, as from thirty-five to forty degrees,

grees, and are formed with pavement on the furfaces, cannot coft lefs than from nine-pence to one fhilling and fixpence the cubic yard. One made on the plan of that fhewn at *fig.* 6. could not be conftructed for lefs than from twelve or fifteen to thirty pounds for every thirty-two yards. And one conftituted of brufh-wood, in the fame method, for foft ground which will not admit of a wall, would not be lower than from fix-pence or eight-pence to fix or feven fhillings for each foot forward in a lineal manner. In many fituations the expences would, however, in all forts of embankments, ftand a great deal higher than thefe.

In fome diftricts embankments are formed by the rod and the floor, the former being from four to five pounds, and the latter about four fhillings and fix-pence, the workmen finding all forts of neceffary things for the bufinefs.

Extent of Land capable of being gained by Embankments.—It is evident, that great quantities of land might in many fituations be obtained from the fea and large rivers by the forming of proper embankments. Some notion of this may indeed be formed by a careful examination of fuch lands, as lie along their fhores and banks, by afcertaining the diftances to which the waters ebb out at common tides, as it is found by experience, that one half of the extent of land, thus uncovered in any particular fituation, may at leaft be gained; hence throughout the whole kingdom it could hardly be eftimated at a lefs quantity than from two to three millions of acres, but it is probably much more than even the laft quantity, if it were capable of being afcertained with any degree of accuracy or correctnefs.

Importance of Embankments.—When the extent and value of the lands which are capable of being gained by thefe means are fully confidered, there can be no doubt of their being of the greateft confequence to the interefts of the country. It has been well remarked by a late writer on this fubject, that there are numerous places in the kingdom where vaft improvements may be effected by the judicious application of thefe means. Vaft tracts of land of the beft kind may not only be gained from the fea, but likewife from the large rivers and lakes, befides the beneficial confequences which muft neceffarily arife from the prevention of fuch rivers from overflowing their banks, and injuring the level grounds in their vicinity by fuch inundations. In fome cafes, it is fuppofed, that by raifing a bank of only three or four feet in height, at very fmall expence, fome thoufands of acres might be prevented from being overflown, the crops from being carried away, and much other mifchief from being produced. In other inftances the forming of very trifling banks might be the means of obtaining much extent of country, which in its prefent ftate is of but very little value; yet fo indifferent are people in general about improvements of this defcription, that though immenfe tracts are year after year overflown, and the moft dreadful devaftations committed, they have recourfe to no means of prevention; nay, even though the fea itfelf, fays the writer, as if to roufe them from their inaction, prefents to their view twice every four and twenty hours large tracts that might by proper means be made of very great value, yet thefe repeated invitations are difregarded, and no attempts are made to poffefs what might, in many cafes, be fo eafily and fo advantageoufly acquired. This is confidered altogether as extraordinary and unaccountable, while the acquifition of diftant poffeffions is conceived by them of fuch great importance, as there can be no doubt but that the addition of portions of ground at home, when brought into proper cultivation, is of far greater national advantage than double the quantities gained in other diftant countries.

The acquifition of additional territory at home fhould, therefore, be more attended to, and have more expence beftowed upon it than has hitherto been the cafe. In particular fituations, indeed, a few active and enterprifing perfons have taken advantage of the opportunities which have been prefented; as in the counties of York, Lincoln, Cambridge, and others, many hundred thoufands of acres have been gained by embankments. In Norfolk, too, a confiderable extent of land has been gained in this way. In the neighbourhood of Chefter, the river Dee company have likewife gained feveral thoufands of acres from the fea, which have been fince divided into different beautiful farms, the whole of which pay in rent more than two thoufand pounds *per* annum. And in Holland the whole country has, in a great degree, been obtained by thefe means.

It is ftated by Mr. Beatfon, in the fecond volume of Communications to the Board of Agriculture, that large fums have been expended in fome places by individuals, with a view of guarding againft inundations; but owing to the embankments they have made being injudicioufly placed, and as badly conftructed, the defired effect has not always been produced, particularly in the northern parts of Chefhire, on the banks of the river Merfey, where works of this kind have been thrown up at a great expence, which, from the manner of their being placed, may, in fome cafes, by confining the courfe of the river, do more harm than good. By the appearance of that part of the country, fo far as he could judge from the curfory view he had of it, it feemed to him that the inundations from that river might have been effectually prevented at a much eafier rate, if a proper method had been taken at firft; but from a certain ill-judged and miftaken tenacioufnefs of property, the embankments are reared fo clofe upon the fides of the river, that, in many places, it is confined to a fpace not more than twenty yards over. Owing to this, and to an aqueduct acrofs the river, with only one arch inftead of two, which it ought at leaft to have had, the water fometimes, in great floods, rifes, he was informed, to the height of about twenty feet above its ordinary level, and overflows the embankments, although now, by frequent additions, they are about that height. Inftead of twenty yards, had thefe embankments been eighty or a hundred yards diftant from each other, and the river widened in the narroweft places, one-third or one-fourth of their prefent height would have been quite fufficient. They would have been much eafier conftructed, and lefs liable to damage by the floods, and a great deal of money would have been faved, not only in the firft conftruction, but in keeping the banks afterwards in repair. Neither would that fpace of ground between the embankments and the river be altogether ufelefs; on the contrary, it would have produced the richeft pafture, or meadow-hay, by its frequent manurings with the fertilizing particles left upon it, when flooded by the fwelling of the river; and in thofe places, if any, that are unfit for pafture or hay, willows or other aquatics might have been planted to great advantage; and thus it might have been of more value perhaps than at prefent, and the interior grounds more effectually fecured from the ravages occafioned by a fudden flood. Notwithftanding the general indolence fhewn in moft parts of the country refpecting the acquifition of land by embanking, and the feeming averfion that moft people have to engage in fuch undertakings, there have been, however, fome ingenious and enterprifing projectors, whofe ideas upon that fubject have foared far beyond the bounds allotted to common underftandings. From the fpeculations of fuch people, the moft important advantages are fometimes produced; and furely the man who is poffeffed of a fpeculative turn of mind, and who confiders no obftacles infurmountable, is a much more ufeful member of fociety than he who is perpetually ftarting difficulties againft every new project, and is for all things remaining *in ftatu quo*, that is, for leaving the world as he found it. The idea of embanking Lancafter fands, for example, never would have occurred to a torpid genius of this kind. A thoufand difficulties and impoffibilities would have immediately ftarted up at fuch a propofal, which, to a more expanded mind, appear perfectly practicable to overcome. What then, fays he, muft thofe anti-projectors think, when they are told it is propofed to exclude the fea entirely from thefe extenfive fands, which form a bay, expofed to a fouth-wefterly wind, more than ten miles acrofs, containing a furface of near forty thoufand acres, and where the tide rifes about fourteen to eighteen feet perpendicular height. Some propofals and eftimates have already been made for carrying this project into execution. One very public-fpirited and enterprifing gentleman; the late Mr. John Wilkinfon, offered to begin a fubfcription for that purpofe, by leading off with the princely fum of 50,000*l.*; but fo many unexpected obftacles have come in the way, by the claims of lords of the manors, and in proportioning the tythes, in the event of acquiring fo large a tract of country, that few people have on that account chofe to embark their fortunes in this immenfe undertaking, feeing that their profits may be liable to fo many deductions; confequently nothing conclufive has yet been done in it. Ulverftone and Duddon fands, on the fame coaft, have alfo been propofed to be embanked. The latter, over which the writer went with major Gilpin, a gentleman who has paid great attention to that bufinefs, appears to be the moft practicable. According to his opinion, there might be about nine hundred acres of very good land gained there, by laying out a fum not much exceeding 20,000*l.* If, on a correct furvey being made by perfons properly fkilled in fuch undertakings, fo valuable an acquifition is proved to be attainable at fo fmall an expence, can there be the leaft hefitation about immediately commencing a project fo highly advantageous to that part of the country, and to every individual concerned in it.

That there are many large tracts of land in different parts of the kingdom, both on the fea-coafts and on the fides of lakes and rivers, much more eafily attainable than Lancafter-fands, or any of the fands here noticed, there cannot be the fmalleft doubt. It is, therefore, an object worthy of the attention of thofe who are fo fortunate as to poffefs property in fuch fituations, to have it afcertained by perfons of experience in fuch matters, how far the acquifition of additional portions of land may be adequate to the expence which it may be neceffary to incur in procuring it.

But embankments are important in other views than thofe of gaining ground by them. When rivers are concerned, one material advantage is the deepening of their courfes, by which veffels of greater burthen than they admitted formerly may be permitted to trade in them.

And further, as embankments become more frequent on the borders of rivers and fea fhores, the intervening diftances may become a fort of bays, in which accumulations of fhells, mud, fand, gravel, and other matters, may take place by the influx of the tides; and thefe, however difficult they may be at firft to embank, will in time be as eafy to perform the work on, as the natural bays and creeks are at this period. In this way many rivers, which in their prefent ftate are eight or ten miles in width at their junction or influx with the fea, may in the courfe of years be reduced to lefs than half thefe diftances. Confequently fuch embankments would be equally beneficial to the proprietors of land, and the merchant or manufacturer, as many rivers would become more eafily navigable, and thofe obftacles which interrupt their mouths be wholly removed.

Embanking againft the Sea.—When encroachments of this nature are to be guarded againft by embankments, the methods of afcertaining their proper heights have been fhewn above. But as new works of this fort, efpecially where the banks are large, are liable to fubfide too much, it may be a proper precaution to take the levels frequently for fome time after they are completed, in order to guard againft any mifchief which might arife in this way. Where the banks are low this is not, however, fo neceffary, as the fettling is always more or lefs according to their height; in low banks it will of courfe be very little. In the making of fuch embankments, it is fcarcely poffible to lay down any general rule in regard to their fize or dimenfions, as thefe muft be directed by fituation and circumftances, under the management of an expert engineer. In cafes where the embankment to be formed is to exclude the fea from a piece of low marfhy ground, over which it only flows at fpring tides, the work is eafy and capable of being accomplifhed at no great expence. But where it is intended to reclaim a portion of land which is covered every tide, in fome bay or creek, or on the fides or windings of fome large river in which the tide ebbs and flows, the bufinefs will be in fome degree more difficult, according to the depth and rapidity of the current of the water. And where it is propofed to exclude the fea from fome expofed fituation at the mouth of a river, or in a bay or inlet, which is uncovered every tide, the operation will be the moft difficult and expenfive of all, according as it is expofed to prevalent winds, and the depth of the water to be refifted. Each of thefe fituations, therefore, requires a different method of management. The bufinefs of embanking againft the fea, when at any confiderable diftance within high-water mark, is not only the moft tedious, but at the fame time the moft difficult of any; as when the materials are not very good and the work not well performed, the force of the water at every flowing of the tide will quickly undo all that has been effected, efpecially if the foil be of a fandy nature, as is often the cafe in fuch fituations. If it be a ftrong clay, as is fometimes the cafe in marfhy places, there will be the lefs rifk of its being wafhed away. In fandy fituations it has been advifed by fome to lay bundles of ftraw or reeds well-faftened down, or any other impediment, to hinder the foil from being carried away by the ebbing tide. Where a fufficient fupply of good ftrong turf cannot be had, expedients may be tried: but where fuch turf can be provided, as is the cafe in moft marfhy fituations, and where the embankment required is not to exceed the height of four or five feet, it is beft to finifh the flope with good turf as expeditioufly as poffible, as the work proceeds; that is, fuppofing the length of thirty, forty, or fifty feet or yards of it can be completed in a tide; it is better to finifh that length to its intended height, than to trace out or begin a greater extent than can be finifhed before the tide returns, by which a great deal of the foil might be carried away, and much of the work be demolifhed, which is not fo likely to be the cafe when the flope is finifhed. Turf which contains the roots of bent or rufhes is very good for this ufe. The firft thing, however, to be done in an embankment of this kind, is to ftrike out the intended line of it, fetting out the breadth at the bafe, alfo the width of the excavation or trench to be made in the infide, from which moft of the materials that compofe the bank are to be taken: this trench alfo ferves as a drain to keep the grounds within dry. There fhould alfo be trunks or fluices at different parts of it, to fhut of themfelves againft any external water, and to open when the tide ebbs,

ebbs, to let out any water from within. The width of it ſhould be proportioned to the quantity of materials required from it for the raiſing of the embankment, as eight, ten, or fifteen feet wide, and three or four feet deep, leaving a *berme*, or ſpace, between the edge of the trench and the inner bottom of the embankment. If the ſoil be ſtrong, one foot or eighteen inches will be ſufficient for this purpoſe; but if looſe or ſandy, three or four feet at leaſt will be required. The more eaſy and gradual the external ſlope is made, and the leſs ſudden the reſiſtance againſt the ſea will be, as has been ſeen above, and of courſe the embankment be leſs liable to injury; this ſlope ſhould therefore be formed according to the expoſure of it to the winds and tides; nothing, however, can be a greater error than the making it too bold or upright. *Fig.* 1. in the plate, is ſuppoſed to be a ſection of an embankment of this nature, in which the baſe or horizontal line *g h* ſhould at leaſt be three times the perpendicular height *h i*, but *l m*, the inſide ſlope, need not be more than three-fourths of the perpendicular height, that is, nine inches for every foot of riſe. The inſide ſlope ſhould be faced with turf likewiſe, laid greenſide downwards, as in building common ſod walls. Some expert ſodders can finiſh this ſort of work extremely neat by ſetting the ſod on edge, according to the ſlope intended to be given, and with proper mallets and beetles ramming the earth hard behind, which conſolidates the work as it advances, and tends to render it durable. As ſoon as the firſt or lower courſe is finiſhed, the upper edge of the ſods is pared with a ſharp knife quite even, by laying a rule to them, and then they go on with the ſecond courſe, which they finiſh in the ſame manner, and thus proceed until the whole height is completed, which, when properly finiſhed, has a ſmooth beautiful appearance, not a joint between the turfs being ſeen. Where turf is uſed in covering the outſide ſlope, it ſhould all be laid with the graſs uppermoſt, as already noticed, and be well beaten down with a flat ſod-beetle for the purpoſe, and in order the better to ſecure them, it may be proper to drive ſmall ſtakes, about eighteen inches in length, through every ſod. In cutting ſods for this uſe, they ſhould be taken up in a careful manner, and be all traced by a line of the ſame breadth; their edges being cut as even as poſſible, that they may make the cloſer joints, which will tend very much to their ſecurity, until they are grown properly together. In laying the different courſes of ſuch ſods, care ſhould alſo be taken that the joints of the one be covered by the other, in the manner that good brick work is made.

Where it is propoſed to reclaim a piece of land, upon which the ſea ebbs and flows every tide, to a greater depth than in the foregoing caſe, as in a creek, or on the ſide of a large river, a different mode of proceeding muſt be purſued, according to the ſoil, and the nature of the materials to be employed. Where plenty of ſtones can be readily procured, a bank may be formed of them, with a mixture of clay, either by means of land carriage, or which, in ſome inſtances, is better, by conveying them in flat bottomed boats, or punts, and throwing them over-board until the bank is formed. Where ſtones cannot be eaſily had, clay, or other materials proper for the buſineſs, may be thrown in, in ſufficient quantity, in the ſame manner, with perhaps nearly equal ſucceſs. It is ſuppoſed that moſt of the embankments in Holland were formed in this way, the clay dug from the canals being made uſe of for the purpoſe. In either caſe it is requiſite to fix up ſtrong poles before the work is begun, as guides for laying down the materials. Proper ſluices muſt likewiſe be laid in ſuitable directions for taking off the back water when the tide ebbs, under the inſpection of the engineer. Much, in all caſes of this ſort, depends on a ſkilful engineer, who is capable of ſuggeſting and contriving various means of facilitating the buſineſs, and of obviating the difficulties that may ariſe in its execution. A perſon of real genius is often capable, by his different contrivances, of rendering the accompliſhment of a great undertaking comparatively eaſy, which to others would be almoſt impracticable, or carried on at ſuch a heavy expence as to counterbalance the advantages to be drawn from it. In caſes of the kind juſt noticed, he might ſuggeſt the erection of ſtages or platforms, in ſuch a manner as to carry on the work at all times of the tide, which would be an immenſe ſaving, as the delays cauſed by the tides in this ſort of buſineſs are both tedious and expenſive. Waggons might likewiſe be contrived in ſuch a way as to carry on ſuch platforms large quantities of materials at once, which could be eaſily emptied and filled; and at the ſame time be drawn by machinery, in ſuch a manner as to ſave much labour and expence, both in carriage and tide work.

There is another ſpecies of ſea-embankment which is, perhaps, the moſt important of any; as there are few eſtuaries or mouths of rivers in which large tracts of land may not be gained by it. The ſhoals, or flats formed at the entrance of ſuch rivers, are moſtly compoſed of the richeſt materials and moſt fertiliſing particles, brought down from the towns and circumjacent country through which they paſs. Such ſhoals and flats may, therefore, under proper management, be in moſt caſes readily converted into the moſt fertile plains. In ſuch ſituations the firſt object is that of collecting the whole river into one ſtream, and preventing its overſpreading a wider extent than is merely ſufficient for its diſcharge, or it may be better, perhaps, to alter its courſe altogether, and cauſe it to be diſcharged at ſome other outlet. It is in this latter method that it has been propoſed to reclaim the extenſive tract covered by the tides, known by the names of the Lancaſter and Milthrop ſands, as well as thoſe of Ulverſton and Duddon. And the principle on which it is founded is this: it has been found by experience that where the courſe of a river is changed in ſuch a manner as to make it diſcharge itſelf into the ſea at a different place to that where it did before, the former place will, in a few years, by the continued accumulation of ſand and mud brought in every tide, be ſo choaked up and raiſed above its former level, as to form of itſelf, in the courſe of time, a bank that, with a very little aſſiſtance, will quite exclude the ſea; for as the current of the river before carried away all that ſediment which the motion of the waves naturally ſtirred up, from its being now removed, it is obvious that all or moſt of the muddineſs will not only be carried further up the old channel of the river, but a great part of it be depoſited there as the tide recedes. It has been found that in ſpring-tides and particular winds, this ſediment is depoſited in larger quantities than at other times, and the writer has been informed that a gentleman in Lancaſhire, who has gained ſome land in this way, has found, on making a perpendicular cut in the ground ſo recovered, that the different layers were ſo diſtinct, he could readily diſtinguiſh thoſe made at ſpring-tides from the reſt. This curious fact is well deſerving of the attention of all thoſe who have lands ſituated at the mouths of rivers, as there may in many ſuch ſituations be conſiderable tracts gained in this manner at a very light expence. But though this fact may exiſt in ſome places, as has been proved by experience, nevertheleſs it is ſuppoſed that the effect cannot be the ſame in all ſituations. Where there is a great extent of flat or muddy ſhores, the motion of the waves will no doubt ſtir up the mud or ſand, and carry great quantities of them along with the current on the flowing of the tide, and when the tide ebbs, though

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fome of the lighter particles will be carried away again, yet it is reafonable to fuppofe the heavier ones will be left behind. If the fhores are bold and rocky, except juft near the entrance of the river, there will be the lefs of this mud; but on fuch fhores there can, indeed, be little or no occafion for embanking, unlefs perhaps in fome creeks, narrow at the entrance and fpreading out wide above. If the fea were excluded from fuch creeks, a great deal of land might probably be gained.

It was found, on having a furvey made of the Lancafter fands, and of the propofed alteration of the courfe of the river Kent, that the length of the cut, neceffary to be made from a little below Dalham Tower to the river Lune, was 21,340 yards, or twelve miles and one furlong. This cut was propofed to be about thirty-four yards wide, and four yards of average depth, making in the whole an excavation of 2,902,240 cubic yards: the expence of excavating which, at 4½*d.* per yard, would amount to 54,417*l.* But perhaps this eftimate is rather under-rated at 4½*d.* the cubic yard; but on the contrary the average depth of the excavation is prefumed to be confiderably over-rated at four yards, as a great part of the depth neceffary may be made up by the foil thrown out; confequently whatever is made up cannot be confidered as a part of the excavation; befides if the river Kent, Lindale pool, and the other ftreams propofed to be taken into this new cut, require, when united, a fpace or channel to contain them whofe tranfverfe fection is 136 yards fuperficial, it would be much lefs expenfive, it is fuppofed, to add eleven yards to the breadth, and to take one from the depth propofed, unlefs it be neceffary, from the level of the bottom of the river, to make the bottom of the new cut of a certain ftated depth. The whole expence of completing this great undertaking has been eftimated at only 150,000*l.*, and in the opinion of fome perfons fifty, or perhaps fixty thoufand lefs might be fufficient. It is, however, apprehended, that in this eftimate there has been no allowance made for the neceffary buildings on fo extenfive a tract, or for inclofing and draining; all which, as well as the intereft of money laid out before any return can be expected, fhould be confidered in calculating the expence of bringing into improvement fuch lands as thefe. And further, there are other eftimates to be made for neceffary buildings in its cultivation; befides in the eftimates which have been made, it is taken for granted, that if the frefh water be conducted another way, as propofed, in a few years the fea will completely exclude itfelf from this extenfive tract of land, and confequently no allowance whatever is made for any fort of embankment acrofs thofe fands. Experience has not, however, fo fufficiently fhewn the certainty of this method of gaining land from the fea, as to place that fort of confidence in it that is requifite. If, indeed, it could be fully depended on, the fpeculation would be admirable, as well as the advantage and profits arifing from fuch an acquifition immenfe; but if after laying out nearly perhaps 200,000*l.* in altering the courfe of the rivers, &c. it fhould be found that the fea left little or nothing behind, or if it did leave fome at one time, but carried it all away at another, in what predicament muft thofe perfons concerned find themfelves? They muft either lofe the whole of the money laid out, or they muft expend at leaft 200,000*l.* more, perhaps, in performing what they had fo implicitly trufted to the operation of the fea. If, however, it were certain that even a fiftieth part of an inch was depofited every tide, the fuccefs of the undertaking would be unqueftionable, and a concern in it highly profitable, as in very little more than eight years ten feet of perpendicular height would be raifed, and it would be an eafy tafk to accomplifh the reft of the bufinefs.

The Duddon fands are another tract, it is fuppofed, where great improvement is capable of being effected at a very eafy rate, when compared with that juft noticed. In the prefent ftate a great deal of land, that is capable of producing the beft crops, is often overflown and rendered fo wet and marfhy as to be of little or no value. While, by altering the courfe of that river, and bringing it farther north on the low marfhy ground, it would feem from viewing it, without actually taking the levels, that not only the whole of the ground might be completely drained, but a confiderable tract of lands be reclaimed. The making of the new channel for the river feems perfectly eafy and practicable, the ground being nearly level, with the exception of a fmall rife at one place, all the way from where the new cut would begin, which is about two hundred yards above Duddon bridge to Havering pool; where it would empty itfelf into the fea. The length of this cut would therefore be about fix miles, which ought to be made navigable all the way, with a lock near the fea, and a bafin with proper landing places for delivering goods. The quantity of land that might be thus gained, including the fands and marfhy ground on each fide, would, it is fuppofed, on the authority of major Gilpin, be about 2000 acres, and the whole expence under 20,000*l.* The land, too, has every appearance of becoming one of the moft fertile kind: in proof of which a farmer, who fome years ago gained a few acres of it by embanking them againft the fea, found that it produced the beft crops of all kinds, even with little or no manure. So large a tract of valuable land, capable of being gained at fo very trifling an expence, is therefore an object highly worthy of attention, not only as a profitable concern, but on account of many other advantages that would arife from it. It is, therefore, furprifing, that the proprietors in the vicinity or other enterprifing individuals have not long ago taken the neceffary fteps to reclaim thefe fands. The execution of thefe projects would, it is conceived, be attended with the moft beneficial effects to a very extenfive tract of country, and be ultimately felt in fome meafure by the nation at large. There would not merely be an addition of territory larger than either of the iflands of Guernfey or Jerfey, but it would tend to improve at leaft four times that extent of the interior country. A fafe and fpeedy communication would be opened between the towns of Lancafter, Whitehaven, Ulverfton, Ravenglafs, Dalton, Bootle, Egremont, &c. and all the intermediate country, inftead of a mountainous and very circuitous route, or a precarious and dangerous paffage over Lancafter fands, in croffing which accidents are not unfrequent. Independently of the advantage arifing from the produce of the lands to be acquired, the produce of the interior part of the country, which in many places is extremely fertile and well cultivated, would be eafily brought to market; whereas it is at prefent, with the utmoft difficulty and inconvenience, that any commodity whatever can be tranfported over thefe dangerous fands and almoft inacceffible mountains. By diverting the river Duddon into the navigable cut propofed, it would yield the moft important advantages to the town of Broughton and all the back country, by facilitating the importation of coal, lime, and other produce of every kind, and the exportation of flate, iron, and other productions of the country. But though different public-fpirited individuals have been active in forwarding thefe highly laudable and important undertakings, the oppofition which has been given by the proprietors of fome trifling fifheries, who were offered a full indemnification, and from fome lords of manors, who would neither contribute towards fuch improvements, nor relinquifh any part of their claims to the ground when improved, they have been for ſome time in a great meaſure in a dormant ſtate. It is hoped, however, that in theſe enlightened times, when the ſpirit for improvements of this kind ſhould be particularly arouſed, theſe important and neceſſary projects may be again taken up in a ſerious and effectual manner, and that every obſtacle which may ſtand in the way of their completion may be ſpeedily removed. And that if the attempt of re-claiming Lancaſter ſands ſhould be conſidered as a too expenſive and too mighty undertaking to begin with, an experiment may be made on Duddon ſands, where the money propoſed to be expended is comparatively trifling, and where, if the ſcheme ſhould ſucceed, there could not be the ſmalleſt reaſon for doubting the ſucceſs of the other.

In the marſhland diſtrict of the county of Norfolk, lying between the rivers Wyn and Ouze, immenſe tracts of the moſt rich land, ſuch as is compoſed of the muddy depoſitions left by the tides and floods, which is there called filting, have been obtained by means of embanking. In this important buſineſs, the late count Bentinck, and his ſon, the preſent poſſeſſor, have been largely concerned. This kind of work has ſometimes been undertaken by the tenants on a new piece of marſh, in conſideration of having the land free for twenty-one years. But in theſe caſes the banks have often been very imperfectly made, not having coſt more than forty ſhillings a rod. And thoſe which were conſtructed by the landlords were indeed frequently but little better, being moſtly deficient in not having ſlope enough given them towards the water. Count Bentinck therefore laid his out upon a ſcale never practiſed in that part of the iſland before, and his ſucceſſor has ſtill far exceeded it. That planned by the former extends about four miles, and has added to the old eſtates not leſs than a thouſand acres. The baſe of the embankment, in this caſe, is about fifty feet, the ſlope to the ſea thirty-ſix feet, forming an angle, it is ſuppoſed, of about twenty-five or thirty degrees. The crown is four feet in width, and the ſlope to the fields ſeventeen feet, in an angle ſuppoſed of about fifty degrees; the ſlope towards the ſea being very neatly turfed over. The firſt expence incurred in forming this bank was four pounds per rod, but a very high tide coming before it was finiſhed, not only made ſeveral breaches, but occaſioned an additional height and ſlope to be given to ſeveral different parts, in order to bring it to the dimenſions mentioned above, all of which made the groſs expence to amount to about five pounds the rod. The whole coſt was ſomething more than 5000 *l.* The expence of the houſes, farm buildings, and other things, was about as much more, for five new farms, which was a greater expence than was neceſſary, as the land would have let as well in two or three as five farms. Suppoſing, therefore, the expence at 10,000 *l.* and the new rental as 1000 *l.* a-year, it is juſt ten *per cent.* for the capital laid out. The expence here, however, ſeems to have run too high, when the neceſſary repairs of the bank are taken into the account. The repreſentation, given at *fig.* 11. in the plate, fully explains the nature of the embankment formed in this caſe.

In another new embankment, in which two hundred and ſeventy-three acres of marſh land, and eighteen of bank were gained, the men were paid four ſhillings and ſix-pence a floor of four hundred cubical feet, finding wheeling planks, barrows, truſſels, &c. When it is thus formed, the front ſlope is ſodded, for which they are paid in addition four ſhillings a floor of four hundred ſquare feet, earning from five ſhillings and ſix-pence to ſeven ſhillings a day, and there is ſome little further expence neceſſary for beating it down in a firm manner. The whole of the expence of the bank, ſluice, and every thing elſe, was about 3300 *l.* The land was immediately offered to be rented at four pounds an acre for four years, or three pounds an acre for ſix years; which, in the former caſe, would amount to 4368 *l.* in that length of time, or one thouſand guineas more than the whole of the capital laid out in the undertaking.

On this coaſt the operation of *filting* up, or raiſing the ſurface of the marſh land by the repeated depoſitions of muddy matters from the ſea, is performed in a more rapid manner than in many others; and the little hollows and creeks are found from experience to filt up much faſter where the tide waters are ſpeedily taken off by proper cuts and channels formed for the purpoſe, than where the contrary is the caſe.

Embanking againſt Rivers.—The embankments againſt rivers may be divided into two kinds; namely, ſuch as are for preventing their encroaching on the adjacent lands, and for protecting thoſe lands and the neighbouring level country from being overflown, when the water riſes above its ordinary level. It may be remarked, that where the courſe of a river is a ſtraight line, or nearly ſo, it hardly ever makes any encroachment upon its banks, unleſs, perhaps, in very large rivers when they riſe above their common level, either owing to an increaſe in the waters, or to their being, in ſome degree, affected by the tides. In either caſe, the waves occaſioned by a ſtrong wind, where the river is wide, will moulder away the banks on that ſide upon which it blows, unleſs prevented in proper time. This may be done either by ſecuring the bank properly with ſtones, or by driving a row of long piles pretty cloſe together at a little diſtance from the ſhore, the piles being of ſuch a length, and ſo driven, that their tops may be always above the higheſt riſe of the water. It is ſurpriſing the effect that piles driven in this manner have in reſiſting the power of the waves in ſuch ſituations.

Some years ago, when Mr. Beatſon was on duty as an engineer at a fort near Portſmouth, built on a point of land much expoſed to the ſea, the waves made ſuch havock, that the walls on that ſide were conſtantly giving way, although built in the moſt ſubſtantial manner, and having bulwarks of large heavy ſtone beſides to protect the foundation: however, all would not do; thoſe bulwarks were ſoon knocked to pieces, and ſeveral times the wall itſelf. At length it was propoſed to drive a number of piles at about forty to fifty yards from the fort. Theſe piles were twelve or fifteen inches in diameter, and driven about one diameter from each other nearly in a ſtraight line, parallel to the wall where the waves did ſo much damage. They were driven into the ground with a pile engine till perfectly firm, perhaps eight or nine feet deep, and about two feet of the top of them left above the level of high-water mark. After this was done the wall received no farther injury, the ſpace between the piles and the fort being always perfectly ſmooth, however tempeſtuous the waves might be without. The ſame ſimple method might, it is ſuppoſed, ſometimes, perhaps, protect the banks of large rivers, if expoſed to the waves, when other methods might fail.

But it is ſuggeſted, that the moſt common courſe of rivers encroaching on their banks, is the reſiſtance occaſioned by a ſudden bend. In flat countries, apt ſometimes to be overflown, where there are any ſuch bends or windings in the rivers, it would be of great advantage to ſtraighten the courſe as much as poſſible, for, as every impediment or obſtruction will naturally cauſe the water to riſe higher than it otherwiſe would do, and as ſuch bends have that effect, conſequently, in the time of a flood the waters will overflow a greater extent of country, and to a greater depth than if the river had a free and uninterrupted courſe ſtraight forward.

If

If the windings of the river cannot be altered, and encroachments are making on fome part of the banks, it muft firft be confidered, whether the force of the water can be driven to another place where no injury can be done. If, for example, a river is encroaching on its banks, at *x*, *fig.* 2. a jutty of ftone, a little way up the river in the direction *y z*, would throw off the current towards *w*, and might totally prevent any further encroachment. On the river Nith, in Dumfriesfhire, it is ftated that a good deal has been done in this way by Mr. Millar of Dalfwinton, a gentleman of the moft enterprifing genius and moft liberal mind, who has paid more attention, and laid out more money in making important and ufeful experiments, than almoft any other private individual. The courfe of the river, where Mr. Millar has been carrying on his operations, is faid to be nearly as fhewn at *fig.* 3. by *r s t u*; at *t*, it was encroaching moft rapidly, and feemed inclined to take a new courfe towards *v*, which would have deftroyed fome very fine land, and done a great deal of mifchief in that part of the country. To prevent this, Mr. Millar made a large cut about 400 yards in length from *w* to *r*, and threw in a great quantity of ftones quite acrofs the river at *s*, to direct its courfe in a ftraight line from *r* to *w*. This had, in a great meafure, the defired effect, by totally preventing its progrefs at *t*, but now it began to encroach on its banks at *u*. He at firft endeavoured to prevent this by driving in at a confiderable expence a number of piles at a little diftance from the bank, and wattled them with willow branches, &c. thinking thereby to protect the bank. The piles were drove in with heavy mallets, apparently firm into the ground; they continued fo for fome months, till a heavy fall of rain came on, which fwelled the river, undermined the piles, and carried them all away. But, indeed, it is in vain to think of piles doing any good in fuch a fituation, unlefs firmly driven in by a pile engine; for it is not poffible to drive them in properly with mallets; this muft have been the caufe of their giving way fo foon. The piles not fucceeding, Mr. Millar was refolved to try another plan; feveral of his adjacent fields being covered with an immenfe quantity of ftones, he ordered them to be gathered and thrown into the river, fo as to form a jutty at *x*, a little way above the injured bank. Being obliged to go from home about that time, and to leave the execution of the work to fome country people, they carried out this jutty too much at right angles to the ftream. It had not, therefore, the defired effect, but rather made the matter worfe than before; for, if a jutty is carried out at right angles, as at *a* in *fig.* 4, the current will be forced from *a* to the oppofite fide of the river at *b*, and from thence it will rebound towards *c*, more violently than it did before. But if a jutty be placed obliquely, as at *d*, it will force the current gradually towards *e*, in which pofition one jutty may do more good than feveral placed improperly at right angles. Mr. Millar was, therefore, under the neceffity of making other jutties in this way, and has now the fatisfaction to find that they anfwered the purpofe intended. Thefe he made laterally formed a fort of convex flope, the convexity being parallel to the current. Strong planks were alfo firmly fet on edge among the ftones, their ends pointing towards the river, fo that if ever any current came fo rapidly as to move any of the ftones, it muft move them all in a body the whole length of the plank. Perhaps this precaution was unneceffary; for although ftones are thrown into a river loofe in this manner, the flufh fand, &c. that come down the river will foon fill up all the cavities, and render it as firm and folid as a regular built wall. Mr. Beatfon has been the more particular in this defcription, he fays, in order to fhew the errors that Mr. Millar at firft fell into, and the great expence they occafioned, whereas, had he been on the fpot himfelf, and got the work executed as he intended, it would have faved a great deal of unneceffary labour as well as money.

It is ftated by the fame writer, that the next fort of embankments againft rivers, are thofe to prevent them overflowing their banks, and inundating large tracts of country. This may be confidered as the fimpleft and eafieft of all forts of embanking, if judicioufly executed. It is, therefore, the more inexcufable to fee, in fome places, extenfive tracts of the richeft meadows completely overflown by every flood for want of them.

Two ordinary fized rivers rife no more even in the greateft flood than five or fix feet above their common level, unlefs when they meet with fome confiderable interruption or confinement in their courfe. But if interrupted or confined, they will rife twenty feet or more, as is the cafe with fome parts of the river Merfey already mentioned. If, for example, a given quantity of water is fix feet deep, when running over a fpace twenty feet wide, it is clear, if that fpace was only made ten feet wide, the water would rife to twelve feet, and if it were made forty feet wide, the fame quantity of water would only rife to the height of three feet.

It is, therefore, of great confequence, in preventing inundations, to give the river as much width as poffible, by widening every narrow place. All kinds of obftructions fhould alfo be removed, whether occafioned by windings, fhoals, ftones, trees, bufhes, or any thing elfe. In fome cafes this may even preclude the neceffity of embanking; but where embanking is neceffary, let the banks by all means be at a fufficient diftance from each other, to contain with eafe, between them, the largeft contents of the river in great floods. The diftance and height of the banks may eafily be afcertained by meafuring a fection of the river when at its higheft, or when the flood mark is vifible. By not attending to this, a great deal of money has been thrown away on the embankments on the river Merfey, and after all they do not effectually anfwer the intended purpofe; a great part of the country being ftill overflown every time the river rifes to any confiderable height.

Where a fufficient diftance is allowed between the embankments their height need not exceed from four to fix feet. If irremovable obftacles are in the way, which caufe the river to rife higher, the banks muft be higher in proportion. In either cafe, however, the flope of thefe kinds of banks on each fide may be equal to its perpendicular height, and the breadth on the top about one-third of that height, which, fuppofing the bank fix feet high, the bafe would be fourteen feet, and the breadth of the top two feet, as fhewn at *fig.* 5. in the plate.

The materials for making thefe banks fhould be taken as much as poffible from the fides of the river, which will have the double effect of widening the river and forming the embankments; and there fhould be a trench on the infide (from which materials may alfo be got) with fome fluices, as formerly directed, to drain off any water from within; alfo fluices to let in water from the river, if required, which would very much fertilize the meadows if properly laid out for that purpofe.

Such farms as are fituated on the borders of rivers are frequently, it was obferved by a late writer, liable to much injury and inconvenience from them: 1ft. From part of the foil being carried away in times of flood. 2d. From their overflowing their banks. 3d. From their flowing back in times of flood into the channels of the rivulets and ftreams that conduct the water from the more elevated and diftant grounds

grounds to the rivers, whereby thefe rivulets and ftreams are made alfo to overflow their banks.

In refpect to the firft, the danger of the foil being carried away in time of floods, it is inercafed or decreafed according to circumftances, as the form of the banks, the nature of the foil, the rapidity of the river, and the quantity of water that lodges on the margins of the banks, or falls over them into the river. Where the banks of a river are perpendicular, efpecially if the foil be of a rich mouldering nature, the danger of part of them being carried away by floods is much greater than where they flope gently from the furface of the field to the bed of the river, as has been already fully feen.

Where that is not the cafe naturally, they ought to be moulded into that form by art; as when a river, in place of being confined in its progrefs, has a power of efflux and reflux, the damage to be apprehended is inconfiderable, compared with what is likely to happen when, being reftrained within too narrow limits, it is conftantly ftruggling for an extenfion of fpace. Where the foil is rich free mould, and the under ftratum oppofite to the greateft force of the water, fand, or gravel, this ftruggle never fails to be attended with bad confequences. If the foil and fubfoil be one entire mafs of clay or ftrong loam, and the current of the river does not prefs more upon one part than another, a moft fubftantial improvement may be effected by floping the bank, fo that the declivity may be one foot in three or four from the furface of the field to the bed of the river. This fome may object to, as facrificing a certain portion of valuable land; but it fhould rather, it is thought, be confidered as a premium paid for the infurance of the remainder, than as a total lofs. If gravel, mixed with fmall ftones, can be conveniently procured, fpreading thefe materials on the floping bank to the depth of eight or ten inches, and till beyond the flowings of the river, will prove a good fecurity againft further damage; and if the bank be planted thick with any fort of willow, efpecially the Dutch willow, it will in a fhort time become an impenetrable fence, while the annual cuttings of wood will foon be equal to the heritable value of the land thus apparently facrificed. Where no gravel can be procured, the new floped bank fhould be immediately covered with well fwarded turf, which fhould be preffed down as hard as poffible, either with the back of a fpade, or with wooden mallets. If this be done in the beginning of fummer, and willows be planted the following autumn, the improvement, it is fuppofed, will be both effectual and permanent. In cafe the river run with extraordinary violence againft any one particular part of the bank, it may be neceffary to make a fence or bulwark of ftone in the front of that place; the beft way of doing which, is, in place of building a wall, to drop the ftones in a carelefs manner, but fo as they may lie clofe together on the floped bank, as already fuggefted.

This is a much more fecure mode of fencing, if the bank be made with fufficient declivity, than any ftone wall that ever was built for the purpofe, and while it is the moft fecure, it is alfo the leaft expenfive; but care fhould be taken to lay the ftones all the way from the bed of the river, till confiderably beyond where the river flows in common. Where the foil is of a ftrong adhefive nature, and the under ftratum is fand or a pebbly gravel, it becomes in a much greater degree neceffary to flope the banks. The water, when rufhing violently along, has a powerful effect in undermining the bank, and carrying off thofe incoherent fubftances; fo that the foil, having nothing to fupport it, naturally gives way, and frequently in fuch quantities as to occafion very ferious loffes both to proprietors and tenants. In all fuch cafes, the flope fhould be made much more gradual than where the foil and fubfoil is of the fame quality, and fuch as will nourifh aquatic plants. The banks, having been floped according as circumftances require, a thick coat of gravel, mixed with fmall ftones, where fuch can be procured, fhould be laid on fo as to form a kind of natural beach, over which the river, when in flood, may have power to extend itfelf at pleafure. Should it be difficult or impoffible to procure fuch materials as are proper for forming this beft of all defences, ftrong thick fods fhould be placed on the furface in the manner before directed, which, if laid on in fpring, or early in fummer, will have time to unite, and to become one compact body before the autumnal floods (which are thofe whence the greateft danger is to be expected) begin to flow. If the fubfoil be of fuch a nature as that willows will not grow, fuch fods as are full of the roots of rufhes fhould be made choice of in preference to all others; as where thefe plants thrive and fpread over the furface, it becomes in a great degree impenetrable by water, even in great floods, and when the river runs with confiderable violence and rapidity.

The directions above given will, it is fuppofed, be found more or lefs practicable and ufeful according as the river on ordinary occafions runs with greater or lefs rapidity. In level, or nearly level diftricts, all that is neceffary is to fecure full fcope for the rivers to overflow their ufual bounds without interruption; when that is fecured by either of the methods before mentioned, floods, unlefs very violent, feldom do any material damage to the banks of rivers in fuch fituations. It becomes in many cafes extremely difficult to fence rapid running rivers in fuch a manner as to prevent part of the banks from being carried away by inundation. Sloping the banks would be attended with no good confequences. Even ftrong bulwarks made of ftone are often fwept away by the overpowering flood. A method has, however, been fuggefted, of fencing the fides of a rapid running river, which has been practifed with fuccefs, after feveral other attempts had failed; it is by means of a fort of large bafkets, provincially termed creels, formed of hazle, willow, &c. into a kind of open net work, which being placed along the bottom of the banks, were filled with ftones. This is a very fimple, and by no means an expenfive expedient; and as thefe bafkets may be made to contain two or three tons of ftone, it can only be on few occafions, and in very particular fituations, that a bafket, containing fuch a weight, can be difplaced or carried away. Such a mode of fencing as this, it is imagined, would prove effectual in many parts of Scotland and Wales, where the rivers run with uncommon rapidity. Owing to inattention, or rather to not being aware of the confequences, much damage is often done to the banks of rivers in level diftricts, efpecially if the banks be perpendicular, and of a confiderable height, by allowing the land floods to fall over them into the river. As the water from the furrows approaches the bank, it is frequently ftopped in the furrow of the head ridge, which becomes for a time a kind of refervoir; the confequence of which is, that a confiderable proportion of water finks and filters through the earth, which being thus foftened and fwelled, is more eafily undermined and carried off by the river. Sometimes little cuts or openings are made for the furrows acrofs the head ridge, for the purpofe of conducting the rain water into the river; here, again, the confequences are equally bad. Whoever will examine the bank of a river where this mode of management is adopted, and it is very common, will obferve, that at every one of thefe cuts or openings a little creek is formed, in confequence of the bank having been more foftened, and by that means having

ing become a more eafy prey to the river when in flood. To prevent thefe evils, it is neceffary, befides floping the banks, to devote a part of the lands adjoining to the breadth of twenty or thirty yards, for inftance, either to pafturage or the growth of trees, and to form a drain at a proper diftance from, and parallel to the bank, for the purpofe of collecting and carrying off the water from the furrows. Were this done, and were the water from this drain conducted into the river by conduits formed a little above its ordinary level; much land, which is annually loft by neglecting this fimple precaution, would be faved, and preferved in a proper ftate.

In the fecond cafe it is evident that injuries, although of another nature, are often fuftained by farmers, from rivers overflowing their banks. Sometimes the farmer is prevented from fowing his field; at other times the crops of grain and grafs are greatly injured, by being covered for a confiderable time with water; and at others again, the whole produce of the year, the hay and corn crops are fwept away. To prevent evils fo complicated, and fo ferious in their nature, is certainly the bufinefs of every man, who, from the fituation of his farm, has reafon to apprehend, that without ufing proper precautions, he may be fubjected to fuch vifitations. Thefe damages can only happen in level tracts, where the banks of the rivers are low, and where the courfe is not of fufficient breadth to contain the water in time of flood. Some people, although very improperly, raife mounds of earth clofe to the top of the bank, and of a height exceeding that to which the river can be expected at any time to rife. Thefe mounds, from being placed fo near the river, are unable to refift the preffure of the water, and by giving way, frequently admit a current into the fields, which proves much more injurious in its courfe than if no mound whatever had been erected. Were a mound of earth, formed on the fide of the drain, propofed to be made for carrying off the land water, and were that mound well floped on the fide towards the river, it would be the moft fecure and effectual guard againft rivers doing injury to the adjoining lands, of any that could be adopted. By thefe mounds being placed at a diftance from the river, the force of the ftream would be much leffened, and the natural boundaries of the rivers greatly enlarged, as in proportion as the mounds are removed from the centre of the current of the river, in like proportion will they become more fecure, as being lefs liable to violent preffure. The propriety of erecting thefe mounds at a proper diftance muft, therefore, be fufficiently evident, as when mounds are erected near the top of the bank, which can only be owing to ill-judged parfimony, they form as it were a part of the bank, and are liable to be undermined and fwept away. Whereas, when they are placed at the diftance of twenty, thirty, or forty yards, they ferve rather as a boundary to confine the overflowing waters which glides along the bottom, than as a barrier to prevent the encroachments of an impetuous river during the time of floods.

In regard to the third cafe it is obferved, that farmers who poffefs lands in low fituations often fuftain damage from rivers, in time of flood, by their flowing back into the channels of the rivulets and ftreams that conduct the water from the more diftant and elevated grounds to the rivers, whereby thefe rivulets and ftreams are made alfo to overflow their banks.

The only precaution that can be adopted, in fuch a cafe, or at leaft the one which appears to have the greateft probablity of anfwering the purpofe, is to erect mounds at a diftance from the banks, and of a fize proportioned to the quantity of water which, from the caufe now mentioned, may be fuppofed at any time to ftagnate in thefe channels. This may be done at a very trifling expence either in money or land. If the proprietors do not choofe to ornament the county and improve their own eftates, by planting trees on the borders of the rivulets and ftreams, the farmers may fo conftruct thefe mounds, as that they may become fences to their arable fields, while that portion of the farm, neceffarily and properly cut off for the protection of the remainder, may be devoted to pafturage.

Several different embankments of a fuccefsful kind have been lately effected in the northern parts of the kingdom. An important work of this nature has been executed on the eftate of lord Galloway, fituated on the mouth of the river Cree, near Cree town, by his lordfhip's tenant, Mr. Thomas Hannay, who ftates in the third volume of the "Farmer's Magazine," that he "entered to the farm about four years ago, on a leafe of twenty-one years, and his life; at which time upwards of 100 Scottifh ftatute acres were regularly flooded by the higheft fpring-tides, excepting about three months in fummer, when the tides were lower. They were feldom, however, covered above the deepnefs of one or two feet, and never above four or five. Eighty acres of the above confifted of a rich fea marfh, or *ings*, as they call them there, almoft a true level, excepting where hollows were formed by the egrefs and regrefs of the tides, and the paffage of frefh water from the higher grounds; and about four or five acres, which were about fixteen inches lower, being a younger marfh, and nothing but what they call ink-grafs growing upon it (as he is no botanift he can give it no other name); other graffes, fuch as clover, rib-grafs, &c. grew on the reft of the marfh, forming a very beautiful clofe cover in the fummer. The other twenty acres were at an average about eighteen inches higher; confequently, the fea did not cover them fo often. It had formerly been ploughed, but not for about twenty years paft. Laft time it was in corn, it was flooded immediately after being fown, which rendered the crop almoft entirely ufelefs, and deterred former tenants from ploughing it again. He began to bank this field in the autumn of the year 1798, by making a dike along the fide oppofite to the river, in a direct line facing the eaft. This dike was made, at an average, about three feet and a half high, and fix feet broad at bottom, and twenty inches at top, built after the fame manner with that mentioned below. "He inclofed, along with the faid fields," he fays, "four acres of the marfh adjoining, by making a dike five feet high, and five feet in bottom almoft wholly of folid feals or fods, with a very little ftuff, properly beat, in the heart of it, which makes an excellent fence, and promifes to be a very durable one. This dike, together with two fmall drains, one on each fide of it, about two feet deep, coft 3*d.* per yard. He has been more particular in mentioning this dike here, he fays, as the divifion dikes of the whole marfh, which is now divided into four parts, are all built after the fame manner, only that there is no loofe ftuff in the heart of fome of them, but all of folid feal, jointed like brick, as may be feen at *fig.* 6, which reprefents an end-view, or fection of it. This dike, meant as a permanent fence, anfwered as a temporary bank, and enabled him to plough that field in fpring 1799, although the bank round the whole marfh was not finifhed till the winter following." He "fowed oats on this field, and, confidering the badnefs of the feafon, had a very good crop; particularly fo on that part which had not been ploughed formerly. On further confideration, he altered the plan of the bank round the marfh, (which extends in a circular direction facing the north,) by making it, at an average, about four feet and a half high, and allowing about two feet in the base for one in height, as at *fig.* 7, where *a b c* represent an end-view, or section of it, every small span representing the section of a feal or sod; *ab* shews the inside of the bank, with the green side of the feal down; *bc* the base; *a c* the side next the water, with the green side of the feal out, (which adds greatly both to the strength and beauty of the bank); and *d* the heart of the dike, made up with stuff properly compressed with a rammer. The stuff was taken from a ditch in the inside of the bank, leaving a casement of a foot, which ought to have been three at least; and, where the ground is of a sandy nature, more; as the fresh water, running in the inside, was likely to undermine the bank, had he not prevented it, by cutting a new drain, and filling the old one with the stuff cast from it. The only creek worth noticing, through which the bank passed, was was one about forty feet wide, and nine feet deep, in the bottom of which a wooden pipe, with a stopper, was laid through the bank. No tide offered the smallest injury to the bank till January last, when there was one of the highest ever remembered by the oldest inhabitant, which broke it at this creek. This, he thinks, was owing to the wooden pipe not being made strong enough, as the weight of the stuff and water pressed in the sides of it, and thereby admitted the water below. The tide made also three small breaches in that part of the bank, which was built after the first manner; but in the part made after the manner represented in the figure, no breach took place, though it was rather lower than the other part. There are now about fifty acres of the same kind of marsh land adjoining his; and also about 100 acres on the other side of the river, banked in, all neraly in the same manner as represented in the figure. The bank on the farm adjoining his, suffered little from the high tide; but the one on the other side of the river was made almost a complete wreck, owing to its lying quite opposite to the south-west winds, which always send up the highest tides; but this is not the case on this side, these winds blowing right over their bank. In his opinion, the bank on the other side of the river, in order to be durable, would require to be thirty feet broad, and eight feet high, covered with feals, with the green side out; and that no stuff should be lifted within six or seven feet of it, the ground being of a sandy nature. It might be made after the form shewn at *fig.* 8. He has now got the breaches in his bank made up, and has begun to give the whole a complete repair, by adding, at an average, fifteen inches to its height, and two feet of base for each foot in height. The whole bank is about 1500 yards in length, and, when the repairs are completed, will altogether cost him betwixt 80 and 90*l.*

"In the year 1800, he ploughed another field, he says, of about twenty-six acres of the marsh, besides the one formerly mentioned, on which he had an excellent crop of oats, thought by many to be the best they had ever seen. Last year, he had the same field, part in oats, and part in wheat: the wheat was a very good crop; and the oats, which were of the Polish kind, far exceeded the crop of the former year. Last summer, he levelled the old ridges of the first-mentioned field, all by the spade; gave it a complete summer-fallow; shelled and dunged it well; had part sown with wheat, part with potatoe-oats, and all with grass-seeds. The other field is sown, part with wheat, and part with beans drilled; and, what is very surprising, he says, although the wheat was covered several times by the salt water, when the bank was broke, some of it to the depth of three feet, yet it is all looking well. The whole marsh is, he says, this year, under the plough. It may be worthy of observation, that the four or five acres, which he mentioned as being a younger marsh, harrowed easier than the rest, and produced as good, if not better, crops."

Another improvement of the same nature has been accomplished, on what in Scotland is termed Carse land, on the farm of Netherton of Grange, belonging to James Peterkin, esq. by Mr. John Hoyes, his tenant; the estate having been let to him on a nineteen years lease. The work was undertaken under an agreement with the proprietor, to allow one year's rent of 195*l.* sterling, with the further allowance of ameliorating the farm-houses to the extent of 150*l.* more. It is stated in the work already mentioned, that, "under these circumstances, the embankment was begun about the 1st of June, 1802; and, in November, it was brought to its full height over the whole; so that the Carse has been completely defended from the sea ever since the spring tides in October. He cannot positively ascertain, he says, the extent of ground gained, as it has not been measured since the dike was erected; but, from the last survey of that part of the estate, it would appear, fifty acres were improveable; from which is to be deducted the quantity occupied by the base of the dike, the border on the outside, with a few detached spots, probably included in the measure." The method adopted for carrying on the operations was this: "After looking over the Carse, and marking out the line or dike, the length of which is 1400 yards, mostly in a right line, except an angle at the distance of 300 yards from the west end, and a segment of a circle at about 250 from the south-east end, it was resolved to make the embankment six feet of height in the highest part of the ground, and to allow two feet of breadth in the bottom of every foot of height, as seen by the draught of the mould at *fig.* 9. After taking the level of the Carse, it was found, he says, that where the ground was low, and a good deal of it broken by runs of the sea and outlets for the water, the dike would require to be eight and ten feet high, to have it on a level at the top; so that the average will be nine feet high. The embankment was built in the following manner: It was begun on the highest ground, near the west end, and two moulds set up at the distance of seventy or eighty yards; the height six feet by twelve broad in the base; the slope on the outside six feet, on the inside four feet, and the breadth at the top two feet; the sides made up with feal from the broken ground on the outside of the dike, which were laid with the grass-side down, two feal deep on each side of the dike; the outside feal of the first course with the ends out and in, and the other running along; the next course, the outside feal running along, and the inside out and in, and so on alternately, each course consisting of a head and runner; the body of the dike being made up of the Carse ground from which the feal had been cut, and packed down by men with beaters. When this was brought to the height of four or five feet, another piece was begun, leaving an intermediate space, where there were any water-runs, for the egress of the tide: this was found necessary, to draw off the water from the low parts of the Carse, which would have been filled up in spring-tides; and, by coming in at the end and over the high ground, would have been prevented from getting out by the dike, if it had not been done in that way; so that the embankment was all in detached pieces, till it was brought near the height. These intermediate spaces were then filled up, betwixt the fall of one and rise of next spring-tide, after laying down wooden pipes wih stoppers in the dike, to carry off the sink-water." He adds, that "it was a great labour to get the work carried on; in some places having to cross over lakes and runs made by the tides, which required vast quantities of materials, the dike being in some places upwards of ten feet high, and twenty-two broad in the base: the greatest part of the dike is sixteen to eighteen feet broad. There was one lake, of 150 feet in length, and fifty feet in breadth, filled up with earth, clay, and sand, to the height of five feet; on which the dike was then built. This forms a mound, on the outside of the dike, of fifteen or sixteen feet broad; and through this there are pipes laid, to carry off the sink-water." He further adds, that "a stream of water formerly ran this way; but it was turned by the west end of the farm, by cutting a canal, which conveys the water through the embankment there, by means of an outlet built of stone, with a sluice on the inside, raised to the level of the running water, and a folding-door on the outside, to be shut by the spring-tides. At this place, a road, that formerly led to Findhorn at low water through the Carse, is carried over the top of the dike, by making a mound of earth at each side, with a gradual approach and descent." It is stated further, that "since the Carse has been enclosed, the tides have been so high, that the water, during a severe storm, was from six to seven feet deep at the back of the dike: the wind, being from the north, occasioned a heavy swell and surge, but no water came over the top of it." He suggests, that "it is in contemplation, as soon as the ensuing season permits, to cover the outside with seals, the green side uppermost; and he has no doubt, when finished, it will effectually secure the lands from any further visitation of the sea. The expences of the embankment cannot be well ascertained at present; but it will be a good deal more than is allowed by the proprietors." He says, that "a great part of the land is already ploughed; but, the winter setting in so severe, prevented the whole from being done. It is intended to fallow it, in preparation for a crop of oats in the succeeding spring; but this intention may not be unalterably adhered to. There are various sorts of soil in it: some of it clay, sand, gravel, black rich earth, and parts of it of a mossy nature; in some places below the gravel, which may, he thinks, have been forced on by the tides, a thin stratum of clay, upon sand; and some parts, clay and sand alternately. There are other parts not so rich as might be expected, the surface having been carried off by former tenants, for mixing in their dunghills or compost heaps. In *fig.* 9, *a* is the breadth of the dike at the top, when finished; *b*, the breadth of dike at bottom, being twelve feet, when it is six feet high; *c*, the breadth when eight feet high; *d*, the breadth when ten feet high; *f*, the slope on the sea-side of the dike, which is always equal to the half of the breadth of the bottom: the inside slope, and breadth of the dike at top, is equal to the other half; and *e* is a plumb-rule in a frame, made to apply to the mould or dike: the intention of it was, to find if the dike was kept on the proper slope, where a line could not be applied from one mould to another, as in a round or turn, or when the moulds were obliged to be taken down; but this one only answered for the sea-side, another being used for the inside, to fit its slope." *Fig.* 10. is a scale of the mould one-eighth of an inch to a foot.

Various other improvements of this nature have been accomplished, in particular circumstances and situations; and large tracts of land thereby rendered more than doubly beneficial to their occupiers. The methods which have been had recourse to, in such cases, will be fully detailed in speaking of *Hough-land* and *Rivers*.

A curious, useful, and highly ingenious method of embanking, and preventing the waters of the tides from soaking through the porous banks, formed in fenny and moorish situations, has been described by Mr. John Smith, in the fourth volume of "Communications to the Board of Agriculture," who begins by "concisely observing, that the great land of the fens is divided into three large levels; and that each of these levels is subdivided into numerous districts by banks: but as these banks are made of fen moor, and other light materials, whenever the rivers are swelled with water, or any one district is deluged either by rain, a breach of banks, or any other cause, the waters speedily pass through these light, moory, porous banks, and drown all the circumjacent districts. The fens have sometimes sustained 20,000*l.* or 3-,000*l.* damage by a breach of the banks; but these accidents seldom happen in the same district twice in twenty years; the water, however, soaks through all fen-banks every year, in every district; and when the water-mills have lifted the waters up out of the fens into the rivers in a windy day, a great part of the water soaks back through the porous banks, in the night, upon the same land again." And he adds, that "this water that soaks through the bank drowns the wheat in the winter, washes the manure into the dikes, destroys the best natural and artificial grasses, and prevents the fens from being sown till too late in the season. This stagnant water lying on the surface, causes also fen agues, &c. Thus, says he, the waters that have soaked through the porous fen-banks have done the fertile fens more real injury than all the other floods that have ever come upon them."

Having been much concerned in fen-banking from his youth, he had some time since devised the plan which he now finds to answer so well; but found it difficult to prevail with any gentleman, who had a proper extent of this sort of land, to give it a fair trial. However, during the last autumn, he prevailed with a person in the parish where he lives to try it, which shewed it to be equal to his highest expectations.

This improved method of embanking chiefly consists in this: that "a gutter is cut eighteen inches wide, through the old bank down to the clay, (the fen sub-stratum being generally clay,) the gutter is made near the centre, but a little on the land-side of the centre of the old bank. This gutter is afterwards filled up in a very solid manner with tempered clay; and to make the clay resist the water, a man in boots always treads the clay as the gutter is filled up. As the fen-moor lies on clay, the whole expence of this cheap, improved, and durable mode of water-proof banking costs in the fens only sixpence *per* yard. This plan was tried last autumn on a convenient farm, and a hundred acres of wheat were sown on the land. The wheat and grass lands on this farm are now all dry, whilst the fens around are covered with water. This practice answers so well on this farm, that all the farmers in this parish are, he says, improving their banks in the same manner, and some have begun in adjacent parishes."

It is unquestionably a mode of practice that requires to be fully known and understood, in all those districts which have lands of this description; as by it great advantages may probably be derived.

Embanking against Lakes.—The business of forming embankments, in cases of what are termed lakes, or mires, in this part of the country, and loughs in Scotland and Ireland, is much more simple and easy than in the preceding cases. It has been remarked by Mr. Beatson, that the waters in these situations generally subside during the summer months, rising considerably in winter, and whenever the season is very wet. In particular cases, the extent of surface, which is overflown in the winter season, so far exceeds

exceeds that which it covers during the summer, that it would be an object, and sometimes a considerable acquisition, to confine the water within its summer boundaries, or to cut off some of its parts. Where these are intended, the principal outlet must be first carefully examined, and be considerably widened and enlarged; which, on the principle already noticed, in speaking of rivers, will prevent the water from rising so high as was formerly the case. Where the levels will not admit of much depth being had, or where the ground is of a rocky nature, and would of course be difficult and expensive to deepen, the breadth should be increased as much as possible, and all obstacles cleared away, that the water may run freely in a shallow stream. Where it is required to ascertain with exactness, or to fix with certainty, the future limits of the water, a section of the greatest quantity running out during a flood should be taken. Suppose this section, for example, be ten feet in width and four feet in depth; by making it forty feet in width, the same quantity of water will not rise above one foot: consequently, by this means alone, three feet in height will be gained all round the lake, which, in case of embanking it, would be a great object. During the summer season, when the water is lowest, is the most proper time for carrying on these, as well as other embankments. When, however, any materials are to be brought from a distance, they may be laid down or be prepared at other seasons, with the exception of turf, which should always be used as soon as possible after it is cut. The manner of constructing embankments of this kind may be sufficiently understood, from what has been already said in the other descriptions of embankments: observing, however, as a general rule, that when the materials on the spot will answer the purpose, they should invariably be made use of, although at the expence of digging a trench larger and deeper than would otherwise be necessary. It should constantly be attended to, in executing all sorts of embankments, that the greatest care be taken to make them perfectly firm and solid, by continually beating them, and examining them carefully, during the whole of the time they are in the state of being formed.

The various methods and plans of management, which are necessary to be adopted in the improvement of such lands as have been gained from the sea, will hereafter be more fully considered and explained. See MARSH-*Land*.

EMBANKMENT, in *Canal-making*, is a term for any large mound of earth, either for confining the water of a canal or reservoir, or upon which a canal or aqueduct is formed across a valley or low piece of ground. It may have arches under it, for the passage of a road, a river, or brook: such are called *aqueduct-arches*, and ought by all means to be constructed on the true curve of equilibration, for avoiding the great expence and disgrace which attends the failure of less scientific arches, as at Wolverton on the Grand Junction Canal. See CANAL.

EMBAR, in *Geography*, a town of Africa, in the country of Senegal.

EMBARCADERO, in *Commerce*, a Spanish term, much used along the coasts of America, particularly those on the side of the South sea.

It signifies a place which serves some other considerable city farther within land, for a port, or place of shipping, *i. e.* of embarking and disembarking commodities.

Thus Calao is the embarcadero of Lima, the capital of Peru; and Arica the embarcadero of Potosi. There are some embarcaderos forty, fifty, and even sixty leagues off the city which they serve in that capacity.

EMBARGO, a restraint or prohibition, laid by a sovereign on merchant-vessels, to prevent their going out of port; sometimes to prevent their coming in; and sometimes both, for a limited time. See PROCLAMATION.

Embargoes are usually in time of war; in apprehensions of invasions, &c. One great occasion of embargoes is, that the government may make use of the merchant-vessels, with their equipage, &c. in armaments, expeditions, transporting of soldiers, &c.; another is, to stop the communication of intelligence at such critical seasons. Embargoes are of very mischievous consequence to commerce.

EMBARKATION *of Ordnance and Stores.* The first thing necessary is to prepare a list of all the articles to be embarked, with the weight of each. This list must have an ample column for remarks; and the reputed tonnage must have an allowance of one-third added, for all articles whose weights and measures are not always the same, but receive, or lose, in consequence of damp, dirt, &c.; such as tents, &c.: but the tonnage of ordnance, shells, shot, &c. should be set down at their actual weight, according to their natures, calibres, &c. respectively. If vessels are paid for according to the tonnage they carry, the master will, of course, stow away to the best advantage, and load with as much as the vessel can possibly contain; whereas when freighted for a voyage, upon the estimated tonnage of the hold, they will stow so very loosely, as both to carry less, and to subject the cargo to considerable injury. It is, therefore, proper that a naval officer should be appointed to superintend every embarkation, and to see that every thing is stowed to the best advantage. It may be useful, in this place, to shew how tonnage is estimated. The usual method of finding the tonnage of any ship is,—Multiply the length of the keel by the length of the beam, and half that product by the breadth of the beam; divide the last product by 94, and the quotient will be the ship's tonnage. Thus, say a ship's keel measures 90 feet, and that her beam, *i. e.* her extreme breadth, be 30:

$$90 \times 30 = 2700 \times 15 = \frac{40500}{94} = \overset{\text{Tons.}}{430.8}$$

The tonnage of goods and stores is taken sometimes by weight, and sometimes by measurement; and that method is allowed to the vessel which yields the most tonnage: were it otherwise, the owners would be considerably losers in the freight of bulky, light articles, on which the calculation by weight would give them but little claim to charge; and, *vice versâ*, if ordnance, shot, &c. were to be carried by measurement, they would be under a similar disadvantage. In tonnage by weight, 20 cwt. make a ton; and in tonnage by measurement, 40 cubic feet make a ton, the same as in timber computations. All carriages, or other stores to be measured for tonnage, should be reduced to their smallest dimensions, by taking to pieces, and packing into as little space as possible. All ordnance is shipped according to actual weight; as are also musket cartridges in boxes or barrels, and other such ponderous articles. The following table will exhibit the rates of tonnage allowed for the embarkation of the most material stores in the ordnance department.

EMBARKATION.

NATURE.	Number of Articles or Quality.	Tons.	Cwt.	Qrs.
Axes complete with Handles	Pole fort 264	0	10	0
	Pick 100	0	9	0
	Felling 176	0	14	0
Barrows, Wheel, Packed	20	2	2	0
Do. Unpacked	7	1	0	0
Do. Hand, Single	20	0	18	0
Budge (or Bouche) Barrels	32	1	0	0
Bricks	1000	2	5	0
Buckets of Leather	20	0	2	0
Carabines, 25 in a Cheft is 11 Square Feet.				
Carriages, Standing	42 Pieces	1	13	0
Do. Do.	32 Pieces	1	10	0
Do. Howitzer	10 Inch	1	10	0
Do. Do.	24 Pieces	1	9	3
Do. Do.	18 Pieces }	1	7	0
Do. Do.	8 Inch }			
Do. Do.	12 Pieces	1	4	0
Do. Do.	9 Pieces	1	3	0
Do. Do.	6 Pieces	1	0	0
Do. Do.	4 Pieces	0	17	0
Carriages, Travelling, complete, with Limber Boxes, Ladles, Sponges, and Rammers	24 Pieces	5	10	0
	12 Pieces	4	10	0
	9 Pieces	4	7	2
	6 Pieces	3	7	2
	3 Pieces	2	19	0
	Medium { 24 Pieces } 12 Pieces }	2	9	2
Carriages, 6 Pieces, Light, with Ammunition Boxes, and 5½ Inch Howitzer do.	———	2	3	0
Carriages for 5½ Inch Howitzer of 10 Cwt.	———	3	2	0
Do. for 8 Inch do. common	———	3	7	2
Sling-Cart complete	———	3	0	2
Forge-Cart, with Limber	———	4	0	0
Pontoon and Carriage, with Appurtenances	———	11	0	0
Ammunition Waggon	———	4	18	1
Gravel Cart	———	2	16	2
Duke of Richmond's clofe-bodied Waggon	———	5	0	0
Road Waggon, with upright Sides	———	7	10	0
Gin; Triangle complete	———	0	14	0
Grate for heating Shot	———	0	4	2
Hand-Spikes	120	1	0	0
Hand-Crows, Lever of 5 Feet	120	1	0	0
Hand-Screws	Large 15	1	0	0
Do.	Small 17	1	0	6
Helves, Picking or Felling	300	0	14	0
Do. Sledge	300	1	0	0
Do. Pin-Maul	360	1	0	0
Junk	Cwt. 20	1	5	0
Linftocks, with Cocks	600	1	0	0
Do. without	1000	1	0	0
Mufquets, a Cheft of 25 is 16 Cubic Feet.				
Do. Do. of 20 is 11 do.				
Match	Cwt. 6	1	14	0
Powder, whole Barrels	11	1	0	0
Do. half do.	22	1	0	0
Pitch or Tar, 1 Barrel is 7 Cubic Feet.				
Piftols, a Cheft of 50 or 60 is 10 Cubic Feet.				
Park-Pickets	40	0	9	1
Pikes	280	1	0	1
Sheep-Skins	Dozens 12	1	1	0
Shovels, } of Iron	100	1	0	0
Spades, } of Iron	184	1	0	0
Shovels fhod with Iron	138	1	0	0
Sand-Bags, in Bales, 1 Bufhel	500	0	12	0
Do. half Bufhel	500	0	7	1
Do. 2 Bufhels	250	0	8	1

When ordnance and ftores are embarked, all appertaining to the fame fpecies fhould be claffed and divided into the feveral veffels, in fuch manner as may infure the fafe arrival of a certain portion; thereby avoiding that great inconvenience which could not fail to arife, were any one veffel, containing the whole of any particular ftores, to be loft, taken, or unable to make the place of deftination. With each piece of ordnance fhould be embarked every thing neceffary for its fervice; fo as to be inftantly come at, when required to be landed. This principle fhould be carried to the fulleft extent: even the platforms for the battering cannon fhould be in the fame veffel with them; and, in fhort, every precaution ought to be taken to obviate delay, or omiffion, or imperfection. In general, all the heavy ftores fhould be put in firft; both to prevent their crufhing lefs fubftantial articles, and to ferve as ballaft: the lighter ftores, being generally moft perifhable, fhould be ftowed uppermoft, and be all numbered according to their feveral natures, and to their feveral intentions. Thus, every piece of ordnance, its carriage, and even all the parts of that carriage, together with its fponges, rammers, limbers, and boxes, ought to bear the fame number; fo that, when about to be landed, the whole may be difcharged at one time from the fhip, and be fent on fhore in that regular manner, which may enable the artillery men and artificers to mount every one in fucceffion with promptnefs and exactitude. All the chefts, barrels, &c. muft be lettered and numbered diftinctly, in fuch manner as may indicate their refpective contents. The numbers, &c. ought to be painted in clear white on a black ground, thereby to be legible at night: for the fame purpofe, it would perhaps be found ufeful to have the letters marked with white-headed tacks; fo that, when not legible, for want of light, as often happens, they may be traced with the finger. In fhipping gun-carriages, it is eligible to fend them down into the hold, &c. without taking off the axle-trees from the cheeks; as they cannot be replaced without proper workmen, and a tedious operation. When a carriage is difmounted, all the fmall articles, fuch as elevating-fcrews, linch-pins, drag-wafhers, &c. fhould be carefully collected, and fecured either in a fmall box, or in a bag of leather, tarpaulin, &c. duly marked.

In order to give more room, all articles, of the fame defcription in particular, fhould be placed fo as to lock into each other, or to fit in fuch manner as may leave the leaft poffible intervals. A perfon fhould attend to regifter, not only the feveral articles as they fhould be fhipped, but to note the exact part of the hold, &c. where each might be ftowed. Thefe precautions, added to the affixment of particular marks, fuch as numbers, in white paint, on each bow, and each quarter of every tranfport, fo as to be diftinguifhable at feveral miles diftance, will tend confiderably to facilitate the debarkations, and enable the feveral commanders and public officers to afcertain with perfect precifion the amounts of loffes, and the fituations of the feveral ftores, according as veffels may lie to windward, or to leeward, &c. It is a matter of confiderable importance in embarking ftores, to have them ready at hand which would be the firft wanted in cafe of emergency: as well as to arrange them in fuch manner as fhould anfwer the purpofes of the expedition in the moft efficacious manner. Thus, if it is expected that troops will have to difembark in the prefence of an enemy, the light field-pieces, and howitzers, in lieu of being fent below, ought to be kept, together with all their implements, and a certain portion of their ammunition in fome fecure part, whence they could be lowered into the boats at a fhort notice. Entrenching tools fhould alfo be held in equal readinefs, together with abundance of fand-bags. When troops are to be embarked, every precaution muft be taken to prevent confufion, and to obviate danger. Certain corps fhould be appointed to be in readinefs on given days at particular ports; taking with them only fuch baggage as fhould be allowed on the occafion. The ftores of every defcription and the difpofable lumber fhould be previoufly fent on board, under charge of the quarter-mafter, who fhould be particular in feeing that every thing neceffary to the comfort and efficiency of the troops were duly arranged. The tranfports being in readinefs, they fhould, if poffible, be brought up to a pier, fo that, by the aid of gang-boards, the files might march on board at once; otherwife recourfe muft be had to boats and fmall craft, in which the troops muft proceed from the fhore to the fhipping. The lee-fide is generally preferred for embarking; it being the fmootheft water, and often the afcent up the gang-ladder lefs difficult. The fafeft mode is for the arms to be handed up into the main chains, and from thence into the veffel. The bayonets ought to be well fecured to their fcabbards, and the pouches fhould be buttoned down. The men neareft the gang-ladder fhould be the firft to afcend; the others taking care to balance the boat, &c. as fhe becomes lighter, and requiring equipoife in confequence of being quitted by the troops. It fhould be obferved as a ftanding regulation never to let one boat lie abreaft of another that is difcharging her crew into a veffel: otherwife there will not only be danger of broken-legs, but of being upfet: each boat fhould range up under the lee-quarter, in fucceffion, and when evacuated by the troops fhould pull a-head, by means of a painter, or a boat-hook, fo as not to impede its fucceffor. When the troops are on board boats, they fhould fit as low as poffible, keeping their mufkets perpendicular, and refted on the bottom, or on their own feet. In going on board the men fhould proceed very leifurely and filently to their places, fpreading fo as to preferve the due time of the boat, and fitting down fo foon as duly arranged. In cafe of accident, or running foul of any other veffel, they fhould be particularly enjoined to remain feated, and not to obftruct the boat's crew in their endeavours to remedy the mifhap. Where troops are to embark in the face of an enemy, the greateft order and coolnefs will be requifite; efpecially when within the reach of their cannon. If the embarkation in boats is to be made from a fhip, they muft all be manned from that fide leaft expofed to the enemy's fire; the fhip covering them as they fucceffively put off, and reft on their oars, until the whole may be ready to ftart together by fignal; after which no time fhould be loft in gaining the fhore, and in forming on the beach. It fometimes occurs, that a river is to be croffed in boats for the attack of an enemy pofted on the oppofite bank: in fuch cafe, the number of boats being previoufly afcertained, the troops muft be told off into as many divifions as there may be veffels to convey them, the ftrength of each divifion correfponding with the tonnage of that it is to occupy. Each divifion then proceeds on board with rapidity, but with perfect regularity, and the whole put off without delay. Where the water is rather fhallow, the boats muft lie out fo far as to be afloat after the men have, by wading, got on board. All debarkations from boats and fhipping fhould be conducted with as much order as circumftances may admit; and even when troops are driven back to their boats, as much fhould be preferved as the preffure of purfuit may allow. It is a well-known fact, that many re-embarkations have taken place in the prefence of a fuperior force without diforders, or allowing the enemy to make a fingle prifoner. The greateft danger generally

arifes

arifes from allowing the boats to lie in fo clofe, as to touch the ground, whereby, when the troops have got on board, they have been unable to pufh off, and thus remained fubject to a galling fire. When re-embarking after a repulfe, it fhould be ftudied to man fome of the craft, (efpecially a few of the lighteft conftruction, and any gun-boats whofe draught of water may allow them to lie near the beach,) for the purpofe of covering the retreat, and to take in flank fuch of the enemy as fhould follow the fugitives into the water. When fuch a precaution is obferved, the embarkation will proceed quickly, and the enemy will content themfelves with a diftant fire on the retreating force; in lieu of mixing pell-mell, as they would do if there exifted no pre-eftablifhed check. Troops embarked on board tranfports, or fhips of war, are only allowed three-fourths of a feamen's ration of provifions; unlefs when acting as marines, when they are on a footing. The meffes are formed of fix men in each, for each of which a fpace of fix feet fquare is allowed, that is, 36 fquare feet; but only four are ever there at the fame time, it being a rule that one-third of each mefs fhould always remain on deck. When embarked for foreign fervice, fix women are allowed provifions for every hundred men; and when on home fervice, ten women are allowed with the fame number. That part of the charter-party which relates to the provifion, firing, candles, utenfils, &c. intended for the ufe of the troops, is always fubject to the infpection of their commanding officer on board; and is fometimes copied out, and hung up in the cabin, open to the perufal of all. The regulations regarding fmoking, extinction of lights, &c. are alfo pofted up in various parts, together with the whole allotment in regard to births, meffes, and particularly the accommodations for the officers of the veffel, and thofe attached to the troops. It being neceffary to eftablifh fome limit for the quantities of baggage taken on board, the following proportions were fixed for that purpofe.

For a field-officer - -	five tons.
For a captain - -	three tons.
For a fubaltern - -	a ton and a half.

General officers are rarely limited, but it is ufually intimated to all embarking, that the quantity of baggage fhould be reduced as much within bounds as might be practicable.

The embarkation of horfes is ufually effected by means of flings of canvas, which paffing under their bellies, and being duly fecured with cords, enable the crew to hoift them in, and to lower them down between decks without doing the fmalleft injury to the animals; which, however fpirited they may be while on terra firma, generally become perfectly paffive under fuch circumftances. On arriving at the place of deftination they are debarked in the fame manner. It certainly is among the moft important improvements in this branch of fervice, that the horfes can be flung, during bad weather, to the beams in fuch manner as to prevent their fuffering in confequence of the fhip's motion. Yet we cannot but judge, from the crippled ftate in which cavalry are fometimes debarked, that much room remains for improvement.

EMBARRAS, Embarrasment, a French term, though now naturalized; denoting a difficulty, or obftacle, which perplexes or confounds a perfon, &c.

EMBASIS, in the writings of the *Ancient Phyficians*, the name of a large veffel, in which they prepared their medicated baths, and which was capable of holding the perfon to be bathed at his full length.

EMBASSADOR, or Ambassador, is a public minifter fent from one fovereign prince or independent ftate to another, as a reprefentative of that prince or ftate, and furnifhed with credentials which verify his miffion as an embaffador.

Such a public minifter is called in Latin *legatus*, or *orator*, but the meaning of the word embaffador is much more extenfive. The only circumftance in which the modern embaffador and the ancient legatus agree is the protection of the law of nations. See Legation.

The Englifh word embaffador is probably derived from the Spanifh *embaxador*, the fame as the French *ambaffadeur*, which comes from *ambafciator*, a Latin word of the middle age, formed of *ambactus*, or *ambact*, an agent, domeftic, or client among the Gauls. The term *ambafcia* is found in the Salic law, Tit. xix. and in the law of Burgundy.

The cuftom of fending embaffadors dates from the origin of civil focieties. As foon as mankind were divided into diftinct nations, differences would arife which muft be amicably fettled by the interference of neighbours, guarded againft by the protection of the more powerful, or decided by wars ending in reconciliations. The negociating of thefe mediations, alliances and treaties of peace is entrufted to public minifters; and fovereign princes having, like private perfons, interefts to difcufs with other princes regarding their own concerns as individuals, fuch as the contracting of matrimonial alliances; the management of thefe tranfactions is likewife confided to public minifters, or negociators. See Negociation.

Among the public minifters fent as negociators, from one independent ftate or fovereign prince to another, embaffadors hold the firft rank. Envoys, minifters plenipotentiary, and refidents, are negociators of lefs eminence. (See Envoy, Plenipotentiary, and Resident.) Their functions are the fame; they are equally under the protection of the law of nations, and they enjoy nearly the fame privileges.

The pre-eminence of embaffadors manifefts itfelf chiefly in the particular ceremonial of their reception in the country where they are appointed to refide. They are entitled to be faluted with the firing of guns; to be complimented by deputies of the prince or ftate to which they are fent; to make a folemn public entry; to fpeak at the audiences they obtain with their heads covered; to have places of honour affigned to them at all public ceremonies; to keep a canopy or throne in their dwelling; and, fince the year 1593, when this title was firft given them at Rome, to be ftyled excellencies. The name of embaffador, Cicero obferves, is facred and inviolable: "non modo inter fociorum jura, fed etiam inter hoftium tela incoluma verfatur:" (In Verr. orat. 6.)

The privileges which embaffadors fhare with other public minifters, fent as negociators, are.

1. The right of being received by the prince or ftate to which they are deputed, unlefs there be a juft caufe for refufing to receive them. The duke of Buckingham, fays Hume, had Englifh familiarity, and French levity, two of the moft offenfive qualities in an embaffador. When, in 1626, he was defirous of being once more embaffador at the French court, it was fignified by the French embaffador to the court of St. James's that for reafons well known to the duke his perfon would not be agreeable to his moft Chriftian majefty. His prefumption to talk of love to the queen in a former embaffy had given offence, and would have been a juft caufe for his non-admiffion.

The correfponding obligation of receiving foreign embaffadors has its foundation in the deareft interefts of fociety and of humanity. As nations are in continual need of mutual affiftance, they could never freely communicate, if the law

law of nations had not made it an imperious duty to all ftates to admit the embaffadors who are fent to them. Even the embaffadors of an enemy have a right to be received and to be heard, fince it is the duty of nations at war with each other to endeavour by all poffible means to re-eftablifh the accuftomed relations of peace and amity.

2. The inviolability of their perfons. Embaffadors reprefent the fovereign or chief magiftrate of an independent ftate; their miffions are frequently of the moft delicate nature, and could not be accomplifhed if the fecurity of their perfons were not exprefsly provided for. Thofe who infult an embaffador infringe not only the civil law, which forbids the doing of injuries in general, but more particularly the public law of nations, which extends its fpecial protection to public minifters, that the harmony of nations may not be difturbed, or if unfortunately the ties of friendfhip have been broken, that the effecting of a reconciliation may labour under no reftraint. The fmalleft infult offered to an embaffador ought to be punifhed with the greateft feverity; the neglect to punifh the offender is a juft caufe of war.

If an embaffador grofsly offends, or makes an ill ufe of his character, he may be fent home, and accufed before his mafter: who is bound either to do juftice upon him, or avow himfelf the accomplice of his crimes. (Mont. Sp. of L. 26. 22.) But writers on the law of nations are not agreed, whether this exemption of embaffadors extends to all crimes, as well natural as pofitive: or whether it only extends to fuch as are *mala prohibita*, as coining, and not to thofe that are *mala in fe*, as murder. Our law feems formerly to have taken in the reftriction, as well as the general exemption. For it has been held, both by our common lawyers and civilians (1 Roll. Rep. 175. 3 Bulftr. 27.) that an embaffador is privileged by the law of nature and nations; and yet if he commits any offence againft the law of reafon and nature, he fhall lofe his privilege (4 Inft. 153.); and therefore, if an embaffador confpires the death of the king in whofe land he is, he may be condemned and executed for treafon; but if he commits any other fpecies of treafon, it is otherwife, and he muft be fent to his own kingdom. However, the general practice of this country, as well as of the reft of Europe, feems now to purfue the fentiments of the learned Grotius, that the fecurity of embaffadors is of more importance than the punifhment of a particular crime. And therefore few, if any, examples have occurred within a century paft, where an embaffador has been punifhed for any offence, however atrocious in its nature.

Even the domeftics and the perfons in the retinue of an embaffador are inviolable. If any one of them were infulted, the punifhment ought to be as fevere as if the infult had been offered to the embaffador himfelf. The domeftics of the duke of Créqui, French embaffador at Rome, having been infulted by the Corfican guards of Pope Alexander VII. Louis XIV. infifted upon their being feverely punifhed.

But this inviolability extends only to the perfons who compofe the embaffador's family, as his wife and children, and who being actually in his retinue are regiftered as fuch by the police of the country where he refides. Should, however, any of them be guilty of a great crime, as a forgery, theft, or murder, it would be no violation of the law of nations to claim the offender, and to punifh him according to the laws of the country. When Sully refided in England as embaffador of Henry IV of France, he was informed that one of his gentlemen had killed an Englifhman in a houfe of ill fame. He immediately got him arrefted, and fent word to the magiftrates of London that they might feize the murderer. The latter having been tried, the king of England granted him his pardon and his liberty.

In confequence of this inviolability the actions of an embaffador or of any perfon in his retinue are not fubject to the controul of the private law of the country in which he is appointed to refide; and with regard to civil fuits they cannot be profecuted for any debt contracted in that country as long as the embaffador continues in it in his public capacity. This privilege is allowed in the Englifh courts of law, and, the more effectually to enforce the law of nations in this refpect, when violated through wantonnefs or infolence, it is declared by the ftatute 7 Ann. c. 12. (an act paffed in 1708, in confequence of the arreft of an embaffador from Peter the Great, czar of Mufcovy, for a debt of 50*l.*) that all procefs whereby the perfon of any embaffador, or of his domeftic or domeftic fervant, may be arrefted, or his goods diftrained or feized, fhall be utterly null and void; and that all perfons profecuting, foliciting, or executing fuch procefs, being convicted by confeffion on the oath of one witnefs, before the lord chancellor and the chief juftices, or any two of them, fhall be deemed violators of the laws of nations, and difturbers of the public repofe; and fhall fuffer fuch penalties and corporal punifhment as the faid judges, or any two of them, fhall think fit. But it is exprefsly provided, that no trader, within the defcription of the bankrupt laws, who fhall be in the fervice of any embaffador, fhall be privileged or protected by this act; nor fhall any one be punifhed for arrefting an embaffador's fervant, unlefs his name be regiftered with the fecretary of ftate, and by him tranfmitted to the fheriffs of London and Middlefex. Thefe exceptions are ftrictly conformable to the rights of embaffadors, as obferved in the moft civilized countries. In confequence of this ftatute, thus declaring and enforcing the law of nations, thefe privileges are now held to be part of the law of the land, and are conftantly allowed in the courts of common law. (Fitz. 200. Stra. 797.) Blackftone's Commentaries, vol. i. and iv.

3. The moft perfect freedom and independence in the difcharge of their official duties. This is a further confequence of their inviolability. If an embaffador fhould even excite difturbances, or enter into any confpiracy againft the prince, or the ftate to which he is fent, the general practice of Europe is in favour of the opinion of the learned Grotius, in his book "De Jure Belli et Pacis," that the inviolability of an embaffador is of greater importance than the punifhment of a particular crime. His public character ought to be conftantly and invariably refpected; but he may be difmiffed, and fent back to the prince or ftate whofe reprefentative he is. The bifhop of Rofs, embaffador of the queen of Scotland at the court of Weftminfter, having engaged in a confpiracy with the duke of Norfolk againft the queen, he was arrefted, confronted with his accomplices, and fent back to Scotland. In the reign of Henry IV. of France, the Spanifh embaffador took a part in the confpiracy of the count d'Auvergne and duke d'Angoulême, who were both tried; but no mention was made of the embaffador. A certain Mérargues had agreed, with the fecretary of the fame embaffador, to deliver Marfeilles into the hands of the Spanifh monarch. The French parliament condemned Mérargues to death; but the Spanifh fecretary was delivered to the king of France, who gave him up to the Spanifh embaffador, and obliged the latter to fend the fecretary out of the kingdom.

If an embaffador be difmiffed and efcorted to the frontiers, he is entitled to the privileges and immunities of his dignity, as long as he is on the territory of the ftate that fends him back. He ought alfo to be allowed a convenient time to prepare for his departure. This indulgence muſt even be granted to the embaſſador of a power againſt which a declaration of war has been iſſued, and he muſt be furniſhed with paſſports to return home unmoleſted. The cuſtom of the Turks, who, in the caſe of war being declared, confine the embaſſador of the power againſt which it is declared in the caſtle of the Seven Towers, is in direct violation of the law of nature, and of the public law of nations. The enlightened ſovereigns of Europe ſhould join in remonſtrating againſt ſo unjuſt a practice, and inſiſt upon its abolition.

4. The inviolability of the houſe in which they reſide. An embaſſador's dwelling is a ſacred aſylum, where no perſon can be arreſted without the embaſſador's conſent. Any felon, however, that might have taken refuge in an embaſſador's houſe, ought to be given up to the criminal juſtice of the country.

Neither have embaſſadors the right of trying or puniſhing, within the walls of their manſion, perſons of their retinue who have been guilty of any crime. Though independendent of the criminal and civil laws of the country in which they reſide, they cannot exerciſe any judicial functions, becauſe the judicial power of the ſovereign they repreſent does not extend to that country.

5. The right of having divine ſervice performed in their houſes, at a chapel of their own, according to the rites of the worſhip of their country: but embaſſadors cannot claim the free acceſs of others to their chapel than the ſubjects of the country they repreſent, who are under their ſpecial protection in this reſpect. At the time when the Proteſtants were cruelly oppreſſed and perſecuted in France, the French Proteſtants reſiding at Paris have frequently been moleſted in going to and coming from the chapel of the Dutch embaſſador; but he had no right to remonſtrate againſt this cruelty, becauſe it was exerciſed on the ſubjects of the king of France.

6. The right of being exempt of all duties, charges, taxes, impoſts, exciſe and cuſtom dues. This right has ſometimes been reſtricted in countries where it had been abuſed by embaſſadors, who, forgetful of their dignity, had not ſcrupled to make it a cover to an illicit trade.

7. The privilege, that in caſe of death, the houſehold furniture, moveables, and perſonal property of embaſſadors, or of any individual in their retinue, devolve to their heirs, though aliens, without being liable to any deduction, tax, or alien duty, commonly called "Droit d'Aubaine." But this right does not extend to immoveables, or landed property.

8. The right of legalizing or certifying the authenticity of documents or writings which are to be tranſmitted to the ſtate or country which they repreſent, and that of granting paſſports to the natives of that country.

9. The right of following the court at which they are appointed to reſide, to whatever place that court is removed to, unleſs the prince ſhould declare his abſence to be merely temporary, and requeſt the embaſſador's non-attendance. During the ſeven years' war in Germany, from 1756 to 1763, the Engliſh embaſſador at the court of Berlin attended the great Frederick of Pruſſia at all his head-quarters.

10. Laſtly, embaſſadors conſider themſelves as entitled, and indeed cuſtom appears to have ſanctioned it as a right, to receive ſome valuable trinkets as preſents at their laſt audience, when they take leave of the prince at whoſe court they have reſided.

Embaſſadors ought to be very attentive not to ſuffer any of their privileges or immunities to be infringed upon; neither ought they to paſs over any attack on the perſon or dignity of the prince, or on the character of the ſtate they repreſent. Whenever they have a complaint of a breach of privilege to prefer at the court where they are appointed to reſide, they are ſupported in their demands of redreſs by the whole diplomatic body, or corps diplomatique, that is to ſay, by the aggregate of all the foreign miniſters reſiding at the ſame court.

But embaſſadors cannot claim their privileges and immunities, unleſs they have proved their miſſion as embaſſadors by the delivery of their credentials; nor can they diſplay their character of public miniſters in any other country than that to which they are ſent in that quality. When they are under the neceſſity of traverſing the dominions of any other ſovereign prince, they muſt provide themſelves with the permiſſion to travel through that country by means of regular paſſports, for the law of nations does not oblige a prince or nation to reſpect an ambaſſador on his journey through their country, if he ſhould attempt to traverſe that country without having previouſly obtained their permiſſion.

At Athens the embaſſadors from foreign princes and ſtates always mounted the tribunal, or pulpit, of the public orators, and there opened their commiſſion, and acquainted the people with their buſineſs. At Rome they were introduced to the ſenate, and delivered their commiſſion to them. Among us they make their addreſs immediately and ſolely to the king.

Athens and Sparta, ſays M. Tourreil, when in all their glory, were never ſo much delighted as to ſee and hear a number of embaſſadors in their aſſemblies, ſuing for their protection or alliance. It ſeemed to them the nobleſt homage that could be paid them; and that ſtate which received the moſt embaſſies, was judged to have the advantage over the other.

There are ſome uſages to which embaſſadors ought to conform. They ſhould never attend at any marriage, chriſtening, funerals, or other private ſolemnity; nor muſt they even go into mourning on any occaſions of their own, becauſe they are no longer private individuals; they are the repreſentatives of a ſovereign prince or independent ſtate.

Embaſſadors, in modern times, are either *ordinary* or *extraordinary*.

An *embaſſador ordinary* is he who conſtantly reſides at the court of a ſovereign prince or independent ſtate, to maintain a mutual good underſtanding between the two ſtates, to watch over the permanent intereſts of his country, to tranſact ſuch affairs as may occur, and to give a regular account of his proceedings and obſervations to the prince or ſtate which he repreſents. The practice of keeping embaſſadors ordinary in foreign courts is but of modern invention. It is generally aſcribed to the cardinal de Richelieu. Raymond de Beccaria, baron de Forquevaux de Pavie, knight of the order of St. Miehael, was one of the firſt public miniſters who reſided permanently at a foreign court. He was ſent to Spain in 1565, as embaſſador ordinary of Charles IX. of France at the court of Philip II. probably on account of the miſunderſtanding which prevailed between the Spaniſh monarch and his conſort Elizabeth, who was a French princeſs.

The frequent intercourſe which takes place between modern nations; the many relations in which they ſtand to each other; their mutual intereſts; their political and commercial jealouſies; the wiſh of being rapidly and confidently informed of their reſpective projects, enterpriſes, connections and partialities, of the ſprings by which their governments are ſet in motion, and of the general adminiſtration of their concerns abroad and at home; and laftly, the want of a powerful protection for individuals trading in foreign countries, are indeed circumftances which confer on the permanent refidence of public minifters in foreign courts a high degree of public convenience and utility. Every independent European ftate has adopted the practice, except the Helvetian Republic, and the fublime Ottoman Porte. Thefe two ftates have hitherto at leaft employed only embaffadors extraordinary.

An *embaffador extraordinary* is he who is fent from one fovereign prince or independent ftate to another on fome particular occafion or emergency, and who retires as foon as the bufinefs of his miffion is terminated Hence it follows that an embaffador extraordinary may be difpatched to a court or country where an embaffador ordinary of the fame prince or ftate is permanently refiding. Thus the king of Great Britain appointed Mr. Rofe embaffador extraordinary to the United States of America in 1808, for one particular purpofe, whilft the honourable Mr. Erfkine continued as Britifh embaffador ordinary at Wafhington.

In ancient times, all embaffies were extraordinary. They were generally undertaken from motives of neceffity, policy, or adulation, fometimes even from the mere love of magnificence, and commonly compofed of a great number of embaffadors. This ufed alfo to be the cafe with the extraordinary embaffies of the Swifs, becaufe every canton appointed its embaffadors. The embaffy which Switzerland fent to the king of France in 1663, confifted of forty-two embaffadors.

In our days, extraordinary embaffies of more than one embaffador, are very rare; at leaft they never confift of more than three embaffadors. Their number, however, is noways limited by the public law of Europe; neither is the retinue or train of an embaffador extraordinary reftricted to any particular number of perfons. It ought only not to be fo numerous as to create any uneafinefs in the country where the embaffador extraordinary is appointed to fojourn for a fhort time. The duke of Feria, who went to France as embaffador extraordinary of the king of Spain, to compliment Louis XIII. on his acceffion to the throne, after the death of Henry IV. had fo numerous a retinue, that the governor of Bordeaux refufed to admit him in that city. He affigned him his quarters in one of the fuburbs, and wrote to inform him, that he could not admit him in the place, becaufe his train formed a fmall army, which might eafily affail the governor with a thoufand firelocks. This cautious conduct of the governor was fully approved of at the French court.

Extraordinary embaffies are generally very brilliant. The earl of Manchefter's public entries into Venice as extraordinary Englifh embaffador in 1698 and 170-, are defcribed as uncommonly magnificent. His excellency was attended by fixteen footmen, and fix pages, dreffed in velvet and gold brocade, befides his fecretary, and a confiderable number of Englifh gentlemen.

The embaffador extraordinary has the precedency before the embaffador ordinary of the fame power. When it happens that an embaffador extraordinary is fent to the fame court after another embaffador extraordinary, he who is laft arrived has the precedency, unlefs the prince or ftate by which they are appointed determines their rank differently. When embaffadors ordinary are relieved, he who is going to quit the court or country where he has refided walks at the right of his fucceffor in proceeding to the audience: but, in returning, he gives the right to the new embaffador, becaufe his functions are terminated by the farewell audience.

With refpect to the rank of foreign embaffadors refiding at the fame court among themfelves, the nuncio of the pope was always confidered as holding the firft rank at the French court before the eftablifhment of the French republic in 1792. He ufed to compliment the king on particular occafions in the name of the whole diplomatic body. In other courts the French embaffador had the precedency before the embaffadors of any other kingdom. The Spaniards alone difputed his pre-eminence for a time: but it was folemnly recognized by Spain in 1662, and no other power did ever difpute it. The French embaffador claimed even the precedency before the Ruffian imperial embaffador. M. D'Efterno, the French embaffador at the court of Berlin in 1786, found himfelf highly offended, that the queen of Pruffia, confort of the late Frederick William II. fat down to cards with the Ruffian embaffador, whilft he was only invited to take a hand with the princefs Friderika, eldeft daughter of the king of Pruffia, at prefent duchefs of York.

The right of fending embaffadors is generally vefted in the prince or chief magiftrate, to whom the exercife of the executive power is entrufted in independent ftates. It is an effential attribute of fovereign power. Yet it is not abfolutely neceffary that a prince be in the actual poffeffion of this power to appoint embaffadors; provided he have not abdicated the crown, his embaffadors ought to be received at other courts, unlefs there be fome political motives for refufing their admiffion: but even in that cafe they are like other public minifters, under the fpecial protection of the public law of nations.

The actual poffeffion of the fovereign power, whatever may have been the means by which it has been acquired, is confidered as a fufficient title to the right of fending embaffadors, and the embaffadors of an ufurper have often been admitted in courts where thofe of the lawful prince have been refufed. The embaffadors of Cromwell were received in France, when Charles II. himfelf could not obtain an audience.

To admit an embaffador, is to acknowledge the fovereignty of the prince, or the independency of the ftate which he reprefents. France acknowledged the independence of the United States of America, by admitting Franklin as their embaffador before they were declared independent by Great Britain.

During the minority of a monarch the regent may appoint embaffadors, but always in the name of the king. They reprefent him in whom the executive power is vefted by the conftitution and not his fubftitute. It is this reprefentative dignity which fubjects the proceedings and motions of embaffadors to formalities and ceremonies that frequently impede and obftruct their negociations. Hence it is not unufual to appoint a fimple minifter plenipotentiary to carry on an important and difficult negociation, but to furnifh him at the fame time with the credentials of an embaffador extraordinary, with the ftrict injunction not to make any ufe of them unlefs he fhould be fuccefsful in his miffion. In that cafe he delivers them only at the clofe of the negociation, juft before the figning of the treaty, which derives a certain additional folemnity for being figned by an embaffador extraordinary.

As the functions of an embaffador confift in watching in the country where he is appointed to refide over the interefts of the ftate which he reprefents, in making regular reports of his proceedings, and in communicating every circumftance, the knowledge of which is deemed of importance to the minifter at the head of the department for foreign affairs in his own country, it follows that an embaffador ought to be well acquainted with the political ftate and the language of the country in which he refides, with the temper and difpofition of the prince or chief magiftrate by whom it is governed, with the particular character of the minifter who manages its foreign affairs, with the relations of that country with the other powers of Europe, and with the particular policy which influences them towards that country. To this indifpenfible political information an embaffador ought to join a confummate knowledge of mankind in general, an incorruptible integrity, an enlightened prudence, a fagacious judgment, mild and refined manners, an infinuating addrefs, a generous difpofition, found difcretion, and dignified firmnefs, and above all a great command over himfelf. This catalogue of qualities, which are rarely combined, fhews how difficult it muft be to find fit fubjects for embaffies. There is in France a fort of diplomatic gradation through which all individuals employed in miffions to foreign courts are generally obliged to pafs. The firft ftep is that of fecretary of legation of the fecond clafs, then follows that of fecretary of legation of the firft clafs; the third ftep is that of minifter plenipotentiary, and the fourth that of embaffador. Frequent exceptions, however, take place with regard to the appointment of embaffadors, who are fometimes taken from the army. (Wicquefort. l'embaffadeur et fes fonctions. Pecquet. difcours fur l'art de négocier. L'efprit de Leibnitz, tome ii. Chefterfield's letters ccii. ccxix. clii. cclxxxviii.)

EMBASSADRESS, in French *Ambaffadrice*, is, in the common acceptation of the word, the wife of an embaffador, who as fuch fhares his rank and privileges. But there have been embaffadreffes in their own right, or female embaffadors. The famous league of Cambray was figned, in 1508, on the part of the emperor, by Margaret of Auftria his daughter, to whom he had given full powers for that purpofe. The peace concluded at Cambray, in 1529, in confirmation of that of Madrid, was alfo figned by the fame Margaret of Auftria, duchefs of Parma, in the name of Charles V. and by Louifa duchefs of Savoy, mother of Francis I. by virtue of full powers given to thefe two illuftrious ladies by the emperor and the king of France. In the year 1645, Louis XIV. expreffedly appointed Madame la Maréchale de Guébriant his embaffadrefs extraordinary, to confign Mary de Gonzagues, daughter of the duke of Nevers, to the arms of her royal hufband, the king of Poland, who had married the princefs by procuration. Circumftances might indeed arife in which a lady might with great propriety be appointed embaffadrefs at the court of a fovereign princefs, into whofe confidence fhe might more eafily infinuate herfelf than an embaffador. In fuch cafes fhe would be under the fpecial protection of the law of nations, and enjoy all the rights and immunities of an embaffador.

EMBASSY, formerly *Embaffage*, in French *Ambaffade*, *legatio*, is the charge or office of an embaffador, or any other public minifter fent to reprefent one fovereign prince or independent ftate at the court of another. It alfo denotes the folemn meffage, miffion, or errand, on which fuch a public minifter is fent.

F. Daniel obferves, that under the ancient French kings, their embaffies confifted of a body, or number of perfons, joined together in commiffion, and who compofed a kind of council; fomething like which is ftill retained at treaties of peace. Thus the French embaffy at Nimeguen, for the peace confifted of three plenipotentiaries; that of Utrecht, of two, &c. See Embassador.

EMBATTLED, a term in *Heraldry*, when the outline of any ordinary is notched fo as to reprefent the battlements of a wall, or caftle. See Battlement.

None were fuffered, in ancient times, to embattle their houfes, but thofe who had great dignities, as the barons, and the like. Camden proves this in his account of Tunftal's feat in England, in which he expreffes it as a fignal mark of the royal favour, that he had liberty given to embattle it. The heralds exprefs this embattled line by the term *crenelle*; and when it has the embattling on both fides, which is the more rare, they call it *bréteffe*; which fee.

EMBAUL, in *Geography*, a town of Africa, in the kingdom of Damel. N. lat. 15° 15'. W. long. 15° 37'.

EMBDEN. See Emden.

EMBELIA, in *Botany*, corrupted from the Ceylon name Aembilla. Burm. Ind. 62. t. 23. Juff. 427. (Ribefioides; Linn. Fl. Zeyl. 190.) Clafs and order, *Pentandria Monogynia*. Nat. Ord. uncertain. *Juff.*

Gen. Ch. *Cal.* Perianth fmall, five-cleft, inferior. *Cor.* Petals five, regular, undivided. *Stam.* Filaments five, equal; anthers . . . . *Pift.* Germen fimple, fuperior; ftyle one; ftigma . . . . *Peric.* Berry . . . .

A fmooth fhrub, without thorns. *Leaves* alternate, oblong, entire. *Flowers* in terminal panicled clufters. *Fruit* white, acid, ufed for making rob or jelly. Native of Ceylon. Schreber, by his index, feems to refer this plant to *Antidefma*, but their characters do not accord.

EMBER-Goose, in *Ornithology*, the *colymbus immer* of Linnæus; which fee.

Ember-*weeks*, are thofe wherein the ember or embering days fall.

In the laws of king Alfred, and thofe of Canute, thefe days are called *ymbren*, that is, *circular days*, from whence the word was probably corrupted into ember days. By the canonifts, they are called "quatuor anni tempora," the four cardinal feafons, on which the circle of the year turns; and hence Henfhaw takes the word to have been formed, *viz.* by corruption, from *temper*, or *tempora*. The ancient fathers called them "quatuor tempora jejunii."

Mr. Somner thinks they were originally fafts, inftituted to beg God's bleffings on the fruits of the earth. Agreeably to which, Skinner fuppofes the word ember taken from the afhes, embers, then ftrewed on the head.

The ember days are the Wednefday, Friday, and Saturday, next after Quadragefima Sunday, or the firft Sunday in Lent, after Whitfunday, after Holyrood day in September, and after St. Lucy's day in December; which four times anfwer well enough to the four quarters of the year, fpring, fummer, autumn, and winter. Thefe days are mentioned by Britton, c. 53, and other writers; and particularly in the ftat. 2 and 3 Edw. VI. c. 19.

Thefe ember weeks are now chiefly taken notice of on account of the ordination of priefts and deacons; becaufe the canon appoints the fundays next fucceeding the emberweeks for the folemn times of ordination; though the bifhops, if they pleafe, may ordain on any funday or holiday.

EMBERIZA, in *Ornithology*, a genus of the Pafferine order, the character of which confifts in the bill being conic; mandibles receding from each other from the bafe downwards, the lower with the fides narrowed in, and a hard knob within the upper mandible. This laft-mentioned procefs in the mouth is adapted in a very peculiar degree to the manners of the emberiza tribe; all the fpecies feed on feeds, and by the aid of this knob they are able to break and comminute the fhells of the harder kinds with facility. The genus is extenfive, and includes fome very beautiful birds.

Species.

Species.

Nivalis. Quill-feathers white, primaries black on the outer edge; tail-feathers black, the three lateral ones white. Linn. *Hortulanus nivalis*, Briff. *Ortolan de niege*, Buff. *Pied mountain finch*, Albin. *Snow bunting*, Lath. Donov. Brit. Birds.

Inhabits the northern parts of Europe, Afia, and America, during fummer, and migrates to warmer climates in the winter. Its fize rather exceeds that of the chaffinch; it builds in cavities of rocks and lays five eggs, which are of a white colour, fpotted with brown. The fpecies varies confiderably in its plumage at different feafons of the year, and three diftinct kinds are defcribed as permanent varieties. One variety is white, with the feathers dafhed with yellow, and the chin and throat marked with very fmall brown fpots. This is called by Frifch Weifs Fleckige Ammer. Another (hortulanus nivalis pectore nigro of Briffon), is yellowifh-white above, beneath with the breaft black; wings and tail black and white intermixed. The pied chaffinch of Albin is the third; the body of this is reddifh-brown; head and neck white, breaft with a blueifh fpot; wings and tail varied with black and white.

Mustelina. Quill-feathers dufky, white at the bafe, the laft entirely black; tail-feathers black; middle ones at the edge, and three lateral ones each fide, white with a dufky fpot without. Gmel. *Emberiza nivalis*, Linn. *Emberiza glacialis*, Lath. *Tawny bunting*, Brit. Zool.

About the fame fize as the former, and is by fome writers erroneoufly confounded as a variety of it. The fpecies occurs rarely in the northern parts of Britain.

Montana. Five firft quill-feathers blackifh-brown, the reft white, fpotted with brown at the tip; tail-feathers brown; three lateral ones each fide entirely white. Gmel. *Leffer mountain brambling*, Willughby. *Mountain bunting*, Lath. Donov. Brit. Birds.

Found in Yorkfhire and Lincolnfhire.

Hyemalis. Black, belly white. Gmel. *Fringilla hyemalis*, Linn. *Paffer nivalis niger*, Kalm. *Ortolan jacobin*, Buff. *Snow bird*, Catefby. *Black bunting*, Lath.

The length of this bird is about fix inches and a half. During winter, and more efpecially in fnowy weather, it is feen in Virginia and Carolina; its fummer place of refidence is unknown. By fome it is called the chuck-bird. The flefh is held in efteem as an article of food.

Miliaria. Brown, beneath fpotted with black; orbits rufous. Linn. *Alaudæ congener*, Aldr. *Strilozzo*, Olin. *Cynchramus*, Briff. *Gerft-ammer*, Gunth. *Le Proyer*, Buff. *Common bunting*, Lath. Donov. Brit. Birds, &c.

Common during the fummer and autumn in moft parts of Europe; in England they remain throughout the winter, but in the more fouthern climates migrate at the approach of that feafon. They affociate in flocks. The females build their neft in a low hedge, or on a ftump near the ground, and lay from five to fix eggs. Thefe birds are rather larger than the yellow-hammer, and in the appearance of their plumage fo clofely refemble the lark, that they are commonly fold under the name of bunting larks in the London markets. They are caught in vaft numbers for fale during the winter feafon; the flefh is bitter, and inferior to that of the true lark.

Hortulana. Quill-feathers brown, the firft three whitifh at the edges; tail-feathers brown, the two lateral ones black on the outer fide. Linn. *Hortulanus*, Gefn. *Ortolano*, Olin. *Ortolan*, Lath.

The varieties of this fpecies are numerous; the principal are β (ortolan jaune of Buff.); the plumage of which is yellowifh, with the quill-feathers edged with white; γ (ortolan blanc) fnowy white; δ (hortolanus quintus of Ray) which has the tail white; and ε (ortolan noiratre of Buff.) the colour of which is blackifh, head and neck greenifh, bill red, and legs cinereous.

Thefe birds are found chiefly in the fouth of Europe, from whence they migrate northwards as far as Sweden, but have not been known to vifit England. The fize is that of our yellow-hammer, and its fong is not very diffimilar to the notes of that common bird, but more melodious; its neft is ufually built in a low hedge, or on the ground, and contains five eggs of a greyifh colour. The celebrity of the ortolan for the tables of epicures is perfectly well known: they are caught for this purpofe in vaft number at the times of their periodical migrations in fpring and autumn, and fattened in a peculiar manner. Their feeders place them in a dark room, with an abundance of oats and millet, upon which they feed with avidity, and become in a very fhort time extremely fat, in which ftate they weigh fometimes three ounces each. When thus fed they are confidered exquifitely delicious, and fetch a high price. Ortolans are taken in great numbers in the fouth of France and Italy, fome parts of Germany, and the fouthern provinces of Ruffia and Siberia; and are potted or otherwife preferved, and form an article of exportation to thofe countries where thefe delicious birds are lefs commonly found.

Sinensis. Reddifh brown, beneath pale yellow; leffer wing-coverts yellowifh; quill and tail-feathers with the longitudinal ftreak on the belly brown. Lath. Ind. Orn. *Ortolan de la Chine*, Sonner. *Chinefe bunting*, Lath.

Inhabits the fouthern provinces of China during the months of October, November, and December. Size not mentioned.

Citrinella. Tail-feathers blackifh, the two outer ones on the inner edge with a pointed white fpot. Linn. *Emberiza flava*, Gefn. *Zivolo*, Olin. *Braunt*, Buff. *Yellow-hammer*, Ray. Donov. Brit. Birds.

A general inhabitant of Europe, in every part of which it appears to be common. The male differs from the female in having the colours of the plumage more obfcure, and the head only tinged with yellow; in the male the head is of a very vivid yellow, whence its name. The neft of this common bird, as is well known, confifts of hay, and other dry fubftances, flightly put together, and placed either on the ground or in a bufh clofe to it: the eggs from four to five in number, and of a grey colour with ftreaks, and a few blotches of brown. Thefe birds are eaten in Italy.

Olivacea. Olive, beneath whiter; chin orange; pectoral band blackifh. Gmel. *Emberiza dominicenfis*, Briff. *Olive*, Buff. *Olive bunting*, Lath.

Inhabits St. Domingo, and is about the fize of the common wren.

Passerina. Above grey-ferruginous; middle of the feathers black beneath, whitifh-afh fpotted on the fides; tail-feathers black, the middle ones edged with ferruginous; the outer one each fide nearly to the bafe, the next as far as the middle obliquely white. Pallas. *Pafferine bunting*, Lath.

Size of the reed fparrow. The head and chin in the male black; behind the eyes a pale ftreak; tail rather forked; legs brownifh flefh colour. Inhabits Ruffia near the Ural, and Jaick.

Pusilla. Above grey-ferruginous; beneath whitifh; throat fpotted; head with alternate longitudinal teftaceous and black bands. Pallas.

A fmall

A ſmall ſpecies, found among the ſnowy mountains of Dauuria.

Rustica. Head black, with three longitudinal white bands, chin, body beneath, and two outmoſt tail-feathers each ſide obliquely white. Pallas.

Inhabits Dauuria, chiefly in woody ſituations.

Fucata. Grey-ferruginous; ears with a round rufous ſpot; eye-brows, line beneath the eyes and throat white; chin ſurrounded with a brown ſpotted circle. Pallas.

Frequent in rocky parts of Siberia.

Spodocephala. Grey-ferruginous, beneath pale ſtraw colour; frontlet black; head and neck hoary-aſh. Pallas.

Inhabits near the waterfalls in the Alpine regions of Dauuria. Size of the reed bunting.

Chrysophrys. Grey-ferruginous; crown black; eye-brows citron, from the middle of the crown to the nape a white band. Pallas.

Found with the latter; ſize of the common yellow-hammer.

Maelbyensis. Head and neck lead-cinereous; chin whitiſh; belly ferruginous. Sparrman, Muſ. Carl.

Deſcribed from a ſpecimen taken at Maelby, in Sweden, a ſeat of count Carlſon, in the dukedom of Sudermania. Some writers ſuggeſt that the bird mentioned might be either the female or young of the pine bunting.

Rutila. Sanguineous rufous; beneath ſulphur; wings grey ruſty. Pallas.

Inhabits Siberia, and is the ſize of the yellow-hammer.

Ferruginea. Ferruginous; belly, and two ſpots on the primary quill-feathers, white. Arct. Zool. *Ruſty bunting*, Lath.

Native of North America.

Americana. Above cinereous, ſtreaked with brown; beneath yellow; chin white; quill and tail-feathers black, with pale edges. Gmel. *Black throated bunting*, Arct. Zool.

Found in New York. Size of the yellow-hammer. The female is like the male, but has no black ſpot on the throat, nor ſtreak of yellow above the eye. Dr. Latham deſcribes a variety met with in Hudſon's bay, the colour of which is aſhy brown, beneath whitiſh, front and eyebrows yellow; band under the eyes, and the creſcent on the front, black; chin, as in the male of the other, with a triangular black ſpot in the middle.

Brasiliensis. Crown, neck, and body beneath, yellow; back, wings, and tail greeniſh, varied with yellow and brown. Gmel. *Guiram heemgata*, Ray. *Guirnegat*, Buff. *Braſilian bunting*, Lath.

Size of a ſparrow. The ſpecies inhabits Brazil.

Mexicana. Above browniſh, beneath whitiſh, ſpotted with brown; head and throat yellow. Gmel. *Thereſe jaune*, Buff. *Mexican bunting*.

Length ſix inches and a half; the legs and bill pale; wings and tail browniſh. Native of New Spain.

Militaris. Head, wings, tail, and back brown; lower part of the back and breaſt yellow; ſhoulders greeniſh; belly white. Haſſelq. *Military bunting*, Lath.

Inhabits Malta.

Melanocephala. Yellow, head black; back rufous. Scop. *Black-headed bunting*, Lath.

Size of the yellow-hammer, and inhabits Europe.

Brumalis. Body beneath; front and region of the eyes citron; hind head and neck cinereous. Scop.

Native of the Tyroleſe country. This and the two following are ſmall ſpecies.

Coccinea. Body above ſilvery, beneath crimſon; vent white; bill, head, and quill-feathers black; hind head and tail black-blue. Sander.

Found in the woods about Baden.

Badensis. Olive, ſtriated with blackiſh, beneath paler; throat orange; breaſt with black ſtreaks. Sander.

Inhabits Baden. The bill is black above, beneath yellowiſh, with a ſingle obtuſe tooth in the middle.

Erythrophthalma. Black, with a red gloſs; belly reddiſh; wings with a white ſpot. Gmel. *Fringilla Carolinenſis*, Briſſ. *Towhee bird*, Cateſby.

This ſpecies inhabits Carolina, frequents ſhady woods, and is generally ſeen in pairs. Called by ſome the American bulfinch. Length eight inches.

Leucophrys. Ruſty brown, beneath white; vent yellow; crown black, with a white fillet in the middle; eye-brows white. Forſt. *White crowned bunting*, Arct. Zool.

Inhabits Canada, feeds on graſs, ſeeds, and worms, ſings melodiouſly, and lays three or four chocolate-coloured eggs. Length rather exceeding ſeven inches.

Luctuosa. Black; beard on the cheſt, front, breaſt, belly, rump, and vent white. Scop. *Wreathed bunting*, Lath.

Size of the greater titmouſe.

Aureola. Rufous, beneath yellow; tranſverſe pectoral band ferruginous; crown, cheeks, and chin black. Pallas. *Emberiza Sibirica*. Lepechin. *Yellow breaſted bunting*. Lath.

Size of the reed ſparrow, and inhabits the pine groves of Siberia

Sandwichensis. Brown, beneath whitiſh, ſpotted with brown; eye-brows yellow; temples duſky. Gmel. *Unalaſha bunting*, Arct. Zool. *Sandwich bunting*, Lath.

Length ſix inches; bill and legs black; under the eyes a duſky line; middle of the belly whitiſh and immaculate. Native of Sandwich bay.

Aoonalaschkensis. Reddiſh brown; beneath whitiſh, ſtreaked with brown; middle of the belly white. Gmel.

Length ſeven inches, inhabits Aoonalaſchka, and reſembles the former.

Atricapilla. Cheſnut, beneath cinereous; chin white; crown pale yellow, front and ſtreak through the eyes to the nape black. Gmel. *Black crowned bunting*, Lath.

Native of the Sandwich iſlands; its neck is ſeven inches, the bill black, and legs brown. A variety is deſcribed in Cook's laſt voyage, which has the breaſt waved with black; the female without the yellow ſpot on the crown.

Pithyornus. Middle of the crown with an oval white ſpot; nape varied with white; chin red-teſtaceous; two exterior tail-feathers, each ſide with an oblique white band. Pallas. *Emberiza leucocephala*, S. G. Gmelin. *Emberiza alia ſpecies*, Lepechin. *Pine bunting*, Lath.

Inhabits the pine foreſts of Siberia, from the Uralian chain of mountains to the Lena; it lives among reeds on the ſhores of rivers, and paſſes the winter ſometimes on the borders of the Caſpian ſea. The ſize is that of the yellow-hammer, and it has the note of the reed ſparrow.

Cinerea. Bay, beneath whitiſh, ſpotted with bay; tail and quill-feathers brown, edged with grey; rump grey; tail-coverts reddiſh white. Gmel. *Emberiza canadenſis*, Briſſ. *Cul-rouſſet*, Buff. *Cinereous bunting*, Arct. Zool.

Length five inches and a half, and inhabits the juniper woods in Canada.

Cærulea. Rufous and blue varied; crown rufous;

greater

greater wing-coverts, quill-feathers, and tail-feathers, brown, with the outer edge rufous. Gmel. *Emberiza canadenſis cærulea*, Briff. *Azuroux*, Buff. *Blue bunting*.

Inhabits Canada, and rarely New England. Its length is four inches and a half.

Cyanea. Blue; crown deeper; quill, and tail-feathers brown edged with blue. Lath. Ind. Orn. *Emberiza cyanea, rectricibus fuſcis*, Gmel. *Tanagra cyanea*, Linn. *Miniſtre*, Buff. *Blue linnet*, Cateſby. *Indigo bunting*, Lath.

Size of the ſiſkin. The male, when in full plumage, is blue, at other times reſembles the female, which is nearly throughout of a browniſh colour; in the latter, however, the edge of the wing is tinged with green, and by this peculiarity the female may be diſtinguiſhed from the male, the edge of his wing being blue. In Carolina, the inland parts of which this ſpecies inhabits, it is called the parſon, and by ſome the biſhop; and the Spaniards at Mexico, which country it inhabits, alſo name it azul lexos, or "far-fetched blue bird." It feeds on ſeeds, and is ſaid to have the note of the common linnet.

Cyanella. Shining blue-interſcapulars and ſhoulders varied with blue and rufous; quill and tail-feathers edged with blueiſh. Sparrm. Muſ. Carlſ. *Emberiza cyanella*, Gmel. *E. cyanea*, β Lath.

Deſcribed by Sparrman as a ſpecies. Gmelin admits it with doubt, and Latham conſiders it as a variety only of cyanea; it is a native of North America.

Quelea. Grey; front black; bill ſcarlet. Gmel. *Moineau à bec rouge du Sénégal*, Buff. *Black faced bunting*, Lath.

The bill of this bird is thick; cheeks and chin black; reſt of the head, ſhoulders, and back varied with black and grey; breaſt and belly reddiſh white; quill and tail-feathers blackiſh, edged with cinereous. The ſpecies inhabits Senegal, and is four inches and a half in length. The female reſembles the male, but wants the black about the head. The bird deſcribed by Buffon, under the name of Moineau du Senegal, is conſidered as a variety.

Tetrix. Cheſnut, beneath yellow; eye-brows and rump yellow; middle of the head and breaſt with a broad black band. Gmel. *Weaver bunting*, Lath.

Size of the houſe ſparrow, which bird it reſembles in the browniſh colour of the plumage during winter. The name of weaver bunting was given to this bird from its propenſity to interweave ſilk between the wires of its cage, like the weaver oriole, and, it is conjectured, the neſt of the weaver bunting is compoſed in a manner ſomewhat ſimilar to that of the above-mentioned oriole, which conſiſts of leaves curiouſly ſewed together with the filaments of plants. This bird inhabits Africa.

Rubra. Crimſon; neck and back varied with olive and black, and a few crimſon marks; belly and vent cinereous; quill and tail feathers black, edged with grey-green. Gmel. *Moineau de l'iſle de France*, Buff. *Crimſon bunting*, Lath.

Size of the laſt, and inhabits the iſle of France. The bill is black; legs pale fleſh colour; female olive and paler beneath.

Capensis. Grey; throat whitiſh; ocular band and another beneath blackiſh. *Hortulanus capitis bonæ ſpei*, Briff. *Ortolan du Cap de Bonne Eſperance*, Buff. *Cape bunting*, Lath.

Native of the Cape, and in ſize reſembles the ſparrow. Three varieties of this ſpecies are deſcribed in Buffon's "Planches Enluminees," namely, β, the body of which is yellow beneath, and the ſides of the head and neck marked with three black ſtripes; γ, having the body beneath whitiſh; and δ, which is whitiſh beneath, and has the throat varied with cinereous. The two firſt of theſe are conceived to be merely varieties of the Cape kind, the laſt is a native of Cayenne, where, according to Buffon, it is called *Bonjour-commandeur*, from being accuſtomed to commence its ſong at the break of day.

Fusca. Browniſh; wings and tail brown with duſky bands; belly white; noſtrils, cheeks, and chin with feathered tufts. Gmel. *Barred-tailed bunting*, Lath.

Deſcribed by Dr. Lathan from a figure met with among ſome Chineſe drawings. The ſize is ſaid to be that of the common bunting. The beak is fleſh-coloured; legs roſy.

Ludovicia. Rufous ſpotted with black; beneath pale; breaſt rufous; head with a black creſcent. Gmel. *Hortulanus ludovicianus*, Briff. *Ortolan de la Louiſiane*, Buff.

Length five inches and a quarter. The bill rufous ſpotted with black, head and throat reddiſh; rump and cuneated tail black; breaſt rufous; legs cinereous. Native of Louiſiana.

Cia. Reddiſh; head with a few blackiſh lines; eye-brows white. *Emberiza barbata*, Scop. *Emberiza pratenſis*, Geſn. *Bruant fou*, Buff. *Bruant de ſprés*, Buff. *Fooliſh bunting*, Lath.

Native of the warmer parts of Europe, and delights moſt in mountainous ſituations; it is a ſilly bird, and eaſily caught in any ſnare, whence its name; its note is only a repetition of ſounds, like the pronunciation of the words zi-zi-zi-zip-zip. The Genoeſe call it Cia montanina.

Cirlus. Fuſcous; breaſt ſpotted; eye brows pale yellow; two outmoſt tail-feathers with a white cuneated ſpot. Gmel. *Emberiza ſepiaria*, Briff. *Cirlus*, Aldr. *Cirl bunting*.

Size of the yellow-hammer, and inhabits Italy and France; the ſpecies has been lately found in Britain.

Familiaris. Cinereous ſpotted with brown; tail-feathers white at the tip; hind part of the back yellow. Gmel. *Bruant familier*, Buff. *Familiar bunting*.

Oſbeck deſcribes this ſpecies under the name of Motacilla familiaris. This writer ſpeaks of it as a docile bird, and ſays, if the cage-door was opened it would jump out upon the perſon's hand who releaſed it, and if any one whiſtled in its hearing, it ſang ſweetly in return. If a diſh of water was placed before it, the bird inſtantly plunged into it, and bathed itſelf. It was fed with rice.

Flaveola. Grey; face yellow. Gmel. *Flaveole*, Buff. *Yellow-faced bunting*.

Native of warm climates, and very ſmall.

Amazonia. Brown; crown fulvous; vent whitiſh. Gmel. *Amazone*, Buff. *Amazon bunting*.

Size of the titmouſe, and inhabits Surinam.

Oryzivora. Black; crown reddiſh; belly black; tail-feather daggered. Gmel. *Agripenne ou Ortolan de riz*, Buff. *Rice bird*, Cateſby. *Rice bunting*, Arct. Zool.

About the ſize of the ſparrow. The ſpecies is confined to the continent of America, and is of the migratory kind, paſſing in flocks at particular ſeaſons from one part to another. The Americans call it Bob Lincoln and Conquedle. Its food conſiſts of grain and inſects, and the maize eſpecially; they are remarkably fond of this plant, and prove highly deſtructive to the crops, by unneceſſarily perforating the huſks after ſatisfying their appetites, and thus leaving openings

openings through which the rain penetrates, and effectually deftroys the plants. Some, for this reafon, call it the maize thief, or white backed maize thief. Its note is much admired. There is a variety of this bird of an olive-brown colour, beneath y llowifh; rump yellow, tranfverfely lined with brown; greater wing-coverts and quill-feathers edged with white.

SCHOENICULUS. Head black; body grey and black; outmoft tail-feathers with a white wedged fpot. Linn. Fn. Suec. *Junco turneri*, Gefn. Buff. *Reed bunting*, Lath.

Native of Europe and the fouthern parts of Siberia. The female differs from the male in having the head brownifh inftead of black.

LESBIA. Beneath white; face white with three black bands; breaft and rump brownifh; tail-feathers white, the two middle ones dufky, edged with rufous. Gmel. *Mitilene de Provence*, Buff. *Lefbian bunting*, Buff.

Length about four inches and a half; it inhabits Provence, where it is called Chic de Mitilene, being rare in that part, and known to be common in the Greek ifle Mitylene, or Lefbos. They are faid to exert a peculiar kind of fcream on the approach of any bird of prey, a circumftance which the Greeks turn to fome advantage, for they place one or more of thefe birds inclofed in ftrong iron cages in their poultry yards, and the approach of the hawk, or any other bird of prey, is loudly announced by thefe little centinels the moment it appears in fight; and by this means the poultry are allowed fufficient time to effect their efcape.

PROVINCIALIS. Beneath white; band acrofs the eyes and on the wing and chin white; fpot under the eyes, ftreak each fide the chin, and breaft brownifh fpotted with black; quill and tail-feathers dufky, edged with rufous. Gmel. *Gavoué de Provence*, Buff. *Muftachoe bunting*, Lath.

Size of the laft, and inhabits Provence.

LOTHARINGICA. Spotted with black; above rufous, beneath cinereous, abdomen rufous; ftreak acrofs the eyes and on the mandibles black; tail-feathers black and white, middle ones rufous; exterior ones nearly all white. Gmel. *Ortolan de Lorraine*, Buff. *Lorrain bunting*.

Inhabits Lorrain; the female is white beneath, and has a whitifh fpot above and a rufous one beneath the eyes. Length fix inches and a half.

PSITTACEA. Brownifh-afh; wings tawny; two tail-feathers very long. Gmel. *Fringilla brafilienfis*, Seba. *Veuve éteinte*, Buff. *Pfittaceous bunting*, Lath.

Size of a fparrow, and inhabits Brafil.

PARADISEA. Black; breaft red; four middle tail-feathers long, and pointed; two very long, bill black. Scop. *Vidua*, Briff. *Indian long-tailed fparrow*, Will. *Red-breafted long-tailed finch*, Edw. *Whidah bird*, Lath.

Native of Angola in Africa.

SERENA. Head black; crown red; tail cuneated; two middle tail-feathers very long; legs grey. Gmel. *Vidua minor*, Briff. *Veuve dominicaine*, Buff. *Dominican bunting*, Lath.

Like the reft of the long-tailed buntings, this bird is deftitute of the two long tail-feathers during winter, and changes its plumage twice in the year.

VIDUA. Blackifh; beneath whitifh; four middle tail-feathers long and pointed, two of them very long; bill red. Gmel. *Vidua major*, Briff. *Grande veuve*, Buff. *Long-tailed fparrow with a fcarlet bill*, Will.

The body of this fpecies is lefs than that of the fparrow; the fpecies inhabits Angola in Africa and India.

PRINCIPALIS. Variegated; breaft rufous; four middle tail-feathers very long; bill and legs red. Gmel. *Vidua angolenfis*, Briff. *Variegated bunting*, Lath.

Inhabits Angola.

REGIA. Middle tail-feathers very long, equal, feathered only at the tip; bill red. Gmel. *Veuve à quatre brins*, Buff. *Shaft-tailed bunting*, Lath.

Inhabits the maritime parts of Africa. Length four inches and a half. The body above and vent black; throat, temples, orbits, and body beneath rufous; legs red.

LONGICAUDA. Black; fhoulders orange, edged with white; tail-feathers long, the fix middle ones very long. Gmel. *Veuve à épaulettes*, Buff. *Yellow-fhouldered oriole*, Brown.

Native of the Cape of Good Hope.

PANAYENSIS. Black; breaft with a large fcarlet fpot; four middle tail-feathers very long, pendulous, pointed and equal. Gmel. *Veuve en feu*, Buff. *Veuve de l'ifle de Panay*, Sonnerat. *Panayan bunting*.

Inhabits the ifle of Panay.

ANGOLENSIS. Black; crown and collar yellow; tail long. Gmel. *Gros-bec à poitrine couleur de feu*, Salerne. *Angola bunting*.

Size of a finch, and inhabits Angola.

CIRIS. Head bule; abdomen fulvous; back green; feathers green brown. Gmel. *Painted finch*, Catefby. *China bulfinch*, Albin. *Painted bunting*, Arct. Zool.

Length five inches and a half, varies in colour, and inhabits South America; they build in the orange trees, and feed on plants of various kinds. In Holland, and fome other parts of Europe to which they have been tranfported, they are reared in cages like the Canary with us, and are faid to live eight or ten years in this ftate of captivity.

QUADRICOLOR. Head and neck blue; back, wings, and tail at the tip green; tail and abdomen in the middle red; breaft and remainder of the belly brownifh. Gmel. *Grofbeak de Java*, Buff. *Red rump bunting*, Lath.

Native of Java. Length five inches.

CYANOPIS. Green; rump and abdomen rufous; front, cheeks and chin blue; quill-feathers brown, edged with green; tail-feathers edged with red; middle ones green, the reft brown. Gmel. *Chloris javenfis*, Briff. *Toupet bleu*, Buff. *Blue faced bunting*, Lath.

Length four inches; inhabits fame country as the laft.

VIRIDIS. Above green; beneath white; wings and tail blue. Gmel. *Chloris indica minor*, Briff. *Parement bleu*, Buff. *Green bunting*, Lath.

Size of a fparrow; the bill greenifh brown; fhafts of the quill and tail-feathers white; and legs black. Native of India.

PLATENSIS. Above greenifh-brown; beneath whitifh-afh; back varied with black; quill, and lateral tail-feathers edged with yellow. Gmel. *Emberife à cinq couleurs*, Buff. *Plata bunting*, Lath.

Length eight inches. This fpecies inhabits near the river Plata in South America.

BORBONICA. Rufous red; wings, tail, and legs chefnut. Gmel. *Mordoré*, Buff. *Bruant de l'ifle de Bourbon*, Buff. *Bourbon bunting*.

Inhabits the ifle of Bourbon.

CALFAT. Hoary; beneath vinaceous; head, chin, and edge of the tail black; bill and orbits rofy. Gmel. *Calfat*, Buff. *Red-eyed bunting*, Lath.

Lefs than the common fparrow, and inhabits the ifle of France.

CHLOROCEPHALA. Fufcous; head and neck olive; back and wing-coverts varied with brown and black; tail forked. Gmel. *Green-headed bunting*. Brown's illuftr.

A very ambiguous kind; probably an accidental variety of fome European bunting. The bird defcribed was caught in Mary-le-bone fields, and preferved in the Tunftal Collection.

Grisea. Grey; wing-coverts and breaft varied with red; quill and tail-feathers within white, without varied with grey and red. Gmel. *Emberiza Surinamenfis*, Briff. *Gonambouch*, Seba. *Grey bunting*, Lath.

Inhabits Surinam, where it is common, and its note is faid to be equal to that of the nightingale. Its food is chiefly maize. The natives call it gonambucho.

Surinamensis. Grey, beneath pale-yellow; breaft with oblong black fpots. Gmel. *Prayer*, Fermin. *Surinam bunting*. Lath.

Rather larger than the lark. Inhabits Surinam.

Ruficapilla. Body above fufcous, beneath cinereous; chin ferruginous; frontlet white; above reddifh; tail black. Sparm. Muf. Carlf.

Asiatica. Cinereous; wings and tail brown. Lath. Ind. Orn. *Gaur bunting*.

Inhabits the Eaft Indies, where it is known by the name of gaur.

EMBLEM, Εμϐλημα, a kind of painted ænigma, which, reprefenting fome obvious hiftory, with reflections underneath, inftructs us in fome moral truth, or other matter of knowledge.

The word is pure Greek, formed of the verb εμβαλλειν, *to caft in, to infert*. Suetonius relates, that Tiberius caufed the word to be erafed out of a decree of the Roman fenate, becaufe it was borrowed from another language.

Such is that very fignificant image of Scævola, holding his hand in the fire; with the words, "agere & pati fortia, Romanum eft;" "to do and fuffer courageoufly is Roman."

The emblem is fomewhat plainer, and more obvious, than the *ænigma;* which fee. Gale defines emblem an ingenious picture, reprefenting one thing to the eye, and another to the underftanding.

The Greeks alfo frequently gave the name emblems, εμβληματα, to inlaid or mofaic works, and even to all kinds of ornaments of vafes, moveables, garments, &c. And the Latins ufed emblema in the fame fenfe. Accordingly, Cicero, reproaching Verres with the ftatues and fine wrought works he had plundered from the Sicilians, calls the ornaments fixed thereto (and which, on occafion, might be feparated from them) emblemata. Add, that Latin authors frequently compare the figures and ornaments of difcourfe to thefe emblemata: thus, an ancient Latin poet, praifing an orator, fays, that all his words were ranged like the pieces in mofaics,

"Ut tefferulæ omnes,
Arte pavimenti, atque emblemate vermiculata."

We do not ufe the Englifh word emblem in this fenfe; though the ancient jurifconfulti always retain the Latin emblema to exprefs fuch ornaments; becaufe the Greek εμϐλημα literally denotes any thing applied, or added to a body by way of enrichment.

With us, emblem ordinarily fignifies no more than a painting, baffo relievo, or other reprefentation, intended to hold forth fome moral or political inftruction.

What diftinguifhes an emblem from a device is, that the words of an emblem have a full, complete fenfe of themfelves; nay, all the fenfe and fignification which they have together with the figure. But there is yet a farther difference between emblem and device; for a device is a fymbol appropriated to fome particular perfon, or that expreffes fomething which concerns him particularly; whereas an emblem is a fymbol that regards all the world alike.

Thefe differences will be more apparent from comparing the emblem above quoted with the device of a candle lighted; and the words, "juvando confumor," "I wafte myfelf in doing good." See Device.

According to lord Bacon, emblems are of ufe in the art of memory, as fenfible objects ftrike the mind ftronger than what is intellectual. Thus, it is eafier to retain the image of a fportfman hunting a hare, of an apothecary ranging his boxes, an orator making a fpeech, a boy repeating verfes, or a player acting his part, than the correfponding notions of invention, difpofition, elocution, memory, and action. Works abr. vol. i. p. 136. vol. ii. p. 475. and vol. iii. p. 106.

Emblems, *Hagiographical*. The ftatues and pictures of the apoftles, martyrs, and other ancient faints, are diftinguifhed by their refpective emblems. Thefe appear to have been fixed upon by the artifts of the 12th and 13th centuries. Sometimes they reprefent the inftruments of their death or torments, as the Burgundy crofs of St. Andrew, the gridiron of St. Laurence, the cardine comb of St. Blafe, the wheel of St. Catharine; at other times they relate to fome circumftances in the life or legend of the faint, as the organ of St. Cecily, the dove of St. Gregory the Great; frequently they bear allufion to the name of the holy perfonage, as the lamb of St. Agnes, the gigantic ftature of St. Chriftopher, bearing the infant Chrift upon his fhoulders.

EMBLEMATICAL Characters. See Character.

EMBLEMENTS, *Fr.* from *emblaver*, q. d. *femer en blè*, to fow with wheat, a term ftrictly fignifying the profits of lands fown; though fometimes ufed more largely for any profits arifing, and growing naturally from the ground; as grafs, fruit, &c.

If a tenant for life fow the land, and die before harveft, his reprefentatives fhall have the emblements to compenfate for the labour and expence of tilling, manuring, and fowing the lands, and alfo for the encouragement of hufbandry; and not he in reverfion. But if the tenant for years fow the land, and before feverance the term expires, or the eftate for life be determined by the tenant's own act, as by forfeiture for wafte committed, or if a tenant during widowhood thinks proper to marry, there the leffor, or he in reverfion, fhall have the emblements, and not the leffee.

The advantages of emblements are particularly extended to the parochial clergy by 28 Hen. VIII. cap. 1.

All the cafes of emblements turn upon the point of uncertainty; fince the tenant could not poffibly know when his landlord would determine his will, and therefore could make no provifion againft it; and having fown the land, which is for the good of the public, upon a reafonable prefumption, the law will not fuffer him to be a lofer by it. But it is otherwife, and upon reafon equally good, where the tenant himfelf determines the will; for in this cafe, the landlord fhall have the profits of the land. (Co. Litt. 55, 56.) Thefe emblements are diftinct from the real eftate in the land, and are fubject to many, though not all, the incidents attending perfonal chattels. They were devifable by teftament before the ftatute of wills (Perk. § 412.); and at the death of the owner, fhall veft in his executor, and not his heir; they are forfeitable by outlawry in a perfonal action (Bro. Abr. tit. emblements, 21. 5 Rep. 116.); and by the ftatute 11 Geo. II. c. 19. though not by common law (1 Roll. Abr. 666.), they may be diftrained for rent arrear. Although the emblements are affets in the hands of the executor, are forfeitable upon outlawry, and diftrainable for rent, they are not in other refpects confidered ſidered as perſonal chattels; and particularly, they are not the object of larciny, before they are ſevered from the ground. (3 Inſt. 109.)

EMBLICA, in *Botany*, Gærtn. t. 108. f. 2. See Phyllanthus and Myrobalanus.

EMBODY, in the *Military Art*. To *diſembody*, relates to the ſeparation of thoſe individuals forming a regiment, &c. when its ſervices are no longer required. This term is totally diveſted of that diſgrace which is conveyed under the terms *diſmiſſed*, or *broken*. Thus we find, that, during times of danger, the militia are called out; and on the return of peace, that orders are iſſued for their being "diſembodied." Hence, in that admirable ſatire, "the Mayor of Garrat," major Sturgeon ſays, "Our corps is diſembodied, ſo the French may ſleep in ſecurity."

When a regiment is diſembodied, or, in other words, diſbanded, (though the latter term is often, but erroneouſly, intended to convey reproach,) the arms are lodged in the proper ſtore-rooms; and every thing is numbered or ticketted, in order that when the regiment may again be called out, all may be in readineſs for its equipment.

EMBOLE, in *Surgery*, the reduction or ſetting of a diſlocated bone. The term is derived from the Greek εμβαλλω, *to put in*.

EMBOLI, in *Geography*, a town of European Turkey, in the province of Romania, a colony from Athens. It is called by the Chriſtians "Chriſtopolis," but is little better than a heap of ruins; 48 miles E. of Saloniki.

EMBOLIMA, in *Ancient Geography*, a town of India, on this ſide of the Ganges. It was ſituated S.W. of Petra Aornos, upon the right of the Indus, and N. of Taxila.

EMBOLIMÆAN and Embolismic, *Intercalary*, is chiefly uſed in ſpeaking of the additional months which chronologiſts inſert to form the lunar cycle of 19 years.

The 19 ſolar years, conſiſting of 6939 days, and 18 hours; and the 19 lunar years only making 6726 days; it was found neceſſary, in order to render the 19 lunar years equal to the 19 ſolar, which make the lunar cycle of 19 years, to intercalate or inſert 7 lunar months, containing 209 days; which, with the 4 biſſextile days happening in that interval, make 213 days, and the whole, 6939 days. See Cycle.

By means of theſe ſeven emboliſmic, or additional months, the whole 6939 days and 18 hours of the ſolar years are employed in the calendar.

In the courſe of 19 years there are 228 common moons, and 7 emboliſmic moons. Their diſtribution is thus: every 3d, 6th, 9th, 11th, 14th, 17th, and 19th, years, are emboliſmic, and conſequently contain 384 days a-piece. And this was the method of computing time among the Greeks, when they uſed the enneadecæterides, or cycle of 19 years. But they did not keep regularly to it, as the Jews ſeem to have done. The Greeks were followed by the Romans till the time of Julius Cæſar.

The emboliſmic months, like other lunar months, are ſometimes 30 days, and ſometimes only 29. See Year.

The emboliſmic epacts are thoſe between XIX and XXIX; which are thus called, becauſe, with the addition of the epact XI, they exceed the number XXX: or rather, becauſe the years, which have theſe epacts, are emboliſmic; having 13 moons a-piece, whereof the 13th is the emboliſmic.

EMBOLISMUS, Εμβολισμος, in *Chronology*, ſignifies intercalation.

The word is formed of εμβαλλειν, *to inſert*. See Embolismic.

As the Greeks made uſe of the lunar year, which is only 354 days, in order to bring it to the ſolar, which is 365 days, they had every two or three years an emboliſm, *i. e.* they added a thirteenth lunar month every two or three years; which additional month they called embolimæus, εμβολιμαιος, becauſe inſerted, or intercalated.

EMBOLUS, the immoveable part of a pump, or ſyringe; called alſo the *piſton*, and popularly the *ſucker*. See Piston, Pump, and Syringe.

The pipe, or barrel of a ſyringe, &c. being cloſe ſhut, the embolus cannot be drawn up without a very conſiderable force; which force being removed, the embolus returns again with violence. This phenomenon the Ariſtotelians attribute to nature's abhorrence of a vacuum.

But the modern philoſophers finding, that in an exhauſted receiver the embolus is eaſily drawn up, though the orifice be ſtopped, prove that it is the preſſure of the atmoſphere on the external parts of the embolus, that makes the difficulty of drawing it up. See Air, Atmosphere, and Suction.

EMBORDERED, in *Heraldry*, a term applied to a border, when it is of the ſame metal, colour, or fur, with the arms.

EMBORISMA, an aneuriſm.

EMBOSSING, or Imbossing, the act of forming, or faſhioning works in relievo, whether they be caſt, or moulded, or cut with the chiſſel, &c.

Emboſſing is one great part of ſculpture; being that which has to do with figures raiſed, or prominent from the plain, or ground; the other part, which makes figures, &c. that are indented, or cut in below the ground, is called engraving. See Enchasing.

Embossing, or *Imboſſing*, in *Architecture*, is that kind of ſculpture wherein the figure is made to ſtand in relief beyond a plane or naked from which it ſeems to riſe. It has three denominations, according to the degree with which it riſes from the ſurface, as baſſo-relievo, mezo-relievo, alto-relievo; or low-relief, mean-relief, high-relief.

EMBOTHRIUM, in *Botany*, ſo named by Forſter from εν, *in*, and Βοθριον, a *little pit*, or *hollow*, alluding to a ſmall cavity towards the point of each petal, in which the almoſt ſeſſile anthers are ſeverally placed. Forſt. Gen. 8. t. 8. Linn. fil. Suppl. 16. Schreb. 62. Willd. Sp. Pl. v. 1. 537. Juſſ. 79. Mart. Mill. Dict. v. 2. Sm. Bot. of N. Holl. 19—29. t. 7—10. Claſs and order, *Tetrandria Monogynia*. Nat. Ord. *Proteaceæ*.

Gen. Ch. *Cal.* none. *Cor.* Petals four, cohering by their lower part into a tube, linear, oblique, at length revolute; their ſummits dilated, concave, bearing the ſtamens. *Stam.* Filaments four, very ſhort, inſerted into the hollow in the tip of each petal; anthers rather large, kidney, or heart-ſhaped. *Piſt.* Germen ſuperior, ſtalked, linear, aſcending, inflexed; ſtyle incurved; ſtigma large, obtuſe, lateral. *Per.* Follicle ſtalked, ſomewhat cylindrical. *Seeds* in two rows, imbricated, compreſſed, each with a membranous wing, generally numerous.

Eſſ. Ch. Petals four. Stamens inſerted into the limb. Follicle containing ſeveral winged ſeeds.

This is a fine genus of the Proteaceous order, chiefly found in New Holland. One of the two original ſpecies, indeed, E. *coccineum*, Linn. Suppl. 128, Cav. Ic. v. 1. 47. t. 65, grows on the cold hills bordering the ſtraits of Magellan, even in Terra del Fuego. Yet this appears by Commerſon's and Forſter's ſpecimens to be a very handſome ſhrub, with all the air of a North American *Kalmia* or *Rhododendron*. The *leaves* are elliptical and entire, ſmooth, pale beneath. *Flowers* ſcarlet, in a denſe terminal cluſter, with

with small linear *bracteas*. *Follicle* short, and rather semi-ovate.

E. *speciosissimum*, Sm. Bot. of New Holland 19, t. 7, is a still finer species, a native of New South Wales, where the natives call it Waratah. Living plants were sent many years ago to the dowager lady de Clifford. This is remarkable for the numerous large scarlet *bracteas*, which envelop its dense spike of the same colour. The *leaves* are obovate and serrated, remarkably obtuse.

E. *silaifolium*, Sm. Bot. of N. Holland, 23. t. 8. flowered at Mr. Grimwood's nursery, Kensington, in 1792, being forced in the stove. It comes also from New South Wales, and has finely divided rigid *leaves*, with loose spikes of white *flowers*.

E. *sericeum*, ibid. 25. t. 9, and some of its varieties are now not rare in the greenhouses about London. See Curt. Mag. t. 862, and Andr. Repos. t. 100 and t. 272.

Mr. R. Brown, in paper on *Proteaceæ*, read last winter before the Linnæan Society, has new-modelled and greatly subdivided the genus *Embothrium*, he having had opportunities of studying its species alive in their native situations, which no other botanist has so fully enjoyed.

EMBOUCHURE, a French term in *Music*, literally the hole in the upper joint of a German flute, in which the performer breathes; but when it is said that a flute player has a good embouchure, it means that his tone is good.

EMBOUL, in *Geography*, a town of Africa, in the country of Senegal.

EMBOWELLING Alive, in *Law*, is part of the punishment of high treason.

EMBRACE *a* Volt, in the *Manege*, is used when a horse, in working upon volts, makes a good way every time with his fore legs. The opposite term to embracing a volt, is beating the dust, which is putting his fore-feet near the place from whence he lifted them.

Embracing the ground is used in the same sense with embracing the volt. A horse cannot take in too much ground provided his croupe does not throw out; that is, does not go out of the volt. See Beat.

EMBRACEOR, in *Law*, a person who, when a matter is in trial between party and party, comes to the bar with one of the parties (having received some reward so to do), and speaks in the cause, or privately labours the jury, or stands there to overlook, awe, or put them in fear; or, who makes any attempt to influence a jury corruptly to one side by promises, persuasions, intreaties, money, entertainments, and the like. (1 Hawk. P. C. 259.) The punishment for the person embracing is by fine and imprisonment; and for the juror so embraced, if it be by taking money, the punishment is (by divers statutes of the reign of Edward III.) perpetual infamy, imprisonment for a year, and forfeiture of the tenfold value.

EMBACERY, the act or offence of embraceors. See Embraceor.

EMBRASURE, in *Architecture*, an enlargement of the gap or aperture of a door, or window, within-side the wall. See Door.

Its use is to give the greater play, for the opening of the door, wicket, casement, &c. or to take in the more light.

The embrasure coming sloping inwards, makes the inner angles obtuse. When the wall is very thick, they sometimes make embrasures on the outside.

Embrasure, in *Fortification*, is an opening made through the upper part of the defences, called the *parapet*, for the purpose of pointing the cannon, so as to be as little as possible exposed to the fire of the enemy. The embrasure must vary in dimensions with the several sizes, or, as they are technically termed, the "natures" of the cannon to be employed in them respectively. It is, however, generally found, that about $2\frac{1}{2}$ diameters of the muzzle of the cannon intended to be mounted give space enough for traversing, and at the same time afford but little opening for the shot from opposing batteries. The embrasure must be cut down in that proportion which may suit the height of the carriages on which the cannon may be mounted: thus, for all under 24 pounders, the height, between the front of the platform, and the crest, *i. e.* the interior, or highest part of the slope, over which the cannon is levelled, ought not to exceed 28 inches, unless the trucks on which the carriages run are unusually high; for all cannon of 24 pounds calibre, and upward, the space above described, and which is called the *genouillere*, ought to be from 34 to 40 inches. The best rule is, to allow eight inches between the crest of the slope and the under part of the cannon, when horizontally laid, thereby to command freedom of action, even when the depression of the line of fire may be considerable: were this not attended to, the cannon might, at such times, be levelled after each discharge, before it could be run up to the *genouillere*; whereby considerable delay would be created. The slope, by which we mean that part under the muzzle of the cannon, is ordinarily made with a descent of about ten or twelve degrees from the crest outwards, to allow of depression, so as to fire either into the ditch, or over the glacis; this slope must necessarily vary according to the situation, and intention of the battery. Thus, in some situations it is found necessary even to invert the slope, the cannon being always pointed above the horizon: this occasionally happens in erecting batteries while besieging a place, where it would be both useless and disadvantageous to cut the embrasures any lower than the lowest direction to which the cannon should be pointed. On the other hand, we sometimes see the slopes made at full forty degrees of depression, in consequence of the battery being intended to command some work, of approach, far below its own level. But, as before observed, when works are constructed upon an ordinary *defilement*, (or branching out,) originating from a level at the exterior of the *glacis*, and proceeding without any increase of elevation to the centre of the place, then from 10 to 12 degrees of depression in the slope will be fully adequate to all the purposes of depression of the cannon. The expansion of an embrasure, that is, its becoming wider exteriorly, than it is interiorly, must depend on circumstances; but we generally find their sides to diverge at an angle of about 12 or 15 degrees from a line passing through the centre of the slope, in a direction with the chace of the cannon when brought up square to the *genouillere*. It should, perhaps, seem proper to make the embrasure spread as widely as possible, for the purpose of including a greater extent of direction; but were such to be practised, the *merlon*, *i. e.* the body of parapet left between any two embrasures, would be so considerably diminished as to afford little protection from the enemy's shot, which would, at the same time, gain admission, obliquely, into the battery, and dismount the cannon by a plunging fire. On the other hand, it is absolutely necessary to give such an expansion as may not only allow the reasonable traversing of the cannon, thereby to cover a greater extent of the approaches, but to prevent the *merlons* from being destroyed by the fire of their own cannon, of which the explosion would speedily bring down the revetements, whether of masonry or of turf, unless ample space were allowed for the concussion of the air created by the discharge to be sufficiently weakened. We have heard of defences that were destroyed rather by the want

want of this confideration, than from the enemy's fire. Where the *merlons* are of folid mafonry, and confequently the thicknefs of the parapet inconfiderable, when compared with that attendant upon *merlons* made of foil, there may be allowed rather more contraction than in the latter cafe, becaufe the explofion is not confined for fuch a diftance. Few cafes, however, can occur, in which the divergence of the fides can come under ten, or exceed fifteen degrees. Where it is not adviseable to keep all the intended embrafures open, or where deception is an object, they are either left unfinifhed, the parapet being left entire, or their fronts are filled up with the fame materials as the front of the parapet. The former is common in fituations where the foil is loofe, and the difficulty of fuftaining the merlons confiderable. When embrafures are cut through fuch parapets, their fides muft be fuftained by *fafcines*, as in the cafe of field batteries, and approaches during a fiege. The latter defcription, *i.e.* the concealed embrafures, form what is called a mafked battery, which generally opens by furprife; the firft difcharge generally ferving to clear away the flight work built up for the purpofe of concealing the fituations of the cannon. Where it is abfolutely neceffary that cannon fhould be allowed to traverfe freely in various directions, fuch, for inftance, as fea-lines, where every gun fhould be made to follow a fhip paffing with a rapid tide, and likewife in block-houfes mounting heavy ordnance on their roofs, no embrafures fhould be made; but the cannon fhould be mounted on carriages traverfing on pivots, and elevated above the body of the ramparts, which may neverthelefs be made high enough to cover the defenders very completely. Cannon mounted in this manner command a great range of direction, and, though not fo well fecured from being difmounted as when placed in embrafures, are pre-eminently ferviceable in fome fituations. Batteries of this defcription are called *barbet batteries*, and fhould, with little exception, be invariably preferred, wherever they are not liable to be oppofed by cannon, or where the force to be acted upon is expected to pafs with velocity, without being able to take a fettled aim at the *barbet*. Mortar batteries have no embrafures, they requiring only a given line of direction, aided by due elevation, to effect their object; and, as both may be given without feeing it, the parapets of fuch batteries are left entire. What are called embrafures on board bomb-ketches, are nothing more than temporary openings made by unfhipping hatches, and by fitting ftout planks at the fides to confine the fparks from fpreading within the veffel. In cafemates, efpecially thofe in the *curtain*, &c. the embrafures are made like the portholes in a fhip; that is, nearly fquare, and allowing the muzzles of the cannon to pafs completely through.

EMBREGMA, an embrocation. The term is derived from εμβρεχω, *to make wet.*

EMBROCATION, or rather EMBROCHATION, *Embrocha*, Εμβροχη, formed from βρεχω, *irrigo*, *I fprinkle*, or *moiften*, in *Pharmacy*, denotes the application of remedies, as oils, fpirits, decoctions, and other liquids, by fprinkling, or even rubbing them on the part affected: this is alfo called irrigation.

Embrocations are only a kind of lotions; they are ufed to remove obftructions, and to relieve pains, numbnefs, and palfies. The pumping ufed in natural baths is properly an embrocation.

EMBROCATION, *gall.* See GALL.

EMBROIDERY, the enriching of a cloth, ftuff, or muflin, by working diverfe figures thereon with the needle, and thread of gold or filver.

The word embroidery is derived from the French *broiderie*, of *broider*, *to embroider*; which fome deduce, by tranfpofition, from *bordeur*, becaufe they formerly embroidered only the borders of ftuffs, whence the Latins alfo call the embroiderers *limbularii*. Du-Cange obferves, that they anciently wrote *aurobruftus* for embroidered with gold, or *bruftus brudatus*, and *brodatus*; whence *broderie.*

That done with filk, flax, or the like, is not now called embroidery; though anciently, and properly, the word denoted all kind of figuring or flourifhing.

The chief ufe of embroidery is in church veftments, cloaths, houfings, guidons, ftandards, &c. The invention of embroidery is attributed to the Phrygians; whence the Latins call embroidered garments "veftes Phrygioniæ," and embroiderers *Phrygiones*. In the "Menæchmi" of Plautus, (act ii. fcene 3), a young woman, defirous of fending her mantle to be embroidered, fays: "Pallam illam ad phrygionem ut deferas, ut reconcinnatur atque ut opera addantur, quæ volo." The Greeks feem to have ufed the words κεντειν and καταποικιλλειν, as we ufe the word embroider.

The embroidery of ftuffs is performed in a kind of loom; that of muflin is done by ftretching it on a pattern already defigned; the former kind is the moft eafy, but the latter admits of the greateft richnefs and variety. The thinneft muflins are the beft for this purpofe; and they are embroidered to great perfection in Saxony.

There are diverfe kinds of embroidery; as *embroidery on both fides*, that which appears on both fides. *Guimped embroidery*, performed either in gold or filver. In this work, a fketch is firft made on the cloth, then they put on a cut vellum, and afterwards few on the gold and filver with filk thread, interfperfing filver and gold cord, tinfel, and fpangles. *Embroidery on the ftamp*, where the figures are very high and prominent, being fupported on wool, cotton, hair, &c. *Low and plain embroidery*, where the figures are low and flat, and without any enrichment between them. It is probable that the covering of the fword of Goliath, which was laid up in the tabernacle as a confecrated memorial of the victory gained by David over that vain-glorious idolater, or the wrapper that enveloped it, was fome beautiful piece of embroidered work. (1 Sam. xxi. 9.) By ftatute 22 Geo. II. c. 36. no foreign embroidery, or gold or filver brocade, fhall be imported, upon pain of being forfeited and burnt, and penalty of 100*l.* for each piece. No perfon fhall fell or expofe to fale any foreign embroidery, gold or filver thread, lace, fringe, brocade, or make up the fame into any garment, upon pain of having it forfeited and burnt, and penalty of 100*l.* All fuch embroidery, &c. found, may be feized and burnt, and the mercer, &c. in whofe cuftody it was found fhall forfeit 100*l.*

EMBRUN, or AMBRUN, in *Geography*, a town of France, in the department of the Upper Alps; chief place of a diftrict of the fame name, fituated upon a high rock on the right fhore of the river Durance, 66 miles S.W. of Grenoble, and 480 miles S. by E. of Paris, is chiefly remarkable for its cathedral, and has a population of 3138 individuals. The canton contains 8 communes and 9667 inhabitants, on a territorial extent of 285 kiliometres.

As chief place of a diftrict Embrun has a fub-prefect, two courts of juftice, and a regifter office. The whole diftrict is extremely mountainous, but the vallies and the declivities of the mountains are uncommonly fertile. It contains five cantons, 36 communes, and 26,968 inhabitants, on a territorial extent of $1472\frac{1}{2}$ kiliometres.

EMBRYO, or EMBRYON, in *Anatomy* and *Phyfiology*, is the child, with its coverings, as contained in the uterus previoufly to the time of birth. It is fuppofed at firft to be in an imperfect ftate, but to contain rudiments of all the parts.

parts, which, when fully developed, make up a perfect animal. The term is derived from the Greek word ἔμβρυον, which has the ſame ſignification, and is formed from ἐν, *in*, and βρύω, *I ſhoot out;* conveying a notion, that the living germ buds forth and expands in the uterus of the mother, as a ſeed is developed in the earth. The term embryo is employed, in its moſt ſtrict acceptation, during the firſt ſix weeks only after conception, but it is often uſed more generally during the whole time of utero geſtation. The young animal, after the firſt ſix weeks, is called a *fœtus;* but we uſe this word alſo to denote the ſame object as ſoon as it can be diſtinctly perceived. By the *ovum*, we underſtand the fœtus, together with its ſurrounding membranes; but that term is ſometimes applied to the latter only, in contradiſtinction to the former. We ſhall conſider, under the preſent article, the progreſs of the uterine contents, until the time of utero-geſtation is completed; the changes, which they paſs through, in the different ſtages of this period; the peculiarities of ſtructure belonging to the fœtus; and the mode of its nutrition and exiſtence.

A ſketch of the progreſs of the germ, after impregnation, from the ovarium into the uterus, and of its developement in the latter cavity, will be found in the article CONCEPTION; a more detailed hiſtory of the anatomy of the ovary and uterus, together with a ſtatement of all the facts that can be aſcertained concerning the mode of impregnation, and its immediate conſequences, will be contained under the head of GENERATION.

When the germ is detached from the ovarium, the mode of its exiſtence differs in the different claſſes of the animal kingdom. In the greateſt number of inſtances it is accompanied by an organized maſs, to which it adheres by means of veſſels, and the abſorption of which is ſufficient to nouriſh and develope it, until it is brought forth into the world. It requires no ſupply therefore from the body of the mother; and is even ſeparated from her by more or leſs numerous and ſolid coverings. The germ, together with the nutritious ſubſtance, and the common envelopes, conſtitute an *egg*, and the animals which propagate their ſpecies in this way, are called *oviparous*. In many of theſe, the germ contained in the egg is not developed and hatched, until the egg has quitted the body of the mother, or has been *laid;* in which caſe fecundation may be performed afterwards, as in many fiſhes, or external heat only may be required, as in the incubation of birds: or, laſtly, the natural temperature of the climate may ſuffice, as in reptiles and inſects. All theſe are *oviparous* animals, properly ſo called. In ſome others, the egg, after having been fecundated, and detached from the ovary, remains in the mother's body, until the young one is developed and hatched, as in the viper, and in ſeveral fiſhes: ſuch are falſely viviparous, or *ovo-viviparous* animals. Mammalia only are truly *viviparous;* their germ is provided with no ſupply of aliment, but derives the materials of its growth from the juices of the mother. For this purpoſe it is attached to the internal ſurface of the uterus, and occaſionally, by accident, to ſome other part, by a kind of root; by an infinite ramification of blood-veſſels, conſtituting the *placenta*. Inſtead, therefore, of being ſeparated by its coverings from the body of the mother, theſe are the medium of a moſt intimate connection between them, eſſentially neceſſary to the life of the germ. Through them there is a conſtant influx of nutritious juices until the embryo is completely developed. At that time the membranes are torn, and the young animal comes into the world, capable of enjoying an independent organic exiſtence, and free from all external covering. The very rare occurrence, of the child being born with its membranes entire, cannot be regarded as an exception to this aſſertion; Wriſberg only ſaw it three times in 2000 births; (ſee his Obſervat. de Structurâ ovi, p. 76.) and it is probably ſtill leſs common on the average. In the mammalia then there is no *egg*, in the ſenſe already explained: the membranes of their *ovum* being an intimate connection between the mother and the germ, by which the former ſupplies the latter with nouriſhment; while the *egg* is entirely detached, and contains, with the germ, the nouriſhment neceſſary for its growth. Hence we ſee that the old and much-conteſted maxim of "omnia ab ovo," cannot be received without great limitation, and is more likely to perplex, by confounding together things eſſentially different, than to impart any additional light to a ſubject already very obſcure.

The following parts, which are of courſe contained in the cavity of the pregnant uterus, make up the human ovum; *viz.* the *placenta*, *membranes*, *navel-ſtring*, *liquor amnii*, and *fœtus*. The three firſt are called alſo the ſecundines or after-birth; as they are expelled, in the act of parturition, after the child. The placenta and membranes every where line the cavity of the uterus, and the former muſt undoubtedly have ſome communication with the veſſels of the mother, although anatomiſts have not yet ſucceeded in demonſtrating the preciſe mode of that connection. In the membranous bag formed by the ſecundines, there is found, beſides the fœtus, a greater or ſmaller quantity of clear fluid, called the liquor amnii. The umbilical chord contains blood-veſſels, by which the circulating organs of the fœtus communicate with the arteries and veins of the placenta.

The ſecundines are all more or leſs gelatinous and tranſparent, and contain no manifeſt fibrous ſtructure. Being deſtroyed after every pregnancy, their exiſtence is temporary; and their organization correſponds to this limited term of duration. They never contain any fat, either in the ſound, or in the morbid ſtate of parts, at any period of utero-geſtation, however the mother or child may be circumſtanced in this reſpect.

The cavity of the uterus, examined immediately after conception, exhibits nothing which can be regarded as the fruits of that proceſs. In a few days, we perceive a tranſparent membranous veſicle, filled with a gelatinous liquor, but offering no appearance of organization or life. Some writers have aſſerted that ova may be found in the uterus of the human ſubject, or of animals, immediately after conception; and have even publiſhed delineations of them in the firſt days of pregnancy. Such ſtatements deſerve no credit. Thoſe modern phyſiologiſts, in whom we can place the greateſt confidence, have found, during the firſt ſeventeen days, nothing but a fluid like white of egg, in which there was no trace of any more conſiſtent body. Mr. Cruikſhank, however, has met with ova in the tubes and uteri of rabbits, at a much earlier period. He found them in the former ſituation on the third day after coition: they were mere points, but the diſtinction of the chorion and amnios could be diſcerned by the aid of magnifying powers. The fœtus was rendered viſible on the eighth day, by pouring vinegar on the ovum. We may regard all obſervations in which an ovum is ſaid to have been diſcovered in the human ſubject, earlier than the twentieth day, as extremely ſuſpicious: indeed, we know of no inſtance, in which it has been obſerved, before this time, by any perſon whoſe teſtimony has ſufficient authority. A round little body is gradually developed in the cavity of the uterus, and may be recognized at the end of the third week. This is the covering of the future, but not yet diſcernible fœtus. The ſurface of ſuch an ovum is probably flocculent from the firſt; this at leaſt is the caſe in the ſmalleſt hitherto delineated,

delineated, and in well preferved fpecimens of very fmall and early abortions. The flocculi are very fine vafcular ramifications, connecting the ovum to the decidua, which refembles in appearance a layer of coagulable lymph produced by inflammation. The refemblance of thefe villi to the roots of a plant, the mode of their infertion in the decidua, and the analogy of their function, in draining from the uterus and conveying to the child, the materials of its fupport, to the office which roots perform, in extracting nourifhment from the foil, has led almoft every writer to compare the rudiment of the future animal to a feed, and to confider its connection with the mother's body as fimilar to that between a plant and the earth. The vafcular proceffes are fmall in very young ova, but enlarge afterwards rapidly till the fecond month: they gradually difappear from two-thirds of the furface of the ovum, and are collected together on the remainder, to be united into a mafs, and form the placenta.

It has not been hitherto determined at what period the ovum becomes connected to the uterus; indeed it is fo fmall, at its firft arrival in the cavity, that the inveftigation is difficult. Cruikfhank fays, that the ovum increafes in the rabbit, to one hundred times its original fize, before it becomes fixed to the uterus. The fize of the ovum, at different periods of pregnancy, cannot be determined with much accuracy, becaufe many abortions are not well formed, and their exact age cannot be well afcertained. Hence different writers contradict each other confiderably in this point. Within the firft month it is not larger than a hazel nut; in the fecond and third it may equal a pigeon's or hen's egg. At the latter period its developement is complete, and the future changes are chiefly in fize. It increafes in proportion to the augmentation of the uterus.

Particular defcription of the component parts of the ovum.— The membranous covering including the fœtus, within the uterus, confifts of feveral diftinct parts, which admit eafily of artificial feparation. The number of thefe has been very varioufly reprefented. The older anatomifts only defcribe two; *viz.*, the chorion and amnios; and divide the former into two laminæ. Moft moderns defcribe three coverings, adding the decidua of Hunter to the two former. Haller mentions four;—the membrana exterior ovi, chorion, membrana media, and amnios. Blumenbach's divifion into the proper, and adventitious coverings is a good one: the latter are the chorion and amnios; the former, the decidua, which covers the ovum and lines the uterus.

The *decidua*, or *membrana caduca*, is the medium of connection between the embryo and the mother. In its appearance, as well as in its mode of formation, it refembles the lamina of coagulating lymph, which is formed by inflamed furfaces. Both membranes are of a yellowifh white colour; both are tender, pulpy, and vafcular. The lamina of lymph is formed by an inflamed membrane; the uterus, before the appearance of the decidua, becomes much more vafcular, and is probably in a ftate of increafed action analogous to inflammation. The developement of this membrane is probably anterior to the arrival of the germ in the uterus, and may be regarded as a meafure of preparation for its reception. It is not neceffary for the formation of the decidua, that the ovum fhould reach the uterus. For when it grows in the ovarium, or in the Fallopian tube, the decidua is formed in the uterus, and that organ is confiderably enlarged; fo that it undergoes, to a certain degree, changes exactly fimilar to thofe which take place in natural pregnancy. It lines the whole internal furface of the uterus, being perforated at the Fallopian tubes, and cervix uteri. Numerous fmall arteries and veins, often feen containing red blood, ramify from its outer furface inwards through its fubftance, and are derived from the veffels of the uterus. It is very thin, and has no perceptible veffels near the cervix uteri; but grows thicker and more vafcular towards the placenta, at the very edge of which it acquires a confiderable thicknefs, and fplitting into two ftrata, is continued over both furfaces of the placenta, but efpecially the inner fmooth furface, blending itfelf there infeparably with the umbilical portion of the placenta. The layer of the decidua, which lies between the chorion and placenta, is in one cafe much thicker than in another. It fometimes forms a fmooth, tender, opaque membrane; but is more frequently reticulated, efpecially towards the edge of the placenta, looking fomewhat like lace. Occafionally there are portions of it a good deal thicker than the reft; which, fhining through the tranfparent chorion, bear fome refemblance to pieces of fat. This layer is generally thicker than that which adheres to the rough, external, lobulated furface of the placenta. It communicates with that other, by means of the proceffes of the decidua, which pafs between the lobules of the placenta, and along the external furface of the umbilical veffels.

We have already obferved, that the decidua adheres clofely, on its external furface, to the uterus, and that this adhefion is effected by means of blood-veffels paffing to the former from the latter. By its means the whole external furface of the ovum grows to the uterus. Its internal furface is very clofely attached to the chorion, fo that their feparation is difficult in recent fecundines. Gentle putrefaction makes them part eafily; and we obferve, on the feparation, numerous white flender threads, emerging from the fubftance of the chorion, and ramifying into fmaller filaments upon the decidua. Thefe appear like veffels by the aid of a magnifying glafs.

As this membrane is an adventitious production of the internal furface of the uterus, formed for the temporary purpofe of a connecting medium between the mother and the child; its office ceafes as foon as the fœtus has quitted its original fituation; and it is confequently fhed whenever a woman bears a child, or fuffers a mifcarriage. Hence its names of *decidua* and *caduca*. As it may be partially feparated into two ftrata, one of thefe is left on the uterus after delivery, and afterwards diffolves, and comes away with the lochia. Frequently a thicker ftratum feparates from the uterus in one part, and a thinner in another. The adhefion of the decidua to the uterus and chorion is ftronger than that of the two layers of the membrane to each other; and hence, probably, we may explain the circumftance of a ftratum being left upon the uterus after parturition. The beft method of feeing the decidua after labour, is to wafh the fecundines well in warm water, to remove the loofe coagulated blood, and then put them into cold water, that the blood, which remains in the veffels, may congeal. The decidua will then be very diftinguifhable by its yellowifh appearance and pulpy confiftence; and numerous veffels may be clearly difcerned in its fubftance. The number and fize of the veffels, paffing from the uterus to the decidua, fufficiently account for the bleeding which always takes place on the feparation. Thefe veffels are reprefented as filled with blood in Hunter's 29th plate, fig. 4: and in their injected ftate in feveral other figures of the fame work; *viz.* the arteries in fig. 3, tab. 24; the veins in tab. 24, fig. 4: and both kinds of veffels coming from the uterus, in tab. 31. The fecond fig. of tab. 29. of the fame work, exhibits the reticulated lace-like appearance of the membrane, when viewed with magnifying powers: in this refpect it much refembles the adventitious productions of coagulating lymph.

The preceding defcription applies to the decidua, as it is found

found in ova of feven, eight, or nine months. The membrane is very different in the earlier periods; and as the defcriptions of anatomifts have been derived chiefly from abortions, in which more or lefs of the decidua may come away with the ovum, and as the appearance of the membrane differs very much in the different periods, the accounts of it are very perplexed, and difficult to underftand. The thicknefs of the membrane is in an inverfe ratio to the age of the embryo. In an early ftate, too, its external furface is covered with numerous loofe and floating flocculi, by which it adheres to the furface of the uterus; thefe are not feen at more advanced periods: they are excellently reprefented in an abortion of the feventh week, in two beautiful figures, forming the vignette of the title page of Soemmerring's Icones Embryonum Humanorum: alfo in Hunter, figs. 1, and 2. pl. 33.

From the time that the ovum has acquired fome fize, until about the fourth month, the decidua not only lines the whole cavity of the uterus, but alfo gives another covering to that part of the chorion, which is not occupied by the placenta. This fecond inveftment is continuous with the former at the edge of the placenta; and, as it appears at this part as if reflected from the exterior layer over the ovum, Dr. Hunter, to whom we are indebted for the moft accurate obfervations on the whole fubject, called it *decidua reflexa;* the addition of Hunteri is often made by foreign anatomifts. He compares, in the explanation of pl. 33, fig. 1, the reflection of the decidua over the ovum, to that of the pericardium over the heart; and the comparifon might be correct, if the exterior portion of the pericardium covered the whole of the heart, as the outer layer of decidua does the whole ovum. According, then, to the preceding defcription, we may diftinguifh three portions of decidua, all, however, completely connected together; 1ft. The exterior portion, covering the whole ovum, and lining the whole uterus, excepting the apertures correfponding to the Fallopian tubes and cervix; *decidua uteri, d. vera, membrana ovi exterior* of Haller, membrana caduca *craffa* of Mayer (Befchreib. des menfchlichen Körpers, v. 5. f. 272.) becaufe it is thicker than the reflected portion, firft membrane of the ovum of Mekel, decidua externa of Sandifort, and external lamella of the Hunterian decidua of fome authors. 2dly. A production over the concave furface of the placenta. 3dly. D. *reflexa*, covering the chorion, and continuous at the margin of the placenta, with the D. uteri. This is Blumenbach's acquired membrane, Mekel's fecond membrane, villofa membrana placentæ, involucrum membranaceum of Albinus, membrana filamentofa of Wrifberg and Roderer, chorion of Haller, chorion fungofum, flocculentum, &c., fpongy chorion, reflected vafcular membrane, &c. Denman calls it connecting membrane, and Baillie decidua chorii. A cavity muft neceffarily be intercepted between this and the d. uteri. The diftinction of thefe two parts, and their relative pofition, are beft feen in the plates of Hunter; as in fig. 1, of tab. 28: alfo in a perpendicular fection of the uterus, containing an ovum of three months, reprefented in tab: 32, where the letters *k*, *l*, *m*, *n*, *o*, reprefent the two deciduæ, the angle of reflection, and the cavity left between them. The fame facts are alfo reprefented in two abortions, figs. 1, 2, 3, and 4, of tab. 33. The d. reflexa covers the fhaggy veffels of the chorion, which feem to be implanted in it. In proportion as pregnancy advances, it becomes gradually thinner and thinner, fo that at the fourth month it forms an extremely fine layer covering the chorion. It comes at the fame time into more clofe contact with the d. uteri, and, at length, the two adhere together. Yet the membrane diminifhes in thicknefs, and continues to decreafe until parturition. How it comes to pafs, that the decidua fhould envelope the ovum in the way already defcribed, is mere matter of fuppofition, and does not admit of being fhewn by direct demonftration. In two examinations, mentioned by Dr. Baillie as having been performed with great care at an early period of pregnancy, the decidua was already formed, but no ovum could be difcovered.

In the 18th fig. of his work already quoted, Soemmerring has given an excellent view of the external furface of an ovum of five months. It appears on clofe infpection covered with fine and thinly fcattered flocculi, which are the moft numerous and long in the fituation of the placenta. The firft, or external coat, (the decidua,) is continued into the placenta, or the placenta is extenuated into this membrane, in fuch a way, that we might, with equal propriety, either regard the placenta as the thickeft portion of the decidua, or the decidua as an extenuated production from the placenta. The decidua grows gradually thinner as we recede from the placenta, fo that its thinneft portion is precifely oppofite to the placenta.

The *chorion* is that covering of the ovum which is placed next in order to the decidua. It is the firft proper membrane of Blumenbach, the third membrame of Mekel, and the fecond of many anatomifts; the membrana media of Haller, chorion pellucidum or læve.

It is a firm and ftrong membrane, forming a complete bag, which includes the amnios and child. It adheres firmly to the concave furface of the placenta, and in that fituation is thicker, and covers the great divifions of the umbilical veffels; being clofely attached to the amnios at the infertion of the umbilical chord. At firft it is nearly tranfparent, and tender in its texture: as the ovum increafes, it becomes more opaque, ftronger, and of a yellowifh colour. We have mentioned already how its external furface adheres to the decidua, and the threads connecting them together, which feem to be veffels. Thefe are the only veffels which the membrane poffeffes.

The external furface of the chorion is covered completely with flocculi in the firft month of pregnancy. A great abundance of thin tender threads of different thicknefs arife from it. Thefe divide and fubdivide in a very minute manner, and the neighbouring ramifications join each other. They are extremely fmall on very young ova; but they cover the whole furface at the end of the firft, and in the fecond month. They difappear from fome parts in the third month; and collect clofer together towards the upper part of the ovum, in order to form the placenta.

The decidua reflexa, covering this external furface of the chorion, unites the flocculi together; which penetrate it, and are implanted in the decidua uteri. Many erroneous names and reprefentations have arifen from this ftructure, becaufe the proceffes of the chorion have been regarded as belonging to the d. reflexa; and hence many of the names applied to that membrane have arifen.

In the fourth, fifth, and fixth months the chorion is fmooth on the greateft part of its external furface. The d. reflexa, which is now thin and fcarcely recognizable, is clofe upon it. When the placenta is formed, the external furface of the chorion is firmly attached to its concavity.

The internal furface of the chorion is fmooth, and united to the amnios. In the firft month there is a confiderable interval between the two membranes, filled with a clear aqueous fluid, probably produced by the veffels of the chorion: this fpace is foon diminifhed; the amnios growing fafter than the chorion, the two membranes foon come in contact;

contact. In the third month they lie near together, and are loofely connected by a tender gelatinous medium.

Twins have a double chorion, as well as amnios; but are covered by a common decidua reflexa.

Amnios; the fecond proper membrane of Blumenbach; and fourth membrane of Haller and Mekel; is found univerfally in animals. In man it forms an oval-bag, including a certain portion of fluid, and the fœtus. It is a thin tranfparent membrane, of tolerably firm confiftence. Its external furface is connected, in the way already defcribed, with the chorion, from which it is eafily feparable. It lines the concave furface of the placenta, and terminates, apparently, by a clofe adhefion at the infertion of the navel-ftring, where the chorion alfo feems to end. The gelatinous fubftance connecting the two membranes adheres more clofely to the amnios than to the chorion, and hence the former membrane has a rough appearance, when feparated. The internal furface is every where perfectly fmooth. In birds and quadrupeds it poffeffes manifeft veffels; but none in the human fubject.

The allantois, which was formerly enumerated among the membranes of the human ovum, is now known to be peculiar to quadrupeds.

There is, however, a fmall membranous bag, named *veficula umbilicalis,* found in the early months of pregnancy between the amnios and chorion. This poffeffes an elliptical figure, and contains a clear fluid. It contracts into a thin and round thread, which runs along the navel-ftring, and divides into two at the infertion of the umbilical chord in the child's body. They are afterwards loft upon the vifcera. This veficula can only be feen until the third month, and in very frefh abortions; for it is fo delicate that it decays very quickly; and it is extremely difficult to trace the thread from it through the umbilical chord. Its fize is in an inverfe ratio to the age of the embryo.

Liquor amnii is the name given to the fluid which fills the cavity of that membrane. This is perceivable as foon as the ovum can be difcerned; it diftends the membranes, and preferves their rounded form. Its quantity is the largeft, in proportion to the fize of the embryo, in the firft month of pregnancy; fo that in the firft and fecond it confiderably exceeds the weight of the fœtus, which muft confequently be loofely fufpended in the fluid. The fœtus weighs more in the third month than the liquor amnii; and, as it touches the membranes in the fifth, the proportional quantity of the water has very greatly decreafed; fo that it merely filled up the intervals caufed by the inequalities of the child's body. Stein, an experienced German writer, ftates that the weight of the fœtus and the amniotic fluid fhould be equal about the middle of pregnancy; and that it muft be regarded as an unnatural appearance, if the latter exceeds the former in the fixth month. It continues afterwards conftantly decreafing relatively to the increafe of the child. The quantity varies greatly in different fubjects; from one to two pounds is the ordinary proportion at the period of nine months; but it may be much more or lefs. It is a clear yellowifh fluid; but fometimes differently coloured and obfcure. In its pure ftate it poffeffes no fmell, and a mild faltifh tafte. Heat and alcohol coagulate it in the recent ftate; but the chief bulk of it is aqueous. The fources of the fecretion are unknown. The abfurd opinions, by which it has been fuppofed to proceed from the fkin or various other parts of the fœtus, are fufficiently refuted by the fact of its exiftence when there is no fœtus. The amnios poffeffes no apparent veffels. For an account of the chemical properties of this fluid, fee the article Amnios.

The old opinion of the ufe of the amniotic fluid in nourifhing the fœtus cannot be fuftained; for deglutition could not be performed without the prefence of air; many fœtufes are born with the mouth clofely fhut, and others have grown to the full fize without any mouth at all. The great ufe of the fluid feems to be that of protecting the fœtus from external violence; and hence we find it moft copious when the child is youngeft and moft delicate in texture, to prevent its different parts from adhering together, or to the furrounding membranes. The bufinefs of parturition, as far at leaft as the dilatation of the os uteri is concerned, is alfo facilitated by the liquor amnii.

The *umbilical chord, funis* or *funiculus umbilicalis,* or navel-ftring, made up of three large veffels twifted together, united by more or lefs gelatinous fubftance, and conftituting, in confequence of certain convolutions of the veffels, an irregular rope, rather lefs in general than the fize of the little finger, is fixed at one end to the child's navel, and at the other to the placenta. This being the organ of communication, through which the materials of growth and nourifhment are derived to the fœtus from the mother, conftitutes a moft effential part of the fecundines, and can never be deficient. It paffes through the liquor amnii, from the child to the reft of the fecundines; is commonly about two feet long, but may be no more than one foot, or on the contrary exceed four feet. Wrifberg once faw it only feven inches long; and it was neceffary to cut it in the courfe of the delivery. Its moft frequent length is between 18 and 22 inches. The younger the fœtus, the fhorter is the chord proportionally. It is alfo thicker relatively to the fize of the fœtus, as that is younger. It is ufually turned round fome part of the child's body; very commonly round the neck, which it has been feen to encircle four times and a half.

From the important function performed by the navel-ftring, we fhall expect to find it as foon as the embryo itfelf is perceptible; and confequently it is feen as foon as the fœtus itfelf is vifible.

The veffels of the chord are two umbilical arteries, and one umbilical vein. The two arteries are of equal fize, and poffefs ftrong coats, fo that their fection prefents a circular area. In rare inftances there is only one. The umbilical arteries are a continuation of the internal iliacs; which, inftead of defcending into the pelvis afcend along the fide of the bladder to the umbilicus. When there is only one umbilical artery, the internal iliac of one fide only is reflected along the bladder. The internal iliac which in the adult is no larger, but rather fmaller than the external, is confiderably the largeft of the two in the fœtus. It paffes obliquely from the fide of the pelvis to that of the bladder, and takes the name of umbilical or hypogaftric; croffing the ureter in fuch a manner that that tube lies internally, and the artery externally. It afcends along the fide to the fundus of the bladder, and proceeds over the furface of the peritoneum, to the umbilicus. Thefe veffels make very numerous convolutions and turnings which differ confiderably in different fubjects: and hence they are much longer than the length of the chord. In the fituation of thefe turns, the diameter of the veffels will appear contracted, and thefe contractions are the *quafi-valvulæ* of Hoboken.

The third veffel of the chord is the umbilical vein, which arifes from the placenta, forms numerous convolutions, in company with the arteries, and enters the child's body at the umbilicus. Paffing over the furface of the peritoneum, it arrives at the fufpenfory ligament of the liver; defcends along its anterior margin to the foffa, dividing the two lobes; and there enters the fubftance of the liver. It diftributes feveral branches to this vifcus, particularly to its left

left lobe, and ends by an anaſtomoſis of its trunk, with the left branch of the vena portarum. From the veſſel formed by this union a ſmall canal, about three quarters of an inch in length, is continued into the inferior vena cava, under the name of *ductus venoſus*.

The umbilical vein is much larger than the artery, and its ſides collapſe when divided. It is ſaid that two veins have been ſeen; but Dr. Hunter never met with a caſe; quadrupeds have two. The umbilical veſſels give off no viſible branches till they come to the placenta; then the two arteries anaſtomoſe, commonly by a croſs canal, nearly of the ſize of one of the arteries.

" There is a great variety," ſays Dr. Hunter, " in the twiſting of the veſſels of the navel-ſtring. Sometimes they are uniformly and cloſely twiſted like a rope, in their whole courſe; and ſometimes they run almoſt ſtraight and parallel, eſpecially in that part of the ſtring which is towards the placenta; for near the fœtus it is almoſt always more or leſs twiſted. In ſome navel-ſtrings there is a great irregularity, from ſolitary turnings of particular veſſels, commonly called knots, as we ſee in twiſting a cord, where ſome of the conſtituent threads are longer and therefore looſer than others. The end of the navel-ſtring which is next the placenta, is always leſs twiſted, and more uniform than the end which is next the fœtus.

" Whatever be the cauſe, in moſt which I have attended to, the twiſting of the navel-ſtring has been in the ſame direction, *viz*. ſuch as would be produced in turning the child round upon the navel, as a centre, by puſhing its head towards the right ſide, and its feet to the left. In two and thirty preparations now before me, four only are twiſted the contrary way; and of the twenty-eight which are twiſted in the common way, three have the contrary twiſt for ſome inches, at the extremity, which was towards the fœtus." The veſſels appear to be ſtraight in young embryos. When the chord is very long, *true* knots are formed in it; as diſtinguiſhed from thoſe which ariſe merely from projections of particular veſſels. Theſe are not ſuppoſed in general to affect the communication between the mother and child, but Dr. Hunter thinks he has ſeen two caſes in which it was obſtructed from this cauſe. The true knots are ſometimes double, as if twice tied; and in very rare caſes treble.

The *urachus* is another part belonging to the umbilical chord; it is a ſmall fibrous ſtring aſcending from the fundus of the bladder to the navel, between the umbilical arteries, and growing more ſlender as it proceeds. In the navel-ſtring it is hardly perceptible, except near the fœtus; it is like a fine thread, a little more white and opaque than the reſt. When once found near the fœtus, it may be traced, with a little trouble, nearly the whole length of the ſtring. This part is a canal in the embryo of animals, leading from the bladder to the allantois; but the latter membrane not exiſting in the human ſubject, the urachus is ſolid. Portal, who has inveſtigated the matter very attentively, found the urachus to conſiſt of four threads in embryos of five and ſix months. Theſe paſs together from the navel to the bladder; then ſeparate and expand over the latter organ. In the eighth and ninth month, theſe threads can hardly be ſeparated. The urachus altogether is largeſt in the youngeſt embryos.

The covering of the navel-ſtring, which is ſmooth and poliſhed, is conſidered to ariſe from a reflection of the amnios. Both that membrane and the chorion are firmly adherent to the chord, at its connection with the placenta; and the covering of the chord itſelf is moſt firmly connected with the ſubjacent ſubſtance, ſo that it cannot be ſeparated like a diſtinct membrane. The integuments of the abdomen are continued for a ſhort ſpace over the chord, and there is an abrupt line obſerved at their termination, beyond which not even the cuticle is continued. The ſeparation is much more ſtrongly marked, when the integuments are minutely injected, by the ſudden ending of the injection, no veſſel extending into the chord. The tying of the chord without the leaſt pain is a ſufficient proof that it has nothing to do with the ſkin.

The ſtrong connection between the abdomen of the child, and the chord, is produced by the three umbilical veſſels, penetrating the tendinous opening of the linea alba. They run externally to the peritoneum, which lies behind them entire and unperforated. The oppoſite end of the funis is connected with equal ſtrength to the placenta, both by the continuation of the veſſels into that body, and by the cloſe adheſion of the chorion and amnios.

Beſides the veſſels, the urachus, and the coat of the navel-ſtring, it contains nothing but a fine cellular ſubſtance, loaded with a tranſparent ropy fluid, giving the part both firmneſs and bulk. By touching the cut ſurface of the freſh funis, and removing the finger ſlowly, we ſee the fluid ſo tenacious and ductile, as to be drawn out into fine threads ſome inches in length. When it has been kept ſome days, the fluid loſes entirely that glutinous quality, and tranſudes like water; by which means the ſtring loſes much of its bulk. In this ſtate, if a ſmall blowpipe be puſhed into the interſtices of the veſſels, and proper ligatures be made, the whole interſtitial ſubſtance may be rendered emphyſematous and white. In this condition it may be dried, and then cut up to ſhew the cellular ſubſtance more diſtinctly. The great variety that is obſerved in the thickneſs or ſize of the navel-ſtring in different parts, and in different caſes, depends principally on the quantity of the cellular ſubſtance, and not on the bulk of the child.

Dr. Hunter thinks that " the winding courſe of the veſſels in the navel-ſtring prevents their being much affected by any ſtretching force, and the firmneſs of the interſtitial ſubſtance, protects them againſt dangerous compreſſion. Theſe accidents might otherwiſe perhaps have occaſioned frequent miſchief, eſpecially where there is a large child, and a ſmall quantity of the liquor amnii. In ſuch a caſe the navel-ſtring paſſing under the arm or ham, or in the groin, might have been compreſſed, ſo as to prevent the return of the venous blood at leaſt. The ſame thing might have eaſily happened, where a knot is formed upon the navel-ſtring."

The umbilical arteries divide in the placenta into ſmaller and ſmaller ramifications; and their ultimate branches communicate with the umbilical veins; injected fluids at leaſt return very readily by this courſe. The vein is made up by the union of the minute branches into larger and larger trunks. In the early periods of pregnancy, the umbilical veſſels branching out very minutely, conſtitute the flocculi of the chorion.

Placenta.—This, together with the membranes, makes a complete bag lining the uterus, and containing the child. As Dr. Hunter has done much in elucidating its ſtructure, and has given a very good account of the ſubject, we ſhall avail ourſelves chiefly of his labours.

Its figure is commonly round and flat; it is about an inch in thickneſs and a ſpan in breadth. It grows gradually thinner towards the edge, ſo as to render the change from the placenta to the membranes more imperceptible. When the cellular part is well filled with wax, or any fluid, it is at leaſt two inches thick. Its ſhape is often oblong or triangular, or irregular; and ſometimes there is a ſmall lobe or two entirely diſtinct from the reſt. The outer ſurface, which adheres to the womb, and is therefore naturally convex, is rough, tender in its fubftance, commonly covered with blood, lightly fubdivided into fmaller conftituent lobes, and, to a common obferver, apparently poffeffing no blood-veffels, or at leaft none of any confiderable fize. The internal furface, naturally more or lefs concave, is gloffy, hard or compact in its texture, and beautifully marked with the ramifications of the umbilical veffels. The navel-ftring, which produces thefe branching veffels, is inferted fometimes into the very centre, but more commonly a little nearer the edge, and often into the very edge of the placenta. In four different inftances, Dr. Hunter faw the navel-ftring terminate on the infide of the membranes, at the diftance of five or fix inches from the placenta. In all thefe cafes the umbilical veffels parted from one another even to confiderable diftances in their courfe upon the membranes, and came to the edge and inner furface of the placenta at different places, even at the oppofite parts. The termination or infertion of the navel-ftring, wherever it happens to be, makes the centre of ramification for the large veffels on the internal furface of the placenta.

The human placenta, like that of quadrupeds, is a compofition of two parts intimately blended, *viz.* an umbilical or infantile, and an uterine portion. The former is made up by the ramification of the umbilical veffels of the fœtus; the other is a certain portion of the decidua, produced, as we have already defcribed, from the furface of the uterus. The umbilical portion of the placenta is made by a regular ramification of the arteries and veins of the navel-ftring into fmaller and fmaller branches, without any lateral anaftomofis, fo that when unravelled by gentle putrefaction, motion, and wafhing, this part takes on the appearance of a tree whofe branches divide to almoft infinite minutenefs, not only towards its outer furface, but every where through its fubftance.

The two umbilical arteries anaftomofe freely by a canal of communication juft where they are going to branch out upon the placenta, fo that by injecting one of them, the other is readily filled alfo. Every branch of an artery is attended with a branch of a vein; thefe cling to one another, and frequently, in the fubftance of the placenta, entwine round one another as in the navel-ftring.

Injections prove, both in the human fubjects and in quadrupeds, that the umbilical arteries terminate in the veins of the fame name, and not in the veffels of the uterus; and that the blood paffes from the arteries into the veins, as in other parts, and fo back to the child again. If the placenta be whole in all its fubftance, which is feldom the cafe, and its blood-veffels be pretty well emptied of their blood, any fubtile injection thrown into an artery will fill the arterial fyftem through the whole fubftance of the part to an amazing degree of minutenefs, and return fo freely by the veins as to fill them very generally and equally. In the fame manner the whole umbilical fyftem may be filled by injecting the vein, the fluid returning from the veins into the arteries. In both thefe experiments the injected fluid is confined to the umbilical vafcular fyftem, none efcaping at the external furface of the placenta, neither by large nor fmall orifices, whether of veins or arteries.

When a placenta is finely injected, and then fteeped, and frequently wafhed in clear water, it is evident that the umbilical veffels do not reach even the outer furface of the placenta, but are only feen through a membrane (decidua,) which covers all that furface. It is rough or ragged, like the inner furface of the uterus, to which it adheres, and by its whitenefs becomes very diftinct from the vafcular injected part of the placenta, over which it is fpread. It becomes ftill more diftinguifhable when the part is put into fpirits, which render it more opaque and whiter. This membrane is an efflorefcence or production of the inner membrane of the uterus, and is analogous to the uterine fungi of quadrupeds. It receives no veffels, demonftrable by the fineft injections, from thofe of the navel-ftring, yet it is full of both large and fmall arteries and veins. Thefe are all branches of the uterine veffels, and are readily filled by injecting the arteries and veins of the uterus; and they all break through in feparating the placenta from the uterus, leaving correfponding orifices on the two parted furfaces.

This decidua, or uterine portion of the placenta, is not a fimple thin membrane expanded over the furface of the part, it produces a thoufand irregular proceffes which pervade the fubftance of the placenta, as deep as the chorion or inner furface; and are every where fo blended and entangled with the ramifications of the umbilical fyftem, that no anatomift will perhaps be able to difcover the nature of their union. While thefe two parts are combined, the placenta makes a pretty firm mafs; no part of it is loofe or floating. But when they are carefully feparated, the umbilical fyftem is evidently nothing but loofe floating ramifications of the umbilical veffels, like that vafcular portion of the chorion which makes part of the placenta in a calf; and the uterine part is feen fhooting out into innumerable floating proceffes and rugæ, with the moft irregular and moft minutely fubdivided cavities between them that can be conceived. This part anfwers to the uterine fungus of the quadrupeds. In a placenta at nine months the two conftituent parts can only be feparated by fome degree of putrefaction, and gentle rubbing and wafhing; but this operation always deftroys the uterine portion, which is more tender, and yields to putrefaction fooner than the other. In the placenta of an earlier age, the union of the two conftituent portions is lefs intimate, and they may both be preferved very entire, like the vafcular chorion and fungus of the quadruped. Dr. Hunter feparated them in a conception of four months, and left the uterine portion attached to the infide of the uterus.

The two portions of the placenta are fo interwoven with each other as to leave innumerable fmall vacuities, with free communications, through the whole fubftance. If this cellular ftructure be inflated or injected, the placenta, like the corpora cavernofa penis, acquires a very confiderable increafe of thicknefs, and fubfides again when the fluid efcapes. This cellular receptacle in the placenta cannot be completely filled after it has been parted from the uterus, becaufe then the fluid, which we may by any contrivance throw in, will be difcharged at innumerable orifices on the outer furface of the placenta; but while it remains attached to the uterus, all the cells may be eafily and completely filled by injecting any fluid into the arteries or veins of the uterus. Thefe veffels, and thefe only, have a demonftrable communication with the fpongy cells of the placenta, which receive the maternal blood from the arteries of the uterus, and give it back into the veins of that part. Both thefe veffels pafs in the decidua, and the larger branches of both, with little or no ramification, terminate abruptly in the cells. The arteries are all much convoluted and ferpentine; the larger, when injected, are almoft of the fize of crow-quills. The veins have frequent anaftomofes, pafs in a very flanting direction, and generally appear flattened; fome of them are at leaft as big as a goofe-quill, and many of them are very fmall. They are very numerous round the edge of the placenta, and many run for a little way, in the direction of tangents to the circle, in the very angle between the membranes and the placenta.

In feparating the latter part from the uterus, which can be effected with very flight force, all thefe veffels are neceffarily torn through; and then each broken veffel has an open mouth on the inner furface of the uterus, and a correfponding orifice on the outer furface of the placenta. They may be readily obferved on a frefh placenta, as foon as it has come away in a common labour. Air blown into the cellular part by thrufting in the end of a blow-pipe, rufhes out readily by the open mouths both of the arteries and veins.

While the placenta remains adhering to the uterus, injection will pafs either from the uterine arteries or veins into the cells of that organ; and, after filling thefe cells, it returns by the oppofite order of veffels to that by which it was thrown in. Hence, if we wifh to inject both fyftems in the gravid uterus, we fhould fill the firft only moderately, and then the other.

The venous fyftem of the decidua and uterus may be filled with air from the cells of the placenta. Introduce a blunt probe through a flit in the coat of the navel-ftring, and force it into the cells of the adjacent part of the placenta; then, withdrawing the probe, infinuate an injecting pipe, and tie it firmly with a broad thread round the navel-ftring. By that pipe you may fill the whole placenta uniformly in its cellular part, and likewife all the venous fyftem of the uterus and decidua, as readily and fully as if you had fixed the pipe in the fpermatic or hypogaftric vein; fo ready a paffage is there reciprocally between the cells of the placenta, and the uterine veffels. It is as much reciprocal, and more largely open, than between the corpus fpongiofum and the veins of the penis.

From all his experiments, repeatedly and diligently made, Dr. Hunter concludes, that the human placenta, like that of the quadruped, is compofed of two diftinct parts, though blended together, *viz.* an umbilical, which may be confidered as a part of the fœtus, and an uterine, which belongs to the mother; that each of thofe parts has its peculiar fyftem of arteries and veins, and its peculiar circulation, receiving blood by its arteries, and returning it by its veins; that the circulation through thefe two parts of the placenta differs in the following manner; in the umbilical portion the arteries terminate in the veins by a continuity of canal, whereas in the uterine portion there are intermediate cells, into which the arteries terminate, and from which the veins begin. Though the placenta be completely filled with any injection thrown into the uterine veffels, none of the wax finds its way into any of the umbilical veffels; and in the fame manner fluids injected into the umbilical veffels can never be pufhed into the uterine, except by rupture or tranfudation.

Several views of the arteries and veins, which pafs from the uterus to the placenta, are exhibited in Dr. Hunter's plates; fee Tab. 15. fig. 1. Tab. 19. Tab. 29. fig. 1. and Tab. 30. and the fame veffels on the furface of the uterus in fig. 3. Tab. 10. and fig. 2. Tab. 28.

It has been ftated already, that the human placenta is made of a fingle mafs; but fome varieties have been obferved in this refpect. It poffeffes fometimes a fmall appendix; or it may be made up of three or more fmall pieces, united by means of the chorion. Wrifberg faw a placenta compofed of feven pieces. Where there are twins, or three children, the placenta is ufually fingle; but there may be two or three feparate ones united by the amnios, which forms the partition of the bags containing the children.

The Fœtus.—The proportions of parts, and confequently the whole figure of the fœtus, differ very much before birth, from that which they poffefs afterwards; and they differ alfo very confiderably at different periods of utero-geftation. Influenced by their opinions of the beauty and due proportions belonging to the human frame in later ftages of exiftence, many have called the fœtus, in its early periods, fhapelefs and deftitute of fymmetry; not reflecting that a different figure and relation of parts belongs, in the order of nature, to the age we are fpeaking of, and that this may ftill be beautiful and fymmetrical according to the ftandard of that age. While the rofe is ftill inclofed in the calyx, its appearance is very different from that which it exhibits when the petals burft forth from their confinement, and the whole flower is difplayed in its mature and perfect ftate: yet we do not deem the rofe bud inelegant or imperfect in its form. We may affirm, on the fame principles, that every age in the human fubject is diftinguifhed by its peculiar kind of beauty; that the embryo, the fœtus, the infant, the youth, &c. poffefs their refpective proportions, thofe of each differing from the others; and confequently, that an embryo may, with propriety, be termed beautiful, if its formation correfpond to the ftandard of its age. It is true, indeed, that the fœtus in abortions is often ill-formed, being fmaller than it fhould be, deviating from the ufual proportions, or monftrous; and, very probably, this mal-formation may be one of the caufes why fuch embryos die, and are feparated with the ovum from the uterus; juft as we fee that mif-fhapen or worm-eaten fruits feldom arrive at maturity, but have their further growth impeded by that very caufe. To the fame purport it is obferved by Autenrieth, § 8, "that he found three monftrous fœtufes, out of nineteen, whofe parts could be diftinguifhed; that Wrifberg met with two among five, which he examined; and Ruyfch two in twelve; the proportion of the whole being feven in twenty-nine. This large number, (if we confider, at the fame time, that all the collections of anatomical preparations abound with monftrous fœtufes, which have died immediately after birth, while adult monfters are extremely rare,) renders it very probable that nature employs the fhort, but effectual means of extirpation, in order to preferve the genuine figure of the human frame, and that one model only, of all thofe into which the human frame may pafs, is endued with permanent vital powers." This author obferves alfo, that a greater number of abortive embryos are of the male than of the female fex; and this obfervation is confirmed by Soemmering, who extends it likewife to monfters.

It is extremely difficult to afcertain at what exact time the fœtus of an ovum becomes vifible; becaufe it is almoft always impoffible, in the human fubject, to afcertain the date of the impregnation. Dr. Baillie ftates, that he faw a preparation in the poffeffion of Dr. Combe, where, from peculiar circumftances, it had been afcertained that the conception was twenty-two days old, and where the fœtus was vifible, although extremely fmall. In an abortion, which came away after the firft ceffation of the catamenia, diffected by Blumenbach, and exhibited in the 4th table of his "Inftitutiones Phyfiologicæ," the amnios was about the fize of a large pea, but no veftige of the fœtus could be difcerned.

The following account of the fucceffive developement of the embryo is derived chiefly from Soemmering's work, "Icones Embryonum Humanorum," which is chiefly devoted to this fubject, and exhibits a moft beautiful feries of embryos from the earlieft period to the fifth month.

Generally fpeaking, the embryo grows the moft rapidly in the firft weeks after conception; the rate of its progrefs afterwards diminifhes to the ninth month: this growth, however, does not proceed uniformly at all times. It is gradually retarded in the fecond month, accelerated in the third; ftopped again in the beginning of the fourth, and continued

continued more rapidly from the middle of that month to the fixth; from which time it is again retarded till the period of maturity. A fimilar obfervation has been made concerning the chief vifcus of the embryo, by Walter, the fon. (Annot. Acad. de hepate, § 8.) He found that the rapid and prodigious growth of the liver did not continue beyond the end of the fourth month. It appears, moreover, that different parts of the body of the embryo grow very differently; and that fome arrive at a certain degree of perfection fooner than others.

The younger the embryo, the larger is the containing ovum. That part, therefore, in proportion to the fœtus, is the largeft, moft capacious, thickeft, and firmeft, in the earlieft periods after conception; and the fmalleft, thinneft, and moft tender, at the complete term of utero-geftation. At the middle of pregnancy it exhibits an intermediate ftate between thefe extremes.

In the firft and fecond months the embryo is completely bent; a little ftraightened in the following month, and afterwards, as the limbs increafe, convoluted into a kind of oval fhape. The head is brought forwards on the cheft during the whole period of utero-geftation. The younger the embryo, the greater is the bulk of the head, compared to that of the trunk; or, what is equivalent, the trunk is fmalleft at that time. The head muft confequently be the largeft when it can be firft diftinguifhed. In the firft month the head confiderably exceeds the fize of the reft of the body. Its growth goes on lefs rapidly after this time, and does not exceed that of the trunk; fo that at the age of five months, it bears a moderate proportion to the body. The younger the embryo, the fmaller is the face, in comparifon to the cranium. The pyramidal proportions of the temporal bones are particularly large in the firft month.

The neck, correfponding in fome degree to the fize of the head, is large and fhort; fo fhort, indeed, that it can hardly be recognized at all in the firft and fecond months, being marked by the flighteft conftriction. It is fcarcely diftinguifhable before the third month, on account of the head being bent forwards.

The extremities are fmalleft, in proportion to the trunk, in the youngeft embryo. They firft fhoot out from the trunk in the form of hemifpherical tubercles, like buds from a tree; are protruded a little further, and elongated in the fecond month; at which time, the upper limbs may be diftinguifhed into arms and hands, and the lower into legs and feet. Then the fingers arife, like little papillæ from the hands; the arms and fore-arms being more developed; at the fame time thighs, legs, and feet, may be diftinguifhed in the lower limbs, but the latter are ftill without toes. Thefe, however, fhoot out at the end of the fecond month, the fingers being at the fame time elongated. In the three firft months the upper limbs exceed the fize of the lower ones; they become nearly equal in the fourth; and in the fifth the lower ones have acquired that fuperiority which they afterwards retain.

The lower part of the fpine is at firft curved round towards the belly, fo as to refemble fomewhat the tail of a quadruped, when thrown between the hind legs. This prominence, fometimes called *tuber coccygeum*, is largeft in the two firft months, projecting beyond the lower limb, fo as to give the fpine a keel-like form. It gradually difappears in the third month, as the lower limbs are elongated.

The eyes are firft obferved, of the organs of fenfe, and are larger and more prominent as the embryo is younger. They are feen very diftinctly in a beautiful and, as it fhould feem, perfectly formed fœtus of the firft month, not larger than a middle fized pea, reprefented by Soemmerring. They may always be recognized, in the very youngeft embryos, by a deep black circle. Before the fecond month either the eye-lids are open, or fo thin, that the black pigment of the bulb is difcerned through them. Soemmerring thinks that the eye-lids are really open until about the tenth week, when they are clofed. After that time he has always found them firmly fhut, and the flit between them fhorter than the diameter of the globe. The circle of the iris, which is of the deepeft black, is completed fooner on the outer than the inner fide.

Very fmall pores are feen in the fituation of the external ears about the feventh or eighth week; the middle of the helix then rifes from the head, and is followed fucceffively by the tragus, antihelix, antitragus, lobulus, and upper part of the helix. The ears are completed by the formation of the concha and fcapha in the fifth month. Their proportions are ftill very different from thofe of the adult. Two fmall holes at firft occupy the fituation of the nofe, which itfelf gradually fhoots out about the feventh week; the dorfum, alæ and feptum are diftinguifhable in the eleventh week. The mouth is largeft in the firft months; and is open, without any lips. The latter parts are diftinctly formed about the eleventh week, and are firmly approximated, fo as to clofe the mouth, from the third month.

The genital organs, fcarcely diftinguifhable in the firft weeks, have acquired a confiderable fize at the commencement of the third month. The penis is large and prominent about the twelfth week, and the glans uncovered; the fcrotum is fmall and empty until the 9th month. Sometimes it is loofe, and diftended with water; fometimes corrugated. A fmall flit is fometimes difcerned in the female in the fecond month. The clitoris is large and prominent in the third month, like the correfponding organ of the male; fo that a female embryo, viewed laterally, might be miftaken for one of the other fex. About the fourth month the clitoris hangs more downwards, but is ftill large even in the fifth.

The umbilical chord at firft is fhort, but large; it fometimes equals the trunk in very fmall embryos. Afterwards its length increafes, but the relative breadth diminifhes. Its furface is always unequal and knotted.

Soemmerring has remarked that the fex of the youngeft embryos can be diftinguifhed, independently of the genital organs, if they are well proportioned. The moft ftriking difference is found in the ftructure of the thorax. That of the male is longer, more conical, formed of thicker ribs, and more prominent, with refpect to the abdomen and pelvis, than that of the female. In the latter, not only is the whole thorax fhorter, but alfo rather larger above, as far as the fourth rib, and therefore lefs conical. It is more diftant from the pelvis, on account of the greater interval between the laft rib and os innominatum, and lefs prominent, fo that where the body is either erect or fupine, the fymphyfis pubis is the moft prominent part in the female, and the thorax in the male fubject.

The abdomen begins higher in the female, and is large and prominent, expanding towards the genitals: we might fay that the female thorax is compreffed, and the abdomen tumid.

The diftinction is fo obvious, in refpect to the points now mentioned, that it will not only be readily obferved in the well formed embryos carefully compared; but it may even be thought ftrange that it fhould have hitherto efcaped obfervation. It will often be noticed, according to Soemmerring, in very fmall embryos; and if we can afcertain the fex by the organs of generation, we fhall readily perceive the diftinction in the form of the cheft.

The

The form of the head exhibits another ſexual diſtinction. It is on the whole larger in proportion to the body, but leſs rounded in the male than in the female: the occiput too is convex, ſo that the neck is hollowed in appearance, and the vortex is flattened. In the female the form is more globular, the occiput not prominent, and the neck conſequently not hollowed, and the vortex ſpherical.

Soms points of diſtinction may be ſeen alſo in the extremities; of which males have the ſuperior rather larger, the ſcapulæ ſtronger and more prominent, and therefore ſuitable to the ſtronger thorax of this ſex, the arms rather conical, the fore-arms more muſcular, the carpi broader, and the ends of the fingers more obtuſe. The lower limbs, adapted to the narrow male pelvis, are contracted above; the thighs are more ſlender, but the feet very ſtrong, with prominent malleoli and heels. The great toe exceeds the others in ſize very remarkably. The characters of the female are juſt the reverſe of theſe. The upper limbs are ſhorter, with the ſcapulæ more ſloping, the arms cylindrical, fore-arms ſlender, wriſts narrow, and ends of the fingers acuminated. The lower limbs, from the ſuperior breadth of the pelvis, are largeſt above, and diminiſh conically towards the knees; the heels and ancles are not prominent, and the great toe exceeds the others but ſlightly.

The ſpinous proceſſes of the inferior dorſal, and ſuperior lumbar vertebræ form a kind of projecting ridge in the back of the male, where the female preſents a depreſſion. The ſame difference is ſeen not only in the mature fœtus, but alſo in infants, and in the beſt proportioned boys and girls.

After deſcribing the progreſs of the embryo, and the differences of the male and female at this early period, Soemmering alludes to the much diſputed queſtion, whether the ſame powers of body and mind are beſtowed on all men, or whether there be not natural diverſity in theſe in different individuals, ariſing from original differences in the ſtructure of the frame. Attentive examination will ſhew that the bodies of embryos are marked by native traits of diſtinction, clearly recogniſable at a time, when neither food, education, habits, clothing, nor the operations of diſeaſe can have exerted any influence on them. Not to mention that fœtuſes are born, who, from too delicate an organization of the eyes, ſhun as the greateſt evil, that light, which is our firſt bleſſing; that imperfection in the ſtructure of the ears incapacitates ſome from the ordinary buſineſs of life; that others are almoſt cut off from human ſociety by deficient formation of the organs of voice; that mal-formation of the heart devotes ſome to an exiſtence of conſtant ſuffering, incapable of all exertion of body and mind, while deformity of the limbs circumſcribes the powers of others; that many are born without brain, and therefore utterly deſtitute of all mental faculties; putting all theſe circumſtances out of the queſtion, we notice great differences in the form and proportions of well made embryos. Wide differences exiſt in the ſhape, capacity, and firmneſs of that part of the head which lodges the brain; the countenance varies infinitely in the diſtance, ſize, and form of the organs of the external ſenſes; and there are marked diverſities in the volume of the cheſt, and in the ſtrength and form of the limbs.

To our account of the progreſſive developement of the different parts of the body, we ſhall ſubjoin a ſhort deſcription of the fœtus in its different periods. In the firſt month it conſiſts of a mere jelly; which is eaſily deſtroyed by very little touching, and evaporates almoſt entirely by heat. Authors have delineated embryos at the end of the firſt month of the ſize of a barley corn, or a pea. Soemmering gives a repreſentation of one very elegantly formed, no larger than a very ſmall pea. At this time the head is fully developed, and much exceeds the reſt of the body. The cranium is particularly large. The eyes and mouth are diſcernible. The figure of the whole is globular, the head and ſpine being ſtrongly bent towards each other. The poſition of the bodies of the vertebræ is diſcernible. The arms are two very ſmall tubercles; the lower extremities are the ſame; and the coccygeal tubercle is a larger prominence between the right and left of the latter limbs.

In the ſecond months the body becomes more firm and opaque, and its parts are more developed. The mouth and noſe are diſcernible; the eyes diſtinguiſhed by their blackneſs; and the ears can hardly be ſeen without the aid of the microſcope. The whole figure is ſtrongly incurvated, ſo that the coccygeal tubercle, which is larger than the rudiments of the lower limbs, nearly touches the head. At the end of this month the fingers and toes are diſcernible. Oſſification alſo commences; firſt in the clavicles, the large cylindrical bones, the lower jaw, frontal and occipital bone, &c. The body may now be half an inch long. The umbilical chord, very ſhort and thick, connects the child cloſely to the ovum. In the end of the third month the features are well formed. The forehead is very prominent. The general figure ſtill incurvated. The coccygeal tubercle diminiſhes and diſappears. The extremities are fully developed, and the fingers and toes perfectly diſtinct. The organs of generation are clearly ſeen; the penis and clitoris being very large, the nymphæ prominent, and the labia thick. The abdomen projects towards the umbilicus. Soemmerring has given a moſt exquiſite figure of a male embryo of about 12 weeks. The eye-balls are clearly diſtinguiſhable, larger than the opening of the lids. The noſe is well formed; and even the philtrum is clearly diſcerned in the upper lip. There is ſcarcely a veſtige of the coccygeal arch. The ſize and form of the ſcapula is evident, and the parts of the extremities in general diſtinctly ſeen; even the prominence of ſeveral muſcles, as the deltoid and biceps, gluteus major, vaſtus externus, &c.

In the fourth and fifth months the form and proportions approach conſtantly more nearly to thoſe which the body poſſeſſes in future. All the external parts are clearly diſtinguiſhable in the 14th and 15th weeks; except the hair and nails. Hitherto the fœtus was ſurrounded on all ſides by a large quantity of the water of the amnios; but as it grows now more rapidly than the ovum, it occupies the cavity of that part more completely. The head, in the fourth month, on account of its conſiderable ſize when compared to the body, ſinks conſtantly lower in the uterus. The fœtus comes completely in contact with its coverings in the fifth and beginning of the ſixth months, and conſequently the mother uſually begins now to feel its motions. On a very rare occaſion, Wriſberg ſaw clearly, for a few minutes, a ſlight motion of the arms and feet in a fœtus of 130 days. He could not diſcern any beating of the heart or arteries; neither did the muſcles of reſpiration act, when he inflated the lungs. In the ſixth month the membrana pupillaris of the eye is very viſible. The ſcrotum is ſtill empty and corrugated. Hair and nails are formed. The integuments ſtill hang rather looſely on the body, ſo that it has a lean and wrinkled appearance. In a fœtus of between 5 and 6 months, the length of the body was $10\frac{1}{2}$ inches; and that of the head, from the vertex to the lower jaw, $3\frac{1}{4}$ inches.

The length of three fœtuſes, whoſe ages were 158, 162, and 170 days, varied from 16 to 19 inches; and their weight from 1lb. 10oz. to 1lb. 13oz. All three came into the world alive; the pulſation of the arteries could be clearly felt,

felt, they refpired, but cried feebly. They moved their limbs freely, could not fuck, but fwallowed milk which was poured into their mouths; and they lived feveral hours.

The fize of the fœtus is confiderably increafed in the laft three months. The greater comparative growth of the limbs makes it appear as if the head became fmaller; the latter part is about one-third of the body in a newly born child. More fat is accumulated under the fkin, fo as to make the outline of parts more rounded.

The increafe at this time is rather in breadth and thicknefs than in length. The hair grows longer, and the nails more firm. The membrana pupillaris difappears, and the teftes defcend into the fcrotum. A child of feven months can live a few hours only out of the uterus, and thofe of eight months feldom live a fortnight.

The fœtus is fully developed and mature, fo that it can live out of the uterus at the end of the ninth calendar month. Experience has fhewn that children may live, when born a fortnight or three weeks before this time, if well taken care of; and it feems probable that a longer interval may elapfe before birth: but the neceffary uncertainty of the mode of reckoning renders the point dubious. The proportions of parts are very different in the fully grown fœtus from thofe of the adult. The head is extremely large; and the upper part of the trunk, and upper extremities, are very confiderable when compared with the lower parts.

"The fize and weight of a child's body at birth, fays Dr. Hunter, are generally over-rated in this country; infomuch that we are often told, even by thofe who ought to know, of children weighing from 15 to 20 pounds. So far is this from being true, that I never knew an inftance of a child which weighed 12 pounds, and the greateft number a little above half that weight. Dr. Macaulay was at pains, at our hofpital, to afcertain the ordinary bulk of new-born children, by firft weighing a great number indifcriminately as they were born; and then by giving an order to our matron to weigh occafionally all fuch as were of a remarkable fize in either extreme. Of feveral thoufands born in the Britifh hofpital at their full time, while the doctor's order was attended to, the fmalleft weighed about four pounds, the largeft 11 pounds two ounces, and by far the greater number weighed from five to eight pounds, avoirdupois. In cafes of twins, it feldom happens that each attains the weight of a fingle child. It has been remarked that the firft is ufually the ftrongeft."

The meafure and weight of the fœtus cannot be much depended on as criteria of its being mature or otherwife: yet if a child is much under between fix and five pounds, and fhorter than eighteen inches, it may be deemed immature. The following are alfo characters from which we draw the fame conclufion. Thinnefs of the body, and mobility of the fkin; a reddifh livid colour of the furface, particularly in the palms and foles, probably from the blood fhining through the thin integuments: and a fine woolly covering of the body. Mobility of the parietal bones, and great fize of the fontanell. Thinnefs and fhortnefs of the nails. The eyes being much clofed, and the child not looking about at furrounding objects. Coldnefs of the hands and feet.

The growth of the child, during its refidence in the uterus, is very confiderable compared to its fubfequent increafe. According to Haller, (Element. Phyfiol. lib. 29. fect. 4. § 17.) it increafes in the firft month to a bulk 300,000 times greater than its original fize. In the fecond month its increafe is to 48 times the fize it poffeffed at the end of the firft. From this time to the full period it will only average an increafe of 15 times for each month. At the end of the three firft years, the proportion to the mature fœtus is as 14 to 5: and at the end of the 22 following years, the proportion to an infant of three years, as 8 to 1. The increafe in the firft month of exiftence is to that of the laft month of growth as 4,885,717 to 1, and the whole increafe is from 1 to 108,000,000,000.

The number of twin-cafes to fingle births, according to Süffmilch, is as 1 to 65 or 70: by the fame calculator, one inftance of three children occurs in 6500 births; but probably it does not happen fo often. Four children are extremely rare, and the cafes of five are ftill more extraordinary. Twins live often enough; three children but feldom; and four, perhaps, never.

As a general obfervation, it may be ftated that male children are larger than females. Dr. Clarke of Dublin has given us fome interefting facts on this fubject from a regifter of 20,000 births, in a paper contained in the 76th vol. of the Philofophical Tranfactions. The weights of fixty males and fixty females were as follows, leaving out fractions:

Males.

℔s. - - -	4.	5.	6.	7.	8.	9.	10.
Number of children	0.	3.	6.	32.	16.	2.	1.

Females.

℔s. - - -	4.	5.	6.	7.	8.	9.	10.
Number of children	2.	9.	14.	25.	8.	2.	0.

He found the dimenfions of the head in the male to exceed thofe of the female: thus, of 120 children, fix only meafured more than 14½ inches round the head; and all thefe were males. This greater fize of males expofes them to greater difficulty in the birth, and confequently a greater number dies in that procefs; one half more than of females. The proportion of males born to females was nine to eight: but, in confequence of the greater mortality of the former in parturition, and the firft days of exiftence, the balance in favour of the male fex, out of 20,177 children, was only 483 at the end of a fortnight, although originally 1177. In countries where polygamy is allowed, more females are faid to be born than males.

Pofition of the Child.—"The fœtus in utero," fays Dr. Hunter, "is naturally contracted into an oval form, adapted to the figure and circumftances of its habitation. The vertex of the head makes one end of the oval, and the nates the other, one fide or edge of the oval is formed by the occiput, the back part of the neck, and the incurvated trunk; the other is made by the forehead, and the mafs of contracted and conglomerated limbs. The chin is clofe to the breaft, the trunk is bended forwards, the knees are clofe to the fore parts of the hypochondria, the legs drawn to the back parts of the thighs, the feet or lower parts of the legs decuffating each other; and the upper extremities contracted into the vacant fpace betwixt the forehead and knees. The moft common fituation of the extremities is not to be determined, as they are found to be a little different in different diffections; and in the living body they vary almoft every moment: thence the hands are feen indifcriminately on the head or face, or acrofs one another, or round the knees, or legs; and the legs are fometimes extended, and the feet are placed by the face; or one is in that pofition, and the other contracted, and the foot downwards.

"The navel-ftring, in paffing from the child to the placenta, is often varioufly entangled with the extremities, and frequently winds once or oftener round the neck.

"When there is a confiderable quantity of liquor amnii, the child takes the advantage of room, and the compofition of its parts is not fo clofe or globular. In proportion as there

there is lefs room, its figure is more compacted and moulded to the fhape of the cavity of the uterus. In two different cafes which I examined, there was fo little fluid furrounding the child, though the waters had not been difcharged, that the uterus had preffed and moulded all parts of the child into a very ugly form, as if it had been made of dough: and in fuch cafes the hands and more particularly the feet are liable to be compreffed and twifted into deformity, on account of their being projecting or pliant parts.

"With regard to the mother, the moft common fituation of the child, by far is, with its head downwards, and its nates at the upper part of the uterus. Once, perhaps, in twenty or thirty cafes, it is the contrary, and prefents, as they term it in midwifery, with its pofteriors. All the obfervations that I have been able to make in diffections, and in the practice of midwifery, would perfuade me that the child's head is naturally downwards through all the later months of utero-geftation."

By the pofition of the fœtus, as we have now defcribed it, rolled up and compacted into an oval figure, it takes up the fmalleft poffible room in proportion to its fize. It diftends the uterus too equably: and, in order to fulfil this object more completely, the intervals left by the inequalities of the child's body are filled with a fluid (the liquor amnii), and the whole is contained in membranes, fo as to form a perfectly oval mafs, diftending the uterus in all directions. Hence the fluid is more copious in younger embryos, becaufe they cannot be compacted into an oval mafs, and are too tender to diftend the uterus.

The peculiarities of ftructure, in various parts of the body, which diftinguifh the fœtus, will come under confideration, moft properly, when we defcribe the different parts in which they are found. We fhall, therefore, merely enumerate them on the prefent occafion.

The furface of the body is covered every where with a firm febaceous and white fubftance, called by fome vernix cafeofa. This covering, which renders the whole body greafy, cannot be wafhed off with plain water. It is infoluble in alcohol, oils, or pure water; but fome alkalies diffolve part of it, and form a kind of foap. It has often been fuppofed that this is a fediment from the liquor amnii; but that is very improbable, as the liquor amnii contains nothing unctuous, and there is none of it on the amnios or navel-ftring. It muft, no doubt, be a fecretion from the fkin.

The cutis, at firft thin and gelatinous, is covered by a cuticle in the earlieft ftages. Proper fat is not formed under the fkin before the fourth month; its place is occupied by a kind of jelly-like fubftance. Afterwards a pretty thick layer of fat is formed over the whole body, next to the fkin; but there is very little about the vifcera or internal parts: little among the mufcles, or in the bony ftructure. The fkin has a very red and vafcular appearance; and is faid to have this appearance, even in negroes, who are affirmed to change to the black colour a few days after birth. A foft woolly covering, feen particularly about the fides of the face, the back, fhoulders and ilia, in young embryos, difappears in the mature fœtus.

The ftate of the bones in the fœtus has been already alluded to in the article Bones. The jelly, of which the embryo is firft compofed, becomes more firm and confiftent in the fourth and fifth weeks. The materials of the parts which will afterwards be bones, are firft changed from the gelatinous confiftence, common to all the organs, into cartilage, at firft foft and tender, and affuming gradually firmnefs and elafticity. Its figure reprefents that of the future bone. It lofes its tranfparency, and white opaque fpots are difcerned in it (*puncta offificationis*) about the feventh or eighth week after conception. Thefe are firft obferved in the clavicles, ribs, vertebræ, large cylindrical bones, lower jaw and other bones of the face, os frontis, and occipitis. Large veffels are feen ramifying through the cartilage, and diftributed on the offifying points; thefe fecrete the offeous matter, which is there depofited. In fimple flat and fmall bones there is a fingle point, from which the offeous depofit extends into the reft of the bone. In moft others, particularly fuch as have an irregular figure, there are two, three, or more points, beginning at the fame time, and extending in their circumference until they meet. Such bones confift of certain pieces in the fœtus and young child, united by plates of cartilage. In other bones, particularly of the long kind, a principal point is obferved at firft, forming the body of the bone, or diaphyfis. Afterwards, fmaller points arife, efpecially at the ends, which had hitherto remained cartilaginous. Thefe are called epiphyfes, and, after their offification has proceeded confiderably, they are ftill connected to the body of the bone by a plate of cartilage. The offific points generally commence in the very middle of the cartilage, and extend thence into the cirumference. They differ in appearance in the different bones. In the flat ones, particularly of the head, they are thin reticulated fcales, perforated with innumerable fmall holes. The bony fibres, as they are called, extend, in thefe fcales, in a radiated manner, from the centre to their circumference: in the long bones they are fhort cylinders, with a fmall depreffion at each end, and poffeffing, apparently, parallel fibres: in the round bones they are globular granules; and in thofe of irregular figure, irregular in their outline, and generally poffeffing feveral points.

At the time of birth the officula auditus, labyrinth, and tympanum, are completely formed; all the other bones of the body are in a more or lefs incomplete ftate.

Phyfiologifts in all ages have attempted to explain how offification is effected, in what manner the cartilage is removed, and bony fubftance put in its place: which points we fhall probably underftand, when the hitherto unveiled myfteries of fecretion and nutrition are completely laid open to our infpection. In the mean time, inftead of bringing forwards a feries of old hypothefes, we fhall juft quote a paffage from Albinus, (Annot. Acad. lib. 7. p. 76). "We may conjecture that there exifts, from the firft origin of the embryo, rudiments of the cartilages, however fmall, foft, tender, and approaching to the nature of fluid: or at leaft that fomething is generated at that time, which is afterwards cartilage. But of the effential nature of cartilage or bone; of the manner in which cartilage is fubftituted in the place of bone; how either cartilage or bone is formed from our aliments; and what particular part of the fluids furnifhes the materials of this growth; we muft confefs ourfelves ignorant, and fhall probably remain fo."

The bones of the fœtus contain much more animal matter, and lefs earth than thofe of the adult; they are confequently of a greyifh colour, and acquire more of a white or yellow hue, as they advance towards their perfect confiftence. The extremities of the long bones, on account of their numerous blood-veffels, are dark coloured. The periofteum is ftrong and thick, and feparates eafily. The place of marrow is fupplied, in the embryo, by a mere gelatine, which acquires fomewhat of a fatty or oily nature towards birth.

The younger the embryo, fo much larger is the head in proportion to the trunk and extremities; fo much fmaller are the bones of the face compared to the cranium; fo much larger the organs of hearing; and fo much lower and flatter is the lower part of the face. The internal furface of the

fkull

skull has no marks arising from the convolution of the brain, nor any grooves for the blood-vessels. The cranium is at first merely membranous; the mode in which it is ossified has been already considered under the article Cranium. We may just enumerate here, as peculiarities of the fœtal cranium, the want of the frontal, sphenoidal, and maxillary sinuses, of the mastoid processes, and of the meatus auditorii externi, and the imperfect state of the ethmoid sinuses. The condition of the jaws, with their contained teeth, has been considered at large in the article Cranium.

The os hyoides has scarcely began to ossify at the time of birth.

The cavity of the thorax is proportionally larger than in the adult, and more conical. Blumenbach attempts to account for this size by the peculiarities in the circulation, and the consequently greater bulk of the liver. The pelvis is very small, so that there is no room in it for the urinary bladder. The individual bones of the chest and pelvis, as indeed of the rest of the body, will be more particularly described in other articles.

In the upper extremities, the clavicles begin to be formed very early, and attain to a very large size, when the rest of these limbs is extremely small. Thus in the tenth week they are three times the size of the femora. The scapula is also considerable at an early period, and has a piece of ossification double the size of that in the os innominatum. The carpus is completely cartilaginous, as is the tarsus in the lower limbs, excepting the astragalus and os calcis, each of which possesses a small ossific point. The ossification proceeds afterwards more rapidly in the tarsus than in the carpus, probably on account of the erect stature of the human subject, and the share which the tarsus has in supporting the body in that position.

All the bones of the embryo are uniform on their surfaces, where, in the adult, elevations and impressions are found.

The muscles can hardly be distinguished in the three first months, like the rest of the soft parts they seem composed of a mere jelly. The fibrous texture becomes discernible in the following months; when we are able to distinguish tendons also. Such, at least, is the observation of Wrisberg, in an embryo of $5\frac{1}{2}$ months. The tendons, which are fixed to the bones of the adult, terminate in the periosteum and perichondrium of the fœtus, and come away entirely with these membranes.

It is observed, by Soemmerring, that the tendons of the recti abdominis are proportionally broader and stronger than in the adult. The pyramidales are considerably larger. There is a round opening in the linea alba for the passage of the umbilical vessels. The muscles of the internal ear are nearly complete at the time of birth; the intercostals and diaphragm are considerably developed at the same period, and the muscles of the upper more than those of the lower extremities.

The eyes are developed at a very early period, being distinctly visible in the youngest embryos hitherto observed. They appear as black points at the end of the first month. The pigmentum is visible from the first, and is particularly thick and black. It has been correctly observed by Hogarth, that no part of the body grows so quickly, and is so perfect in the fœtus, requiring no additional growth after birth, as the iris. The cornea, crystalline lens, and vitreous humor, have a reddish tint. The lens is spherical in its figure. That great peculiarity of the fœtal eye, the membrana pupillaris, will be described in the article Eye.

The external ears are developed rather late, as there is not the slightest trace of them at the end of the first month. The meatus externus is often filled up with the vernix caseosa. The membranous texture of the whole meatus; the covering of the membrana tympani by the membrana mucosa; the attachment of that membrane to the annulus auditorius; the want of mastoid cells are all further explained in the article Ear.

The formation of the nose commences late; and the cavity is small and very incomplete in the fœtus, as a necessary consequence of the state of the bones of the head at that time.

The thyroid gland is large and vascular in the fœtus.

The thymus, which is of very considerable size before birth, and gradually disappears afterwards, will be considered under that article.

The lungs are small, collapsed, of a red colour, and sink in water.

The mammæ are large in proportion to the size of the body. The papilla is small, and not yet surrounded by an areola. The breasts of the male and female fœtus do not differ: they contain a whitish fluid, which can be forced out by gentle pressure, and sometimes flows spontaneously in children.

The abdomen is very large in the fœtus, and is drawn into a conical form towards the navel in young embryos. The great size of the abdomen may be accounted for by considering, that this cavity holds the bladder, and that the liver and renal capsules are very large. The distance from the end of the sternum to the pelvis, in a newly born child, is one-third of the length of the body; in the adult it is not one-fifth.

In the alimentary canal of the fœtus, we observe an almost entire want of valvulæ conniventes in the small intestine; and of appendices epiploicæ in the large. The appendix vermiformis is a gradual conical contraction of the cæcum. The intestines are more or less filled with a soft matter, of a yellowish green colour in the small, and of a dark green, approaching to black, in the large, called meconium. There is very little of this near the stomach; it increases in quantity lower down, and is the most abundant in the large intestines. But in the early months, the latter part of the canal contains no meconium. It is not distinguished by any peculiar taste or smell.

The pancreas is large, and the liver of immense size in the embryo. The kidneys are also considerable, and lobulated on the surface. The renal capsules equal the size of the kidneys. The urinary bladder is very large, equalling the dimensions of the stomach.

The situation of the testis in the abdomen, and its passage from that cavity into the scrotum, will be considered when the testis itself is described.

The heart is proportionally large in the fœtus, and occupies a considerable part of the thorax. Hence, on exposing that cavity, this viscus comes immediately into view, and seems in a manner to cover the lungs. The foramen ovale, by which the two auricles communicate; and the equal strength of the two ventricles, will be considered when the heart itself is described. The pulmonary artery of the fœtus divides into three branches, of which the middle is the largest. This is termed the *ductus arteriosus*, and it runs directly to join the aorta, immediately below the arch of that vessel. It is often named after Botal, although Galen and others knew it. Its length is about equal to a finger's breadth. It conveys into the aorta a large part of that blood which passed from the right auricle into the right ventricle; more than half of it, according to Haller. This canal is closed very soon after birth, often within a few days.

days. The umbilical veffels have been already defcribed in a former part of this article. The arteries are found obliterated from the navel to the bladder, very foon after birth, often within a very few days; near the bladder they are very much contracted, but not clofed, and give origin to the arteries of the bladder. The umbilical vein, and ductus venofus are clofed in the fame way. The mode in which the circulation is carried on through the parts now defcribed, is reprefented in the article CIRCULATION.

The coverings of the brain are at firft fo thin and tranfparent, that this organ can be feen through them. It is almoft fluid until the 5th or 6th month, and remains very foft even to the time of birth, fo that its diffection is difficult. It is always larger in proportion to the body, the younger the fœtus. The nerves are larger in proportion to the body.

Phyfiology of fœtal exiftence.—Some remarks on this fubject will be found in the article CIRCULATION. We have only to obferve, further, on the fubject of the connection between the mother and child, that the *mode* by which this is effected, notwithftanding it has been a favourite fubject of refearch with the greateft phyfiologifts of all ages, remains ftill a problem. The account which we have given of the ftructure of the placenta, fhews that the arteries and veins of the uterus have communications with the fubftance of the former organ; we are, however, entirely unable to ftate *how* the blood of the mother, or any nutritive fluid, is admitted into the umbilical veffels; although the obvious impoffibility of the fœtus deriving the materials of its growth from any other fource, leads us to conclude, without hefitation, that fuch admiffion muft take place. The reader will probably think that the following quotation, containing Mr. Hunter's opinion, does not tend to elucidate materially this obfcure queftion.

"The blood, detached from the common circulation of the mother, moves through the placenta of the fœtus, and is then returned back into the courfe of the circulation of the mother, to pafs on to the heart.

"This ftructure of the placenta, and its communication with the uterus, leads us a ftep further in our knowledge of the connection between the mother and fœtus; the blood of the mother muft pafs freely into the fubftance of the placenta, and the placenta moft probably will be conftantly filled; the turgidity of which will affift to fqueeze the blood into the mouths of the veins of the uterus, that it may again pafs into the common circulation of the mother; and as the interftices of the placenta are of much greater extent than the arteries, which convey the blood, the motion of the blood in that part muft be fo much diminifhed, as almoft to approach ftagnation." (Obf. on certain parts of the Animal Economy, p. 135.)

The exiftence of the fœtus is purely vegetative. Conftantly receiving the materials of its nourifhment and growth from the juices brought to the placenta by the veffels of the mother, it may be regarded as a new organ produced by conception, participating in the general life, but having its own peculiar life, which is, to a certain degree, independent of that of the mother.

The animal life, or that clafs of functions by which the animal is connected to the external world, has not yet commenced in the fœtus. Its ftate therefore cannot, with any juftice, be compared to that of a perfon afleep, in whom thefe functions are only fufpended: but in the fœtus they have not begun.

The fœtus can have no fenfations from the furrounding medium; its temperature being invariable, it can have no object of comparifon, which is effential to fenfation. The fenfes cannot act, becaufe none of the caufes, which excite them, have hitherto operated. That of touch, being dependent on the others, and ferving to rectify the conclufions which they tend to, muft of courfe be inactive. This inaction of the fenfes fuppofes a fimilar ftate of their nerves, and of the brain. Tranfmiffion of impreffions is the function of the former; perception of the latter: but neither of thofe acts can take place when there are no objects to be tranfmitted or perceived. Memory and imagination flow immediately from perception: judgment arifes from one of thefe three, and gives origin to the will. This connected feries of faculties has not begun in the fœtus, becaufe of the want of fenfations. The brain is capable of acting, and poffeffes all the requifites for action; it is not *excitability* but *excitation* that is wanted. The fœtus moves while contained as the uterus; and thefe motions are confidered as fymptoms of pregnancy. As all motion arifes from fome foregoing impreffion, and as the fenfes of the fœtus are completely inactive, it is difficult to affign a fatisfactory caufe for thefe movements of the child.

The functions of organic life, or thofe by which the nutrition and growth of the body are effected, muft commence almoft as foon as the fœtus is conceived. The matter of nutrition arifes in its body in an affimilated ftate, having been prepared by the mother: it enters immediately into the circulating fyftem, without traverfing the digeftive organs, then nearly inactive. The organs of excretion, which decompofe the body, as the lungs, fkin and kidnies, are alfo almoft inert. The fecretions have hardly commenced.

To the great fimplicity of the affimilative procefs in the fœtus, let us add the remarkable activity of the organs employed in it; an activity which depends on the greater proportion of their vital powers. The whole force of the animal economy feems to be concentrated on the two fyftems of circulation and nutrition; the proceffes of digeftion, refpiration, fecretion, and exhalation being exercifed, at moft, but feebly: the diminifhed energy of the latter being made up by the increafed power of the former. If we confider, moreover, that the organs of the animal life, condemned to a neceffary inaction, are gifted with a very fmall fhare of vital powers; we fhall fee, that nearly the whole of that living energy, which is deftined, in the fequel, to animate all the fyftems of the body, is, in the fœtal ftate, concentrated upon thofe which are concerned in building up the various parts; and confequently that the functions of nutrition and growth poffefs, at this age, an energy vaftly fuperior to that of any others.

We may refer the reader to a great number of works on the fubjects of the preceding article. In the eighth volume of the Elementa Phyfiologiæ, Haller has difplayed his ufual erudition and judgment in a complete collection of all the facts afcertained previoufly to his time. Dr. Hunter's Anatomia uteri humani gravidi, folio, and Soemmerring's Icones embryonum humanorum, folio, 1799, contain a perfect feries of reprefentations of the human ovum, and its contents from the earlieft time to its maturity. Dr. Hunter's Anatomical defcription of the human gravid uterus and its contents, publifhed after his death by Dr. Baillie, 4to. 1794, is a clear and plain defcription of the fubject. We may mention further, Wrifberg defcript. anat. embryonis, obfervationibus illuftr. 4to. Gött. 1764, or, in the third volume of Sandifort's Thefaurus; alfo, his remarks on the ftructure of the ovum in the Göttingen Commentaries for 1773 and 1783. Roderer De pondere & longitudine infantum recens natorum in the Göttingen Commentaries for 1753; and Wrifberg de vita fœtuum humanorum dijudicanda;

canda, in the fame work for 1773. Autenrieth fupplementa ad hiftoriam embryonis humani, Tubingen, 1797, 4to.

On the comparifon of the ftructure of the fœtus and adult, fee C. I. Trew de differentiis hominis nati et non nati, Altdorf, 1736. I. G. Roderer de fœtu perfecto, Strafburg, 1750. Portal in the Mem. de l'Acad. des Sciences de Paris 1770. A. and F. Roefslein de differentiis inter fœtum et adultum, 4to. Strafburg, 1783. On the nutrition of the fœtus, fee Leveillé fur la nutrition du fœtus confideré dans les mammiferes & les oifeaux. Paris an. 7. & Lobftein differtation fur la nutrition du fœtus, Strafburg, 4to. 1802. The moft complete book on the whole of the fubject, that is, the ftructure and developement of the ovum, and the anatomical peculiarities of the fœtus, is F. G. Danz Grundrifs der Zergliederungs kunde des ungebohrnen kindes in den verfchiedenen Zeiten der Schwangerfchaft, 2 vols. 8vo. 1793, which contains moft abundant references to all the fources of information on every part of the fubject.

Embryo, in *Vegetable Phyfiology*, εμβρυον, a *fœtus*, or *infant*, the Corculum of Linnæus, under which term we have already mentioned it, is the moft effential part of a perfect feed. When fexual impregnation has not taken place, this organ is defective, however perfect all the other parts of a feed may be, as in the *Cycas revoluta* which bore fruit at the bifhop of Winchefter's, and is defcribed and figured in the Tranfactions of the Linnæan Society, v. 6. 312. t. 29, 30. Here every part of the fruit and feed was apparently in the higheft perfection, except that a fmall cavity was only found in the place of the embryo, a defect doubtlefs to be attributed to the abfence of a male plant of the fame fpecies. The fame has been obferved in cucumbers and melons, whofe fruits are not the worfe in flavour on account of fuch a deficiency, though dates, when unimpregnated, are known to be much inferior in quality. The embryo or corculum is very confpicuous in the walnut, the garden bean, pea, lupine, &c. In a very poifonous plant, the *Jatropha Curcas*, figured in Gærtner, t. 108. f. 1. this author mentions as a remark of Mr. Boyle, that the nucleus or albuminous part of the feed may be eaten with impunity, if the embryo and cotyledons, or rather perhaps *plumula*, be taken away. This fame circumftance was pointed out by the natives of Sierra Leone to Dr. Afzelius and his companion Borone. The internal ftructure of the embryo, before it begins to vegetate, is obferved by Gærtner to be remarkably fimple, confifting of an uniform medullary fubftance, enclofed in its appropriate bark or fkin. When the vital principle is excited to action, veffels are formed, and parts developed, which feemed not previoufly to exift, as in the egg of a bird. The embryo is generally fituated within the fubftance of the feed, but not always, being entirely external to the body of the feed, though within the fkin, in the natural family of graffes or corn. In umbelliferous plants it occupies the very centre of the feed, and in that family its pofition is reverfed; whereas in compound or fyngenefious flowers, though equally central, it is erect with regard to the bafe or infertion of the feed. In the date and fome other palms the embryo is lateral and horizontal; while in the cocoa-nut and others it is erect, in the centre of the bafe of a large *albumen*. Its direction is either ftraight, curved, or even fpiral. Its form is moft fimple in plants that have only one cotyledon, or rather no proper cotyledon at all. S.

Embryo-*worms*. It is a matter of no fmall curiofity, to obferve the arrangement of the multitudes of the embryo-worms, as they are lodged in the bodies of the viviparous two-winged flies.

An accurate diffection of one thefe little animals, fhews very plainly the parts where the embryo-worms are inclofed. This diffection is eafily made with a pair of fine pointed fciffars, taking off the whole upper fhell of the body from the lower; and that part which covers the belly may be turned back upon the corcelet, without difturbing the internal parts by the operation; and the form and arrangement of the parts which contain the embryo-worms in thefe, will be found very different from that of thofe which contain the eggs in the common flies. Baker on the Microfcope, p. 115. 416. 417. 428. 430.

EMBRYOPTERIS, in *Botany*, from εμβρυον, an *embryo*, and πτερον, a *wing*, as appears from an examination of Gærtner's figure; though, from the conftruction of the word, it feems to be derived from πτερις, a *fern*, or *brake*. Hence this name, as it at prefent ftands, is liable to a double objection, as being compounded of one previoufly eftablifhed, *Pteris*, and ftill more as conveying a falfe idea of its own application. *Embryopterum* would have been correct and unexceptionable, and we fhould without fcruple have adopted fuch an alteration; but the name is altogether fuperfluous, the plant in queftion being a *Diofpyros*; under which head its generic character may be feen. We have, therefore, here only to add to that lift of fpecies the following.

Diofpyros glutinifera, Roxb. MSS, (Embryopteris peregrina; Gærtn. v. 1. 145. t. 29. f. 2. E. glutinifera; Roxb. Coromand. v. 1. 50. t. 70.) Stamens numerous. Leaves oblong, palifh beneath. Seeds eight or ten. This is a middle-fized evergreen tree, growing in the moift cool valleys among the mountains of the northern Circars, flowering in March and April. The natives call it Tumika, and eat the fruit, which Dr. Roxburgh defcribes as ftrongly aftringent, and not palatable. The Malays name it Mangoftan-utan, and the Dutch Lym-appel. The wood is of an indifferent quality, and not much ufed. The *branches* are fmooth. *Leaves* alternate, ftalked, oblong, fometimes inclining to elliptic, and occafionally a little heart-fhaped at the bafe; entire, fmooth, palifh beneath. *Flowers* white; the males in fmall axillary clufters; females on a feparate tree, folitary and larger. *Berry* globular, about two inches in diameter, of a rufty yellow, and covered with a rufty farina when ripe. Gærtner miftook the top of the fruit for the bafe, and hence erroneoufly defcribes the calyx as fuperior. He alfo miftook the radicle of the embryo for a fimple cotyledon, but his profound knowledge led him to fufpect that a cavity in the other extremity might be the real feat of the embryo, and that the circumambient fubftance was confequently a vitellus. We prefume this cavity to have arifen in the plumula, from a fhrinking of the parts, after the vital principle was extinct, his fpecimen being an old one, and therefore his fufpicion was, fo far, well founded. He defcribes the *albumen* as gelatinous in its centre, and diffolving in water, to which Dr. Roxburgh's fpecific name, and the Dutch appellation, both feem to allude. S.

EMBRYOTHLASTES, Εμβρυοθλαστες, in *Surgery*, an inftrument wherewith to crufh the bones of an embryo, or dead child; fo as to make it eafier of extraction, and prepare it for the embryulcus, to draw it out of the womb.

EMBRYOTO'MIA, from εμβρυον, *a fœtus*, and τεμνω, *to cut*, the operation of cutting into the womb, in order to extract the fœtus. See Cæsarian *Section*.

EMBRYULCUS, from εμβρυον, and ελκω, *to draw*, an inftrument ufed in extracting dead children. See Crotchet.

EMBS, or Ems, in *Geography*, a fmall town of Germany, which, till the peace of Luneville, belonged in part to the landgrave of Heffe Darmftadt, and in part to the prince of Naffau Dietz, to whom it has been ceded; is chiefly remarkable for five fulphureous baths in its neighbourhood.

Embs, or *Hohenembs*, a fmall diftrict of Germany, in the circle of Swabia, fouth of the county of Bregentz and the lake of Conftance, about 10 miles long and 5 broad, erected into a county by Charles V.

EMDEN, or Embden, a town of the kingdom of Holland, capital of the department or province of Eaft Friefland, which, till the year 1807, belonged to Pruffia, to the fovereign of which it had been fold by the United Provinces of the Netherlands, in 1744. It is fituated on the Ems, not far from the fea, and near the lake Dollart; 30 miles N.E. of Groningen. N. lat. 53° 20′. The harbour is commodious; it holds 400 veffels.

Emden had gained confiderable commercial importance, from having been declared a free-port by the king of Pruffia, in 1751. Its fituation was extremely convenient for the Dutch, to carry on their commerce with the greateft fecurity in time of war; particularly during the late wars between England and France, when the Texel was blockaded by the Englifh. Goods ufed to be forwarded, on the river Ems, to within a fhort diftance of Munfter in Weftphalia; from which city they were conveyed by land-carriage to the interior of the continent, to Switzerland, and Italy. In the year 1781, the number of fhips cleared outwards was 1025, inwards 1004; but in 1799, there entered at Emden inwards 3402 veffels, and 2151 failed outwards. In 1784, Emden had 273 veffels of the tonnage of 38,578 tons, befides 43 veffels for the herring fifhery; in 1804, the number of fhips employed in the carrying trade only, belonging to Emden, exceeded 500.

The population of Emden, in the year 1785, amounted to 7968 individuals, without the garrifon: in 1802, Emden counted 10,400 inhabitants. The herring fifhery produced annually near 1000 tons of herrings. It employed 60 boats, and a great many hands among the lower orders of the people.

EMEGIAGEN, a town and fortrefs of Africa, in the empire of Morocco.

EMENDALS, an old term ftill ufed in the accounts of the Inner Temple; where, fo much in emendals at the foot of an account, on its balance, fignifies fo much in the bank, or ftock of the houfe, for reparation of loffes, and other occafions.

EMENDATIO *Panis & Cerevifia*, the affize of bread and beer; or the power of fupervifing and correcting the weights and meafures belonging to them. See Assize.

EMERALD. Of this mineral there are two diftinct varieties: the true emerald, and the beryl or aquamarine, both of which we fhall proceed to defcribe.

True Emerald.—Emeraude Verte, *Fr.* Schmaragd, *Germ.*

The colour of emerald is pure prifmatic green, of various degrees of intenfity; but the deep-coloured varieties pafs occafionally into grafs and verdegris-green, and the lighter ones into greenifh-white. The only natural ftate in which it has been hitherto met with is cryftallized. Its primitive form is a regular hexahedral prifm; fometimes the lateral edges are replaced by fecondary planes, forming a dodecahedral prifm; or, the folid angles are replaced by fmall triangular facets; or, the terminal edges are bevelled, fometimes very flightly, and fometimes fo deeply as to prefent the appearance of terminal truncated pyramids. The length of the prifms feldom greatly exceeds their diameter. The cryftals are middle-fized and fmall, rarely large: they are generally implanted, and fometimes imbedded, and always occur in clufters. The internal luftre is vitreous and fhining; the fracture is fmall and imperfectly conchoidal, paffing into obfcurely foliated. It is tranfparent or tranflucent, and exhibits a double refraction. Its hardnefs is fomewhat fuperior to that of quartz. Sp. gr. 2.72 to 2.77.

It is fufible *per fe* before the blow-pipe, but with difficulty, into a femi-opake whitifh glafs. With borax it melts eafily, and without effervefcence. Its conftituent parts, according to Vauquelin and Klaproth, are as follows:

	Vauq.		Klapr.
Silex -	64.50	—	69.
Alumine -	16.	—	15.
Glucine -	13.	—	12.5
Lime -	1.6	—	0.25
Oxyd of chrome	3.25	—	0.25
Oxyd of iron	0.	—	1.
Water -	2.	—	0.
	100.35		98.

It is at prefent found only in Peru, in the valley of Tunia or Tomana, between the mountains of New Granada and Popayan; and near Puerto Viejo, in the diftrict of Manta, in the fame province. It is faid to occur in veins, paffing through argillaceous fchiftus, and other primitive rocks, and is accompanied by quartz, felfpar, black fchorl, mica, calcareous fpar, and iron pyrites.

Emerald is reckoned among the gems, and when of a fine colour, and without flaws, is highly efteemed. The moft magnificent fpecimen known of this mineral was prefented to the church of Loretto, by one of the Spanifh kings: it confifted of a mafs of white quartz, thickly implanted with emeralds, more than an inch in diameter.

The emerald is fuppofed by Dutens and others to have been unknown to the ancients; and it is certain, that feveral of their defcriptions of the fmaragdus are not at all correfpondent, except in colour, to the modern emerald. But among the twelve kinds of fmaragdus, or rather pfeudofmaragdus, enumerated by Pliny, one of them, and that the moft valued, appears to be the real emerald. With regard to its colour, this naturalift fays, "Nihil omnino viridius comparatum illis viret." He ranks it, in eftimation, immediately after the diamond and pearl; and adds, that fo pleafing was its tone of colour, that by common confent the engraver was ordered to fpare it; "Quapropter decreto hominum iis parcitur, fcalpi vetitis." The emeralds of the ancients were procured from Ethiopia; but thefe mines have now been for many ages forgotten and neglected; nor is it certain that any except the Peruvian emeralds are now extant. The only one that may with any probability be referred to an African origin, is that with which pope Julius II. adorned the papal tiara: for as this fovereign died in 1513, and the enterprize of Pizarro againft Peru did not take place till 1545, it is not unreafonable to conclude that the emerald in queftion is not an American one. There are two fpecimens, which formerly obtained great eftimation as invaluable Ethiopian emeralds, which the fuperior accuracy of modern knowledge has ftripped of their value, both in the eyes of the naturalift and of the jeweller. The one is a tabular mafs, of the weight of 28 *lbs.* now in the abbey of Reichenau, and which formerly belonged to Charlemagne: this Mr. Coxe has afcertained to be green fluor. The other is the "Sacro cattino de Smeraldo orientale," which was depofited in the treafury of Genoa, and was not allowed to be feen except in confequence of an order from the fenate: in this the acute eye of M. Condamine

mine detected fome air-bubbles, which induced him to confider it as only green glafs; and fubfequent examination has fully confirmed his fufpicion.

Beryl, or *Aquamarine*.—Emeraude verte bleuatre, Hauy. Edler beril, Wern. Its colour is mountain-green, paffing into whitifh-green, yellowifh-green, wine-yellow, and honey-yellow, or blueifh-green, paffing into fmall and fky-blue. Its colours are almoft always pale; and when two exift in the fame cryftal, they are generally arranged in alternate layers. The primitive form and varieties of cryftallization are the fame as thofe belonging to the true emerald; but the actual and proportional length of the prifms is much greater. The lateral planes of the cryftal are ftriated longitudinally, fo as fometimes to give the prifm a cylindrical appearance. The joints perpendicular to the axis are generally very diftinct, and moft commonly are plane furfaces; but fometimes, like thofe of articulated bafalt, they are formed by a convex protuberance let into a cup-fhaped concavity. Another fingular accident to which this mineral is fubject is, that a prifm, which at its lower end is folid, terminates occafionally in a brufh-like extremity, compofed of numerous fmall prifms. Sometimes a joint is fo difpofed, that it is no longer perpendicular to the axis of the prifm; in confequence of which, an elbow is produced, as if the prifm had been broken acrofs, and the pieces ill cemented together again. Sometimes, again, the axis of the prifm is perforated. The fize of the cryftals varies from capillary to 18 inches long by 2 or 3 in diameter. Its external luftre is fhining and gliftening; internally, it is brilliant and vitreous. The crofs fracture is fmall, and imperfectly conchoidal; the longitudinal fracture is foliated. It is commonly tranfparent, paffing into tranflucent; its hardnefs is nearly the fame as that of the emerald. It is electric by friction, and often phofphorefcent. Sp. gr. 2.68 to 2.72.

According to the analyfes of Vauquelin and Rofe, it is compofed of,

	Vauq.		Rofe.
Silex -	68.	—	69.
Alumine -	15.	—	14.
Glycine -	14.	—	14.
Lime -	2.	—	0.
Oxyd of iron	1.	—	1.
	100.		98.

Beryl occurs imbedded in primitive rocks, alfo in veins accompanied by quartz, felfpar, fluor fpar, garnet, mica, and topaz. It is found in Brazil, in Saxony, in the fouth of France, near the village of Barat, whence very large but ill-coloured cryftals have been procured, and occafionally in the higheft mountains of Aberdeenfhire. But the fineft fpecimens of all come from Siberia, and are found chiefly in three places of this vaft country.

Firft, in the Uralian mountains, about 25 leagues to the north of Ekaterinbourg. The fpecimens that come from this mine are of a fmall fize, but a very good colour.

Secondly, in the Altaic mountains, between the Ob and the Irtifch. The cryftals from this mine are large, and of a greenifh-blue colour, but coarfe, and mixed with quartz.

Thirdly, in the granitic mountain of Odon Tchelon, in Daouria. This is by far the moft interefting and the richeft mine. There are in fact three different mines at different heights on this mountain, from which beryls are procured: that fituated the loweft is in a mafs of femi-decompofed granite, mixed with ferruginous clay and nodules of Wolfram; in this there are irregularly diffeminated minute prifms of beryl, rarely exceeding an inch in length, and of a greenifh-yellow colour. About 800 yards above this mine is an irregular vein of micaceous clay, from which are procured the moft valuable cryftals; their colour is a pure pale green, and their dimenfions not very unfrequently amount to feven or eight inches in length by two in diameter. At the very fummit of the mountain is fituated the third mine, in a vein of white indurated clay, mixed with arfenical pyrites: the beryls that it yields are generally of a greenifh blue colour, but fometimes of a pure but pale fky-blue, and very tranfparent.

Beryl is ranked by courtefy among the gems, but its value is greatly inferior to that of the emerald.

Emerald, *Oriental*, is a greenifh variety of fapphire.

Emerald, *Counterfeit*. The manner of making counterfeit emeralds in pafte is this: take cryftal prepared, two ounces; common minium, or red lead, four ounces; mix thefe well together, then add of good verdegris two pennyweights, and crocus martis made with vinegar, eight grains. Mix all thefe well together, and fet the whole in the hotteft part of a potter's furnace, as long as the fire lafts. It muft be put in a ftrong crucible, and covered with a lute. When it is cold take off the lute, and, if it is baked enough, it will be clear to the bottom; otherwife relute the pot, and put it into the furnace again. Twenty-four hours commonly are fufficient for making this; fometimes it requires a little more. The pafte, thus made, is harder than ordinary, and is of a fine colour, and capable of a good polifh. Neri's Art of Glafs, p. 128.

If the pafte be defired of a very deep emerald colour, take prepared cryftal one ounce; red-lead, fix ounces and a half; of verdegris, three penny-weights and thirteen grains; and of crocus martis, made with vinegar, ten grains. This requires a longer baking than the other, and is lefs hard, though of a deeper colour.

The proportions of thefe ingredients may be varied at pleafure, and the colour be made of all degrees of deepnefs; but the more lead is added, the more baking is required, and, after all, the pafte will be fo much the fofter.

Emerald *Colour*, in the *Glafs Trade*. The way of giving this beautiful dye to glafs is this: in the pots of melted metal, made of polverine, and without manganefe, when the matter is well purified, put a little crocus martis calcined with vinegar. About three ounces of this crocus is enough for a hundred weight of glafs; let it ftand till thoroughly mixed, then put into every hundred weight of metal two pounds of calcined brafs; this muft be added at fix different times, letting the metal ftand two hours every time. When this is all in, make a proof of the metal; and if it has any blueifhnefs, add more crocus martis, a fmall quantity at a time. When the whole is of a fine leek-green, let it ftand twenty-four hours to mix thoroughly, and then work it. Neri's Art of Glafs, p. 51.

Emerald, or *Emeraud*, in *Heraldry*, is ufed in lieu of vert, or green, in blazoning the arms of dukes, earls, &c.

EMERGENT Year, in *Chronology*, is the epocha, or date, whence we begin to account our time.

Our emergent year is fometimes the year of the creation; the Jews ufe that of the deluge, or the Exodus, &c. The emergent year of the Greeks was the eftablifhment, or at leaft reftoration, of the Olympic games by Iphitus. The Romans accounted their years from the building of the city, ab u. c. that is, ab urbe condita. See Epocha.

EMERITA Augusta, in *Ancient Geography*. See Augusta, and Merida.

EMERSA, Folia, in *Botany*, applies to fuch leaves of aquatic plants as are raifed above the furface of the water, and

and which are ufually of a different figure from thofe that are *immerfa*, or funk under water. See LEAF.

EMERSION, in *Phyfics*, the rifing of any folid above the furface of a fluid fpecifically heavier than itfelf, into which it had been violently immerged, or thruft.

It is one of the known laws of hydroftatics, that a lighter folid, being forced down into a heavier fluid, immediately endeavours to emerge; and that with a force, or moment, equal to the excefs of a weight of a quantity of the fluid above that of an equal bulk of the folid.

Thus, if a folid be immerged in a fluid of double its fpecific gravity, it will emerge again, till half its bulk, or body, be above the furface of the fluid.

EMERSION, in *Aftronomy*, is when the fun, moon, or other planet, begins to re-appear, after its having been eclipfed, or hid by the interpofition of the moon, earth, or other body.

The difference of longitude is fometimes found by obferving the immerfions and emerfions of the firft of Jupiter's fatellites.

The immerfions are obferved from the time of Jupiter's being in conjunction with the fun, to his oppofition; and the emerfions, from the oppofition to the conjunction; which two intervals are ufually fix months a-piece, and divide the year between them.

But when Jupiter is in conjunction with the fun, and fifteen days before and afterwards, there is nothing to be obferved; the planet, with his fatellites, being then loft in the light of the fun.

EMERSION is alfo ufed when a ftar, before hid by the fun, as being too near him, begins to re-appear, and to get out of his rays.

EMERSION, *Scruples*, or *Minutes of*, an arch of the moon's orbit, which the moon's centre paffes over, from the time fhe begins to emerge out of the fhadow of the earth to the end of the eclipfe. See ECLIPSE.

EMERSON, WILLIAM, in *Biography*, an eminent Englifh mathematician, was born in 1701, at Hurworth, a village near Darlington, in the county of Durham. His father kept a fchool, and was a good mathematical fcholar: to him, and to a young clergyman, the fubject of this article was chiefly indebted for his early inftruction in the different branches of the mathematics. He attempted to keep a fchool himfelf, but foon found his temper unfitted for the tafk; and, on the death of his parents, having come into the poffeffion of a moderate competence, he devoted himfelf to a life of ftudious retirement, where he compofed a great number of treatifes, by which his name has been long known to all lovers of fcience; and from the profits of which he redeemed his little patrimony from fome incumbrances which he found on it. He enjoyed a good ftate of health till nearly the clofe of his life, when he had frequent and very fevere attacks of the ftone; a difeafe to which, in the year 1782, he fell a victim, when he had attained to the 81ft year of his age. Mr. Emerfon was fingular in his behaviour, drefs, and converfation. His manners were rough, coarfe, and often very difagreeable. In converfation, he was pofitive, dogmatical, and impatient of contradiction. His relaxation from ftudy was fometimes working in the fields, and fometimes the amufement of fifhing, to which he was much attached. When he had any treatife for publication, he always went to London, to attend to the printing himfelf. He was an able mathematician; but his ftyle as a writer is not adapted to fmooth the path of fcience for beginners. His works, which are very numerous, are now chiefly fuperfeded by other and more popular writers, who have had the better art of facilitating the ftudies of young perfons, by a more agreeable ftyle, and an eafier method of demonftration. His "Treatife on Mechanics" is that which is now beft known, and to which reference is more frequently made than to any of his other works.

EMERSTORFF, in *Geography*, a town of Germany, in the archduchy of Auftria, feated on the Danube; 6 miles above Crems.

EMERUS, in *Botany*. See CORONILLA, fpecies 1.

EMERY, *Schmiergel*, Wern. in *Mineralogy*. Its colour is greyifh-black or blueifh-grey. It occurs maffive and diffeminated: when in mafs, it is generally encrufted with magnetic iron ore, pyrites, and mica; the latter fubftance frequently penetrates the whole mafs, giving it, when broken, a filvery appearance. It poffeffes a gliftening or glimmering luftre. Its fracture is fine-grained uneven, paffing into fplintery. In hardnefs it is about equal to Adamantine fpar, cutting flint and rock-cryftal with great eafe. It is heavy, and not very eafily frangible. When moft free from iron, it confifts, according to Tennant, of

Silex	- -	3.4
Alumine	- -	92.
Iron	- -	4.6
		100.

When highly impregnated with iron, this ingredient amounts to about 36 *per cent.*

Emery is procured from the iflands of the Archipelago, efpecially from Naxos; alfo from the neighbourhood of Alocer, in Eftremadura, in Spain. Much of the emery ufed in France is imported from the iflands of Guernfey and Jerfey, in the Britifh channel. It is alfo found at Ochfenkopf, in Saxony, in beds of talc and fteatite.

This mineral is largely ufed for cutting and polifhing, by lapidaries and workers in glafs and metal. The mode of its preparation is very fimple. Being pulverized in an iron mortar, it is carefully wafhed over, and thus feparated into five or fix different degrees of finenefs, according to the work in which it is to be employed.

EMER-YAPAR, in *Geography*, a town of Afia, in Thibet; 17 miles from Cha-tcheou.

EMESA, EMISA, *Emiffa*, or *Emefus*, in *Ancient Geography*, an ancient city of Syria, fituated on the eaftern bank of the Orontes, between Apamea and Laodicea Cabiofa. During the troubles which agitated Syria, this city was feized by an Arabian, named Sampficeramus, who, affuming the title of king, held Emefa and its fmall territory, undifturbed by the Seleucidæ, engaged in more important concerns. He left two fons, Jamblichus and Alexander; the former of whom fucceeded his father, and was much attached to the Romans. In the civil wars of Rome, he took part firft with Cæfar againft Pompey, and afterwards with Antony againft Octavianus. After the victory gained by the latter at Actium, Antony, dreading his concurrence with other princes in favour of the conqueror, and upon this fufpicion, having got him into his power, caufed him to be put to a moft cruel death. Upon his death, Antony beftowed the kingdom on his brother Alexander, who, continuing faithful to his benefactor in his greateft diftrefs, was taken prifoner by Octavianus, and not only deprived of his kingdom, but carried in triumph to Rome, and afterwards put to death. His fon, Jamblichus II., was favoured by Octavianus, and reftored by him to his father's kingdom, after he had remained for fome time in a ftate of exile. He had fome fucceffors, who fupported the dignity of this fmall kingdom; but the laft of its kings, whofe name is recorded

corded in hiftory, was Azizus, who, falling in love with Drufilla, the fifter of Agrippa Minor, embraced the Jewifh religion, in order to marry that princefs. This fmall kingdom was afterwards, as we may prefume, feized by the Arabians; for we find that, fome years after, it was poffeffed by the Ituræans. Emefa was the birth-place of the emperor Heliogabalus; and it was one of the cities in which the Romans planted colonies. It is now called *Homs;* and though formerly a ftrong and populous city, it is at prefent only a large ruinous town in the pachalic of Damafcus, containing not more than 2000 inhabitants, partly Greeks and partly Mahometans. An aga refides here, who holds, as a fub-renter of the pacha of Damafcus, the whole country as far as Palmyra. The pacha himfelf holds this farm, as an appanage deriving immediately from the fultan. Hama and Marra are held in the fame manner; and thefe three farms pay 400 purfes, or 500,000 livres (about 20,000*l.*), but they produce nearly four times that fum. Volney's Travels in Egypt and Syria, vol. ii.

EMETICS, in *Medicine,* from ἐμέω, *I vomit,* thofe fubftances which excite vomiting, or caufe the ftomach to reject its contents upwards.

Medicines of this clafs have been employed, for the purpofe of clearing the ftomach, from the earlieft ages to which any authentic records of practice extend. In the time of Hippocrates, indeed, the ufe of emetics feems to have been very general, not only as a remedy in difeafes of fome feverity; but as a popular expedient for relieving flight indifpofition, efpecially the occafional derangements of the organs of digeftion, brought on by indulgence in eating and drinking. Hippocrates even recommends them to the healthy as a prefervative; and he has ftated many precepts with refpect to the proper times for adminiftering them, in conjunction or alternation with fafting, bathing, exercife, &c. under various circumftances of health and difeafe. See his treatife on Diet, book iii. and elfewhere. Yet it muft be remarked, that the catalogue of emetic fubftances in the poffeffion of the ancients was very imperfect, in comparifon with our own; and confifted either of uncertain and almoft inert articles, on the one hand, or of fevere and rather unmanageable fubftances on the other. Hippocrates prefcribed powdered hyffop in about a gallon of water, as a vomit for corpulent men, with the addition of a little vinegar and falt; it was to be drank at firft gradually, and afterwards more quickly.

Celfus has likewife detailed a fet of rules, relative to the ufe of emetics, among the means of reducing the habit, if too plethoric. He fays, " emetics are more ufeful in the winter than in the fummer, becaufe in that feafon there is more phlegm, and a greater heavinefs in the head. They are of no advantage to thofe who are flender, or who have a weak ftomach; but are ufeful to plethoric, and bilious people, whether they have fuffered from repletion, or have their digeftion impaired. For if they have taken more than the digeftive power is able to concoct, they ought not to rifk the danger of its corrupting; and if it is already corrupted, it is proper to expel it in the moft expeditious way poffible. Hence, when any perfon is attacked with bitter eructations, together with pain and weight in the region of the ftomach, let him immediately refort to a vomit. It is alfo proper for thofe, who have a fenfe of heat in the breaft, a frequent fpitting or naufea, or a noife in the ears, or humour in the eyes, or a bitternefs in the mouth," &c. " I grant," he obferves farther, " that emetics fhould not be taken for the fake of indulging a luxurious appetite; but that they are advantageous in fome forms of difeafe, I know from experience: I admonifh thofe, however, who wifh to enjoy good health and attain old age, not to make a daily ufe of them. If any one wifhes to vomit after taking food, he fhould firft drink warm water only, if he vomits eafily; if with fome difficulty, he fhould add a little falt or honey to the water: but he that intends to vomit in the morning, fhould drink *mulfe* (a mixture of wine and honey,) or eat hyffop, or radifh, and then drink warm water, as has been already directed. All the other fubftances, which the ancient phyficians prefcribed, are injurious to the ftomach. If that organ is weak after the vomit, a little food fhould be taken, of a proper kind; and if the fauces have been much irritated, three cups of cold water may be drunk. He who has ufed a vomit, if it were in the morning, ought to take a walk, then anoint, and afterwards fup; but if after fupper, he fhould bathe on the following day, and fweat in the bagnio: he will do well to make the next meal flight, and that of roafted meat, with auftere and unmixed wine, ftale bread, and food of the drieft kind." He concludes with this obfervation: " he that chufes to vomit twice in the month, will find it more advantageous to do it for two days fucceffively, than if he were to repeat it on the fifteenth day; unlefs this intermiffion fhould occafion a weight at his breaft." De Medicinâ, lib. i. cap. 3.

Thefe ftatements fhew, that the ufe of emetics conftituted a part of that regimen, among the ancients, in which more of their time was occupied, and more attention beftowed, than the moderns in this country are accuftomed to give to the fubject. They alfo reforted to vomiting, as a remedy in fevers, and other difeafes. See Celfus, lib. iii. cap. 7. And emetics, as well as purgatives, were employed after the termination of fevers, upon theoretical principles, to evacuate the remainder of the morbid matter, after its virulence was fuppofed to be fubdued by concoction. In the ufe of purgatives, we find fome remains of this theory among the people, as well as among the ignorant part of the profeffion, even at the prefent day. Hippocrates feems to have believed, that this remnant of the morbid matter, like a piece of leaven, if retained after the crifis, was the occafion of the return of the difeafe. " Quæ per morbos poft judicationem intus relinquuntur, morborum reverfiones faciunt." Aphor. 12. fect. ii.

The direct effect of an emetic is the evacuation of the contents of the ftomach. Hence the principal purpofe, for which it may be ufed, would feem to be the removal of morbid or noxious matters from that organ; whether confifting of its own fecreted juices, in a difeafed condition of indigeftible food, either from quantity or quality, of poifons, or of other noxious fubftances, which may have been fwallowed. Hence the vulgar refort to emetics on every occafion of what is popularly called a " foul ftomach," or of " bile on the ftomach." Thefe conditions are prefumed to exift, when fuch fymptoms as the following are prefent: when there is a want of the ufual appetite, or, in addition to that, a loathing of food; or, when, after food, or during the time of its digeftion, an uneafy fenfation of fullnefs, weight, and diftenfion is felt in the ftomach, efpecially if accompanied with heartburn, flatulency, and acid or bitter eructations; and to thefe may be added frequent head-achs, particularly in the morning.

Now, although it cannot be queftioned, that the removal of the prefent contents of the ftomach, in fuch cafes, generally affords more or lefs relief; it is not the lefs certain, that this relief is feldom very durable; for the noxious matters are more frequently to be confidered as the effects, than as the caufes of the morbid condition of the ftomach: they depend moft commonly on the weaknefs and lofs of tone in the mufcular fibres of the ftomach, and the imperfect fecretion of the gaftric juice; and thefe, it is obvious, are not to be cured by by vomiting, though their consequences may be relieved by this for a longer or shorter time. On the contrary, there can be no doubt, that frequent vomiting renders the stomach less able to retain, what is thrown into it, and to weaken its powers of digestion. " They are unhappy," says Dr. Cullen, " who trust to this mode of relief, and have therefore frequent recourse to it; for I am certain, from much experience, that frequent vomiting hurts the tone of the stomach, and often makes the symptoms of indigestion recur more frequently and sooner than they otherwise would have done." Treatise on the Materia Medica, vol. ii. p. 465.

The same author remarks, that the effects of vomiting, and the degree of disease that required it, are commonly judged of by the vulgar, and often by physicians, though not always fairly, by the appearance of the matter thrown up. For example, there is commonly thrown up a considerable quantity of viscid mucus; and to this the symptoms of the disease are frequently imputed. " It is, indeed, possible," he adds, " that an unusual accumulation of mucus in the stomach may be the cause of want of appetite, and other symptoms of indigestion, but not always so justly as might be imagined. The mucous follicles of the stomach constantly pour out a considerable quantity of this matter; a considerable quantity is to be found in the stomachs of the most healthy persons: and the experiments of M. Senac shew, that there is always a considerable quantity of it in the mucous follicles, which may very readily be squeezed out very copiously in vomiting. It is not, therefore, to be judged that the quantity, and even a large quantity, thrown up by vomiting, had either previously existed in the cavity of the stomach, or that such a mucus had been the cause of the morbid symptoms, indicating therefore the repetition of vomiting. It has been upon occasions of this practice, that I have known repeated vomiting, not only to give no durable relief, but rather to increase the supposed cause."

The evacuation, however, occasioned by an emetic, is not confined exclusively to the stomach; the upper part of the intestines, namely, the *duodenum*, and even part of the *ilium*, is commonly evacuated at the same time. The peristaltic motion of the alimentary canal may proceed either downwards or upwards; and when the action of any part of it is directed in one way, the next adjoining portion follows in some degree the same direction. Whence, in vomiting, as the peristaltic motion of the stomach is directed upwards, so the motion of the duodenum, is directed in the same way, and it pours its contents into the stomach; from which it will appear that a considerable portion of the upper part of the intestines may be evacuated. The most clear proof of this inverted motion of the duodenum, in vomiting, is, that, especially after repeated vomiting, a quantity of bile is poured into the stomach, and is in consequence thrown out by the mouth. This frequent appearance may depend entirely upon the quantity of bile for the time present in the duodenum; but it probably extends farther. In the action of vomiting, as the contraction of the diaphragm and of the abdominal muscles concurs at the same time, the whole viscera of the abdomen are strongly pressed: this pressure must affect the gall bladder and the biliary ducts, and occasion them to pour out their contents very largely, which, being thrown into the stomach from the *duodenum*, may be ejected by vomiting. It is commonly supposed, indeed, by the vulgar, that the bile thus thrown up existed previously in the stomach, and in some instances it may have been so: but it is more probable that it had been brought from the *duodenum*, and even from the gall-bladder and biliary ducts in the way just explained. For had the bile been previously lodged in the stomach itself, it might have appeared in the first vomitings, as well as in the last; but it happens, in almost all instances, that the bile is thrown out by the mouth only after repeated vomitings, and often after repeated strainings in the organs employed in that act.

Dr. Cullen attributes some good effect to the pressure on the liver and abdominal viscera, just alluded to, in obviating the stagnations which are liable to occur in the system of the *vena portarum*, and which lay the foundation of obstinate diseases. He affirms, that he knows no means of expediting the circulation in the liver so powerful as that of vomiting. Other writers have expressed an opinion of the advantages derived from this mechanical pressure and conquassation of the viscera of the abdomen, in exciting the mesenteric circulation, as well as that of all the glands, and consequently in favouring and aiding all their secretions. (See Dr. Fothergill, De emeticorum usu, &c. Cullen, loc. cit. p. 468.) Dr. Cullen, however, considers the effects of this mechanical compression and motion as most evident in the viscera of the thorax, especially in promoting expectoration: hence the utility of vomiting in catarrhal affections, more particularly the chronic catarrh of old people. He also allows that it may be useful in many cases of pulmonary consumption; but justly adds, that we cannot, either from theory or experience, find any reason to believe that frequent vomiting is adequate to cure that disease.

There is also another indirect action of vomiting, which is beneficial to the system, arising from the sympathy between the stomach and the skin. This sympathetic consent between the vessels of the skin and of the stomach is very great, insomuch that the several states of each may be communicated to those of the other. Thus, wetting the skin relieves thirst, as was proved by Capt. Bligh and his party; and in the same way the action of an emetic excites particularly the action of the vessels on the surface of the body; and this action is excited by doses of these medicines, which are not sufficient to excite vomiting. Hence most of the substances employed as emetics are capable of exciting perspiration. We are disposed to believe that a similar sympathy, between the stomach and the vessels in the cells of the lungs, is the cause of the utility of vomiting in producing expectoration, rather than the mere mechanical pressure of the lungs.

The action of vomiting, when excited rather briskly, by the general shock or conquassation of the whole frame, affects the nervous system at large as a stimulant. In this way the utility of an emetic, in the commencement of a continued fever, is partly to be accounted for. Dr. Cullen, indeed, attributes the advantages of vomiting in that case to the relaxation of the spasm of the extreme vessels in the skin, according to his theory of fever; and partly, perhaps, the operation may be accounted for in this way: but it is to be remarked, that other expedients, which have nothing in common but the general shock which they occasion to the nervous system, also contribute to cut short or to alleviate fever, under the same circumstances; a brisk purgative, for example, cold affusion, or the shower-bath, &c.

It is also observed by Dr. Fothergill, who ascribes considerable effects to the *stimulant* operation of emetics, that, in spasmodic disorders, and several others of the nervous kind, which seem to arise principally from the torpor and languor of the digestive organs, emetics are often of essential benefit. He mentions Chorea, or St. Vitus's Dance, certainly not the least obstinate of nervous complaints, as often relieved by emetics.

The same celebrated physician cautions us particularly respecting the administration of emetics to those who are of plethoric habit, or who labour under difeafes, in which general or local plethora is prefent. If the fymptoms, in fuch cafes, indicate the propriety of employing emetics, blood-letting ought, in his opinion, to precede their ufe; for there is danger, left in the temporary convulfion of ftraining to vomit, the diftended veffels fhould be ruptured, or the blood be carried with too great force, or in too great quantity, to parts where the refiftance of the veffels is too weak to withftand it. Thus, if the veffels of the head fhould give way, a fudden and fatal apoplexy may be brought on; if thofe of the lungs fhould be ruptured, a fpitting of blood, followed by a flow, but not lefs fatal confumption, may be induced, or fimilar mifchief may be occafioned in other vifcera. (Loc. citat.) In cafes, however, in which thefe plethoric difeafes are to be fufpected, the prudent practitioner will, even after blood-letting, confider emetics as inadmiffible, unlefs the neceffity of immediately emptying the ftomach of its contents be great and preffing.

The occafion, on which fuch a neceffity is the moft obvioufly paramount to all other confiderations, is when poifon has been recently fwallowed. In this cafe, the greateft rifk is from the operation of this fubftance on the ftomach, and therefore the moft expeditious means of inducing vomiting are to be adopted. If the poifon be of the vegetable narcotic fpecies, fuch as opium, it often fo completely paralyzes the mufcular fibres of the ftomach, as that ordinary emetics have no power to excite its action. The white vitriol, or fulphate of zinc, operates in general almoft inftantaneoufly, efpecially if fwallowed with a large quantity of water. When this has failed, we have known a few grains of the blue vitriol, or fulphat of copper, diffolved in warm water, given with fuccefs, where opium had been fwallowed. A ftrong infufion of ipecacuanha, drank copioufly, has fometimes effectually emptied the ftomach under fimilar circumftances.

In a fit of inebriety, when vinous or fermented liquors have been drunk to the extent of inducing a ftate approximating to apoplexy, the fafeft, perhaps, and beft mode of emptying the poifon from the ftomach, confifts in pouring in warm water as copioufly as it can be fwallowed; fince it at once dilutes the inebriating liquor in the ftomach, and therefore diminifhes its effects, and urges the ftomach to expel it. See Drunkenness.

Although emetics have been found to be beneficial in the early ftages of all fevers, as already mentioned, yet we muft not here omit to notice their peculiar good effects in the fcarlet fever, as obferved by Dr. Withering. (See his Treatife on the Scarlet Fever.) This fact, indeed, had been pointed out by Tournefort (in his voyage to the Levant, tom. i.), and other writers; but Dr. Withering recommends vomiting, repeated according to circumftances, as the moft effential remedy for this difeafe. "In the very firft attack," he fays, "a vomit feldom fails to remove the difeafe at once. If the poifon has begun to exert its effects upon the nervous fyftem, emetics ftop its further progrefs, and the patients quickly recover. If it has proceeded ftill further, and occafioned that amazing action in the capillaries, which exifts when the fcarlet colour of the fkin takes place, vomiting never fails to procure a refpite to the anxiety, the faintnefs, and delirium." Dr. Willan alfo fpeaks highly of the utility of emetics in fcarlet fever, with fore throat, but has not found it neceffary to repeat them fo often as Dr. Withering advifed. Treatife on Cutaneous Difeafes, ord. 3.

Emetics are fometimes ufeful in afthma, and in hooping-cough, probably upon the fame principle as in chronic catarrh, before noticed. They have been faid alfo to affift in forwarding a gall-ftone through the ducts into the inteftines as well as an urinary calculus from the kidney to the bladder, through the ureter, by the mechanical agitation of the body, which they occafion. But their operation in this way muft be very feeble and uncertain, and may do injury, when the calculi are large or angular. Sydenham employed ftrong emetics as remedies for dropfy; but they generally purged alfo, to which operation their good effects, when they did prove beneficial, muft be the rather attributed.

The catalogue of medicines poffeffing an emetic power, which were in ufe among the ancients, although fufficiently ample, contained, as we have already faid, fubftances either of feeble and uncertain action, or of acrid and violent qualities. The hellebore was fometimes fatal. Even Sydenham complained in his time, that an emetic fubftance, which was "fafe, and at the fame time effectual," was a defideratum in the Materia Medica. His active emetic confifted of the *crocus metallorum*, as it was then termed, or *crocus antimonii*, (a preparation made by deflagrating the fulphurated antimony with an equal weight of nitre,) which being foluble in any acid, was moft uncertain in its operation, as it depended upon the quantity of acid with which it met in the ftomach. The ipecacuanha root appears to afford that fubftance to us, which was a defideratum in the time of Sydenham.

We may, with Dr. Fothergill, confider emetics under three heads, the very mild, the moderate, and the ftrong or draftic; not to mention the irritation of the throat with a feather; the exercife of fwinging, failing, or whirling round certain objects of fight, &c. which are not reforted to as remedies. Among the mildeft means of exciting vomiting, is filling the ftomach fuddenly with a large quantity of liquid; fimple warm water is generally fufficient for the purpofe; but its operation is aided, when other fubftances of little power are combined with it: thus, infufions of green tea, of chamomile flowers, the carduus benedictus, broths, &c. may be employed for this purpofe. Again, when it might not be proper to give an emetic fubftance, in fuch a dofe as might of itfelf excite vomiting, by the affiftance of copious draughts of warm water, fmall dofes may ferve the purpofe of evacuating the ftomach, and even of obtaining the other effects to be derived from vomiting.

The moderately active emetic fubftances are thofe which are at prefent in general ufe; namely, the ipecacuanha, and the tartar emetic, or tartrite of antimony, in fmall dofes; and alfo fome other fubftances, when much diluted with warm water, which might be of too inflammatory a nature if given alone, in fuch quantity as to produce vomiting; fuch are, an infufion of the root of horfe-radifh, or a tea-fpoonful of muftard as prepared for the table, fome preparations of the fquill, the afarum, &c. The ipecacuanha was firft introduced as a remedy for dyfentery; but it is now afcertained that its utility in that difeafe depends upon its purgative quality.

The metallic falts formed with fulphuric acid are active emetics, and may be arranged in the ftrongeft or draftic clafs. The leaft violent of thefe is the white vitriol, or fulphate of zinc, which has been chiefly employed on account of the fuddennefs of its operation, when poifonous matters have been taken into the ftomach: but, in order to render its effects certain, the dofe muft generally be large, and if it is not thrown out again immediately, it is apt to continue a difagreeable naufea, or even a vomiting, longer than is neceffary. Dr. Cullen fays, "I find that the purpofe of this medicine (that is, a fudden vomiting,) may commonly be obtained by employing a large dofe of ipecacuanha, either in powder or in the wine; and by following this foon after with a large draught

draught of warm water impregnated with chamomile, or rather with what is more at hand, a tea-ſpoonful of table-muſtard; the buſineſs may be commonly very effectually executed."

The preparations of mercury are ſeldom employed as emetics. The ſulphat, or turpeth mineral, has been chiefly uſed, but its operation is violent.

Dr. Darwin obſerves, that "the quantity of the doſe of an emetic is not of ſo great conſequence as of other medicines, as the greateſt part of it is rejected with the firſt effort. All emetics are ſaid to act with greater certainty when given in a morning, if an opiate had been given the night before. For the ſenſorial power of irritation of the ſtomach had thus been in ſome meaſure previouſly exhauſted by the ſtimulus of the opium, which thus facilitates the action of the emetic; and which, when the doſe of opium has been large, is frequently followed on the next day by ſpontaneous ſickneſs and vomitings, as after violent intoxication." Zoonomia, part 3. art. v. 2. 1.

Emetic *Powder*, called alſo *powder of Algaroth*, from the name of its author, is a precipitate of antimony; or butter of antimony ſweetened and ſoftened by repeated lotions. See Antimony.

Emetic *Tartar*, is now called *Antimonium Tartariſatum*. See Antimony.

Emetic *Wine*, *vinum antimonii*, is only white wine, wherein is infuſed ſome glaſs of antimony. See Antimony.

Small doſes of emetic wine have been recommended as deobſtruent and ſudorific in ſlow fevers, in many chronical diſeaſes, and eſpecially in an obſtinate rheumatiſm. See Medic. Eſſ. Edinb. abr. vol. i. p. 170. and Huxham, Obſ. de Aere & Morb. epidem.

EMETZ, in *Geography*, a town of Ruſſian Siberia, in the government of Tobolſk; 28 miles W. of Iſchim.

EMEU, in *Ornithology*, the common name of the Caſſowary, a large bird of the oſtrich kind.

EMILE, in *Geography*, a ſmall town of France, in the department of the Seine and Oiſe, chief place of a canton in the diſtrict of Pontoiſe, with a population of 1800 individuals. The canton contains 20 communes and 13,843 inhabitants, on a territorial extent of $127\frac{1}{2}$ kiliometres.

EMILI, Paul, in *Biography*, a modern hiſtorian, was born at Verona. In Italy he obtained a great character, and was brought into France by the cardinal de Bourbon, in 1487, who patronized him till his death. After this he was obliged to teach the languages for a ſubſiſtence. He undertook to write the hiſtory of France, for which he was rewarded with a canonry in the cathedral of Notre Dame. This hiſtory he brought down, in ten books, from Pharamond to the 5th year of Charles VIII.; it was publiſhed at different times; and likewiſe altogether at Paris in the year 1539, and has been ſeveral times re printed and tranſlated into foreign languages. His ſtyle is pure, but ſometimes too conciſe, and even bordering on the obſcure; he is nevertheleſs to be regarded as the firſt writer who gave to French hiſtory a juſt form and method. He died at Paris in the year 1529, leaving behind him a very excellent character: his morals were as pure, as the language adopted in his works was chaſte and elegant. Bayle.

EMILION, Saint, in *Geography*, a ſmall town of France, in the department of the Gironde, near the river Dordogne; ſix miles E. of Libourne, remarkable for the excellent wine which grows in its neighbourhood.

EMILIUS, Anthony, in *Biography*, profeſſor of hiſtory in the univerſity of Utrecht; was born Dec. 20th, 1589, at Aix la Chapelle, where his father had retired for the ſake of his religion. He received the early parts of his education in his native country, and finiſhed his claſſical ſtudies at Dort, under the famous Gerard John Voſſius: he then went to Leyden and other univerſities, and ſpent ſome years in foreign travel. On his return to his native country he ſucceeded Voſſius as rector of the college of Dort, and ſome time after he went to Utrecht to exerciſe the ſame office, where he was afterwards elected to the profeſſorſhip of hiſtory, an office in which he continued till his death, November 10th, 1660. His lectures, for more than twenty-ſix years, were taken from the annals of Tacitus. He publiſhed, about the year 1651, a collection of Latin ſpeeches and poems. Bayle.

EMILLAGUE, in *Geography*, one of the Pelew iſlands.

EMINENCE, a little hillock, or aſcent, above the level of the adjoining champain.

Eminence is alſo a title of honour given to cardinals.

The decree of the pope, whereby it is appointed, that the cardinals ſhould be addreſſed under the quality of eminence, bears date the 10th of January, 1630. They then laid aſide the titles of *illuſtriſſimi*, and *reverendiſſimi*, which they had before.

The grand maſter of Malta is likewiſe addreſſed under the quality of eminence.

The popes John VIII. and Gregory VII. gave the ſame title to the kings of France. The emperors have likewiſe borne it.

Eminentiſſimus, the ſuperlative of eminent, hath of late been attributed to the cardinals.

EMINENTIAL Equation is uſed by ſome algebraiſts in the inveſtigation of the areas of curvilinear figures; for a ſort of artificial equation, containing another equation eminently. Hayes Flux. p. 97.

EMINENTLY, Eminenter, in the *Schools*, is uſed in contradiſtinction to *formally*, and in the ſame ſenſe with *virtually*, *viz.* to denote that a thing poſſeſſes, or contains, any other in a more perfect or higher manner than is required to a formal poſſeſſion thereof.

Thus an angel is ſaid to have prudence eminently; as he has it in a higher and more perfect degree than it is in man, in whom it is formally.

For one thing to contain another eminently, there are uſually required two conditions. 1. That the containing be of a more excellent nature than the contained. 2. That the leſs excellent be ſome way contained in the more excellent; *viz.* either as in its productive cauſe, or by ſome ſimilitude, or as to the manner and order of acting, &c.

EMIR, a title of dignity, or quality, among the Turks, and Saracens, attributed to ſuch as are relations or deſcendants of their great prophet Mahomet.

The word is Arabic, and literally ſignifies *prince*. It is formed of the verb אָמַר, *amar*, which is originally Hebrew; and in both theſe languages ſignifies *to ſay*, and *to command*. This is a title given to all the nobility of the firſt rank in the empire of the Mogul and in Tartary. The plural of this term is "Omra."

The emirs are held in high veneration, and have alone the privilege of wearing a green turban. On the borders of the Holy Land there are ſeveral emirs ſovereign princes; as the emir of Gaza, and the emir of Terabea, over whom the grand ſignior has but little authority. The title emir, at firſt, was only given to the caliphs: in Perſia they were alſo called *emir zadeh*, *q. d.* prince's ſon; whence by abbreviation of emir, they formed *mir;* and of *emir zadeh*, *mirza*. In after times, when the caliphs had aſſumed the title of ſultans, that of emir remained to their children, as that of Cæſar did among the Romans.

At length, the ſame title of emir came to be attributed to all who were judged to defcend from Mahomet by his daughter Fatimah, and who wear the green turban.

EMIR is alfo a title, which being joined to fome other word, frequently denotes an office or employ; as the *emir al omera*, commander of commanders, who, in the time of the caliphs, was chief of the councils and armies.

The appellation emir is alfo applied by the Turks to all viziers and bafhaws, or governors of provinces. (See BASHAW, &c.) Add, that *emir akhor*, vulgarly *imrahor*, is mafter of the horfe to the grand feignior.

Emir alem, vulgarly *miralem*, ftandard-bearer and director of all the ftandards of the empire.

Emir bazar, the provoft, or fuperintendant of the markets, who regulates the prices of provifions.

The *emir hagge*, or *hadj*, denoting pilgrimage, or prince conductor of the pilgrims of Egypt to Mecca, is bafhaw, or pacha of Damafcus. See CARAVAN and DAMASCUS.

Emir al mofleim, or *emir al moumenin*, *i. e.* commander of the faithful, or the believers, was a title affumed by the Almoravides and Almohades, who reigned in Africa and Spain.

EMIR-*Bacha*, in *Geography*, a town of Afiatic Turkey, in the province of Natolia; 80 miles W. of Tocat.

EMISSARIA, in *Anatomy*, are the veins which pafs into the fkull from the external parts of the head, and terminate in the finufes of the dura mater. Thefe openings are defcribed in the article CRANIUM. The veins are fometimes called after Santorini, an Italian anatomift. See VEINS.

EMISSARIUM, in *Antiquity*, a fluice, or drain, to draw off the water ufed in watering gardens, fields, &c.

EMISSARY, formed of *e* and *mitto*, *q. d.* I fend out, a trufty, dextrous, able perfon, fent fecretly, to found the fentiments and views of another, to make him fome propofal or overture; or to fpread reports, watch the actions, motions, and countenance of a contrary party or perfon, in order to make advantage of them all. See SPY.

The leaders of parties have abundance of emiffaries employed in their fervice, who inform them of what paffes every where, that they may take their meafures accordingly.

EMISSION, the act of throwing, or driving a thing, particularly a fluid, from within, outwards. The ancients took vifion to be performed by the emiffion of vifual rays from the eye.

But the term emiffion is chiefly applied among us to the expulfion or ejaculation of the feed.

EMISSION *of Heat*.—All the heat we experience in the world is derived from three fources; *viz.* from the fun; from compreffion, which comprehends collifion and friction; and laftly, from the decompofition and compofition of bodies.

It is hardly to be doubted, that the emanation of heat from the fun, like the emanation of light from the fame fource, is not conftantly the fame; and it is recorded in hiftory, that at certain times the light of the fun has been obferved to be pale, or lefs bright than ufual; and had the thermometer been in ufe amongft the ancients, it would probably have been obferved that the dimnefs of light was accompanied with a proportionate diminution of the ufual heat; for thefe alterations, as far as we can conjecture, feem to depend upon the fize of the fpots which cover the furface of the fun at different and uncertain times.

The direct rays of the fun on the fame part of the furface of the earth, are more or lefs hot according to the time of the year, the clearnefs of the atmofphere, the ftate of the wind, and the colour or other quality of the fpot upon which they fall. On this ifland, in the fummer feafon, the direct rays of the fun feldom raife the thermometer to 110° But in other climates, efpecially within the tropics, they raife it much higher; fometimes as high as 150°. We muft not, however, believe the ftrange accounts of their melting lead or firing gun-powder; for thofe rays cannot produce any fuch effect, provided they are not concentrated, or affifted, by artificial means.

It is not on account of the fun's being nearer or farther from us, that we receive much more heat at one time of the year than at another; for the difference of its diftance is too fmall to produce any fenfible effect; nor is it owing to the fun's emitting more calorific rays at one time of the year than at another. But we receive more heat in fummer than in winter, 1ft, becaufe the fun being nearer to our vertex, or to the zenith, in the former, than in the latter feafon, its rays have a fhorter way to pafs through the atmofphere, and are of courfe lefs obftructed by it. And the fame caufe renders the fun's rays hotter about the middle, than at the commencement or the clofe of the fame day: 2dly, we receive more heat when the fun is higher, becaufe in that cafe a greater quantity of its rays fall upon any given portion of the furface of the earth; than when it is lower, and its rays come in a direction more oblique; and, 3dly, becaufe in the fummer feafon the fun remains longer above the horizon than in winter.

With refpect to the caufe of the emiffion of heat from the body of the fun, we cannot pretend to have the leaft knowledge. It is generally fuppofed that the fun is a body of fire; but it is impoffible to fay, whether it is an aggregate of caloric, independent of other matter, or a compound body undergoing a gradual decompofition. It was, fome time ago, alfo fuppofed, that the fun emitted only rays of light, and that the action of thofe rays upon terreftrial bodies, extricated the heat from the latter. But the recent difcovery (made by Dr. Herfchell,) of the calorific rays of the fun fuffering a different refraction from that of its luminous rays, befides other confiderations, renders this fuppofition vain. Excepting from the fun, no fenfible degree of heat is derived from the moon or from any other celeftial object.

The immediate production of heat by the other means that have been mentioned above, *viz.* by compreffion, collifion, friction, compofition and decompofition of bodies, arifes either from the caloric being fqueezed out of a body, like water out of a fpunge; or from an alteration of the capacities of bodies for containing heat. We fhall endeavour to illuftrate thefe proceffes.

I. Experiments fhew, that when a certain fubftance is compreffed into a narrower fpace, a quantity of heat comes out of it, and is communicated to the furrounding bodies. On the contrary, when a certain fubftance is expanded into a larger fpace, it abforbs a quantity of heat from the furrounding bodies; for thefe bodies are cooled in confequence of it. Thus, if you wet your hand, and then expofe it to the ambient air, the water, in the act of expanding itfelf into the form of vapour, abforbs a quantity of heat from the hand, which is thereby fenfibly cooled. If, by means of a condenfing engine, air is compreffed in a proper veffel, heat is extricated from it; and if the operation be performed quickly, a quantity of heat will be emitted, which is fufficient to fet fire to tinder, and other light combuftible bodies. When the fteam of water is condenfed, heat is depofited by it upon thofe bodies which are in contact with it.

Wood rubbed againft wood, or againft any hard body; metal rubbed againft metal, or againft any other hard body; in fhort, folid bodies rubbed or knocked againft each other, are thereby heated, often fo far as to become red-hot.

By this means, heat may be produced where there is no oxygen, fo that in thofe cafes it cannot be derived from the decompofition of that air. This has made fome perfons fufpect that heat is not the effect of a peculiar fubftance called *caloric*; but that it is only a peculiar movement of the particles of bodies. The moft ftriking experiments relative to this fubject were made by count Rumford (Phil. Tranf. for 1798. p. 1.) He took a cannon, not yet bored, having a projection of two feet beyond its muzzle, a part which is ufually caft with the piece, in order to infure the folidity of the metal throughout, by the preffure which its weight occafions. This piece was reduced to the form of a cylinder, joined to the cannon by a fmaller neck, and a large hole was bored in it: the whole cannon was then made to revolve on its axis by means of the force of horfes, while a blunt fteel borer was preffed againft the bottom of the hollow cylinder, by a force equal to about 10,000lb. avoirdupoife; the furface of contact of the borer with the bottom of the cylinder being about two fquare inches. This apparatus was wrapped up in flannel, when its temperature was about 60°. In half an hour, when the cylinder had made 960 turns, the horfes being ftopped, a mercurial thermometer was introduced into a perforation in the bottom of the cylinder, extending from the fide to the axis, and it ftood at 130°, which count Rumford confiders as expreffing very nearly the mean temperature of the cylinder. The duft or fcales, abraded by the borer, weighed only 837 grains, or about $\frac{1}{948}$th of the whole weight of the cylinder. In another experiment, the cylinder was furrounded by a tight deal box, fitted with collars of leather, fo as to allow it to revolve freely, and the interval between the cylinder and the box was filled with 19 pounds of cold water, which was excluded from the bore of the cylinder, by oiled leathers fixed on the borer; and after two hours and a half the water was made to boil. Hence count Rumford calculates that the heat produced in this manner, by the operation of friction, was equal to that of nine wax candles, each three quarters of an inch in diameter, continuing to burn for the fame time.

Reafoning upon thefe refults, count Rumford thinks, that the heat, thus produced, cannot be extricated from the bodies concerned; and he is led to afk "What is heat?—Is there any fuch thing as an *igneous fluid?*—Is there any thing that can with propriety be called *caloric?*"

He then fays, "We muft not forget to confider that moft remarkable circumftance, that the fource of the heat generated by friction, in thefe experiments, appeared evidently to be *inexhauftible*.

"It is hardly neceffary to add, that any thing which any *infulated* body, or fyftem of bodies, can continue to furnifh *without limitation*, cannot poffibly be a *material fubftance*: and it appears to me to be extremely difficult, if not quite impoffible, to form any diftinct idea of any thing, capable of being excited, and communicated in thefe experiments, except it be *motion*.

"I am very far from pretending to know how, or by what means, or mechanical contrivance, that particular kind of motion in bodies, which has been fuppofed to conftitute heat, is excited, continued, and propagated, and I fhall not prefume to trouble the Royal Society with mere conjectures."

It muft, however, be confidered, that there is no friction which does not produce compreffion; *viz.* a contraction of the bulk of the bodies concerned, at leaft for a time; and therefore that the caloric is forced out of the bodies themfelves; and, being communicated to the furrounding bodies, produces the ufual figns of heat. It is a ftrong corroboration of this affertion, that fubftances, which are not compreffible, are not heated by mechanical force; thus, a flint will only be broken, but a piece of foft metal will be heated, by the ftrokes of a hammer. Thus, alfo, you may place any weight upon a quantity of water, without altering its temperature, becaufe the compreffibility of water is next to nothing; but if you place an additional weight upon a quantity of air; the bulk of the air will be contracted, and its temperature will be raifed.

By about 15 or 20 fmart and quick ftrokes of a hammer on the end of a foft iron rod of about a quarter of an inch in diameter, placed upon an anvil, an expert blackfmith will render that end of the rod vifibly red-hot; and the fofter the iron is, the quicker the effect will take place. But the production of vivid red fparks from a piece of fteel, when ftruck againft the edge of a flint, is a phenomenon not lefs curious. Thefe particles are fcraped off by the flint, and are of courfe compreffed fo as to become red-hot.

"One of the moft remarkable circumftances, attending the production of heat by friction," fays Dr. Young, "is the difcovery of profeffor Pictet, that it is often much more powerfully excited by foft fubftances than by harder ones. In making fome experiments in a vacuum, in order to examine how far the prefence of air might be concerned in the effects of friction, he accidentally interpofed fome cotton between the bulb of his thermometer and the cup, which was fubjected to the friction of various fubftances as it revolved; and he found that the foft filaments of the cotton excited much more heat, than any other of the fubftances employed."

II. When a body heated above the actual temperature of the atmofphere, is placed amongft other bodies, the fuperfluous heat of the former is communicated to the latter; for there is no known body that can effectually intercept the tranfition of heat from one fubftance to another. But there is a remarkable phenomenon attending the communication of heat, which is neither very obvious, nor eafily obferved. This is, that in the diftribution of heat amongft a variety of fubftances, fome bodies abforb more of it than others, though they be all placed exactly in the fame fituation; hence different bodies are faid to have different *capacities* for abforbing heat. (See HEAT, SPECIFIC HEAT, or SPECIFIC CALORIC.) So that if a certain quantity of heat is communicated to a mixture of equal weights of water and of mercury; the water will imbibe a much greater fhare of that heat than the mercury, and yet both will appear of the fame temperature.

Now it has been found that by mixing certain bodies together, their capacities for abforbing heat is diminifhed; therefore they part with a portion of their heat, which is of courfe communicated to the furrounding bodies. Thus, when a pint of fpirit of wine is mixed with a pint of water, the mixture grows fenfibly hot, becaufe their capacities for containing heat are diminifhed in confequence of their action upon each other. And it is to be remarked that whenever heat is emitted in the act of mixing fluids, as in the above-mentioned example of water and fpirit, or of water and fulphuric acid, &c. a concentration of bulk takes place; thus the above mixture of a pint of water with a pint of fpirit will be found to meafure lefs than two pints.

In combuftions, the heat which is firft communicated by the contact of an ignited body, or otherwife, decompofes part of the combuftible body, and of the furrounding oxygen air, which produces more heat, and this decompofes more of thofe bodies, and fo the combuftion proceeds and continues as long as there are combuftibles and oxygen air ready for the procefs. See EXCITATION *of heat*.

EMISSION *of Light*. The perception of objects, which we receive through our fight, is obtained by the intermediation of fomething, which we call *light*. Hence the blind muft judge of the prefence of particular objects, by means of the found, or the fmell, or the touch, &c. but not by the means of light. In fhort, light does not fenfibly affect any other part of our bodies, befides the eyes. It follows then, that fomething muft pafs between any object we fee and our eyes, but concerning this fomething we have no certain knowledge. A variety of conjectures and hypothefes have been offered; but of thefe hypothefes two only may deferve our attention. Defcartes, Huyghens, and others, thought that a fubtile fluid was difperfed throughout the univerfe; that the luminous bodies, fuch as the fun, the ftars, a lighted candle, &c. put that fluid, not in a progreffive, but in a certain vibratory motion; (fomewhat like the motion which is communicated to the air by fonorous bodies;) and that this motion, being communicated to the nerves of our eyes, rendered the luminous objects perceptible to us. Newton and his followers fuppofe that light is a real emanation from luminous objects; *viz.* that a fubtile fluid, confifting of certain peculiar particles of matter, proceeds from the luminous bodies; and by entering our eyes, excites in us the fenfation of light, or the perception of luminous objects. A variety of facts and confiderations feems to render this Newtonian hypothefis of light by far the moft probable of the two. See the article LIGHT.

Admitting then Newton's hypothefis, feveral confequences, which naturally depend upon it, demand a particular illuftration; *viz.* this emiffion of light muft confift of particles; thofe particles muft have a very minute, but determinate, fize;—they muft be at certain diftances from each other; muft move with a certain velocity, and muft have a certain momentum. Several remarkable difcoveries that have been made in aftronomy, and in other branches of natural philofophy, enable us to determine the above-mentioned particulars, not with abfolute precifion, but within certain limits of probabilty. The facts upon which this probability refts, are as follows.

If a fmall hole be made in a fcreen, and the fcreen be placed before our eyes, as about the diftance of five or fix feet; and if a luminous body, as a red-hot coal, be repeatedly paffed before that hole, on the other fide of the fcreen, we muft naturally perceive the hole luminous at intervals of time. But if the interval of time, during which the coal is not before the hole, be lefs than the tenth part of a fecond, then the hole will appear conftantly luminous, exactly as if the red-hot coal were held fteadily before it. This fhews that the impreffion of light upon our eyes continues a certain time after the removal of the luminous objects. This is alfo the reafon why, when a ftick with a lighted extremity is quickly turned round in a circle before our eyes, we perceive an uninterrupted luminous circle.

The duration of the impreffion of light upon our eyes is longer or fhorter, according as the object is more or lefs luminous; fo that the impreffion is proportionally ftrong. See the article VISION.

Aftronomers have obferved, that the eclipfes of the fatellites of Jupiter appear to take place fooner than the time which is determined by the tables of their motions, when the planet is nearer to us; and later when that planet is farther from us. Hence it is naturally conjectured, that light moves progreffively, and equally; *viz.* that it employs a certain time in going through a certain fpace; and this conjecture is corroborated by other aftronomical obfervations. The calculations, which have been made upon thefe appearances, fhew that light moves at the aftonifhing rate of, at leaft, 170,000 miles per fecond; fo that in its motion from the fun to us, light employs about $8\frac{1}{4}$ minutes.

If a fmall hole be made in a fcreen, and feveral perfons are fituated on one fide of the fcreen; every one of them looking through that hole at a different object placed on the other fide of the fcreen; it is evident that the various ftreams of light from thofe objects to the eyes of the obfervers, muft pafs through the fame fmall hole in different directions, and without difturbing each other, at leaft in an obfervable degree. This fhews, that the particles of light muft be fo very fmall, and fo diftant from each other, as not fenfibly to obftruct each other's paffage through a very narrow aperture.

In fome experiments (rather imperfect) which were made by throwing the focus of a concave mirror upon the extremity of a very delicate beam, which was nicely fufpended, a flight motion was thereby communicated to the beam; whence it was deduced, that the light thus collected had a fenfible momentum. From the weight of the beam, and from the motion which it had received from the impulfe of the light (upon the fuppofition that its motion was occafioned by it); alfo from the above-mentioned velocity of light; it was calculated, that the quantity of matter, which was contained in the light which was thrown upon the end of that beam, during one fecond of time, and which was collected from a reflecting furface of about four fquare feet; amounted to no more than one twelve hundred millionth part of a grain. (Prieftley's Hift. of Light, Vifion, &c. per. vi. fect. i. chap. 3.) Thefe facts, joined to our daily experience, feem to authorize the following conclufions.

1. Since every phyfical point of a luminous object may be feen from every point of an immenfe fpherical fpace which furrounds it, when no opaque body is interpofed, it follows, that the ftreams of light, which proceed from all the points of vifible objects, and move in all manner of directions, are paft all conception. If this be alleged as an objection to Newton's theory, the leaft reflection will fhew, that it offers an objection equally great, if not greater, to the other hypothefis that has been mentioned above; but the following reafoning will, in great meafure, clear the difficulty with refpect to Newton's hypothefis.

2. It has been mentioned above, that the impreffion of light remains a certain time upon our eyes, and (in the experiment with the red-hot charcoal) it has been fhewn to remain about one-tenth part of a fecond; but fuppofe it to remain only during the 100dth part of a fecond. Then it is evident, that if 150 particles of light be emitted in a fecond from a fingle point of a luminous object, as from a point on the furface of the fun; thefe particles will be more than fufficient to give our eyes an uninterrupted vifion of that point; yet ftill thefe particles, on account of their immenfe velocity, may be more than 1000 miles diftant from one another, and, of courfe, may leave room enough for millions of other particles to pafs in all directions. Canton's Calcul. Ph. Tr. vol. 58.

3. The wafte of the fubftance of a luminous body, arifing from the emiffion of light, confidering the minute nature of its particles, is very trifling, even with refpect to the fun, which has been the great fountain of light during fo many centuries. Dr. Prieftley, alluding to the above-mentioned experiment, where an impulfe was communicated to a beam by concentrated light, fays, "Now the light in that experiment was collected from a furface of about four fquare feet, which reflecting only about half what falls upon it, the quantity of matter contained in the rays of the fun, incident upon a fquare foot and half of furface, in one fecond of time, ought to be no more than the twelve hundred millionth part of a grain. But the denfity of light at the

furface of the fun is greater than at the earth in the proportion of 45,000 to 1; there ought, therefore, to iffue from one fquare foot of the fun's furface in one fecond of time, in order to fupply the wafte by light, one-forty thoufandth part of a grain of matter; that is, a little more than two grains in a day, or about 4,752,000 grains, which is about 670 pounds avoirdupois, in 6000 years." Hift. of Light, &c. p. 390.

4. In confequence of the motion of light, it is evident, that if a luminous body were fuddenly placed in the heavens, at the fame diftance that the fun is from us, we could not poffibly fee it before the lapfe of $8\frac{1}{4}$ minutes. Alfo, when we behold a celeftial object, we do not fee it exactly in the place where it actually ftands; but we fee it in the place where it ftood fome time before.

5. Light moves in ftraight lines, as long as it goes through the fame uniform medium, or through a vacuum.

6. When we direct our eyes towards certain polifhed furfaces, we frequently fee in them the appearances of objects, which are fituated in places quite different from thofe in which we fee them. In this cafe the rays of light coming from thofe objects fall upon the polifhed furfaces, and from them they are *reflected* (that is, *fent back*) to our eyes. Thofe objects then are faid to be feen by reflected light, and the furfaces in which their appearances are feen are called the *reflecting furfaces*. Indeed, every body which does not itfelf emit any light, (as is the cafe with all thofe which cannot be difcerned in a dark room,) are feen by reflected light; for the light which is emitted from the fun, from a candle, from a fire, &c. falls upon thofe bodies, and is from them reflected to our eyes; but that light is reflected irregularly on account of the inequalities on the furfaces of moft bodies; fo that though all bodies which do not fhine of themfelves, are feen by reflected light; yet they are called reflectors, or are faid to have reflecting furfaces, only when thofe furfaces are fmooth and polifhed, in which cafe they reflect the light regularly, fo as to reprefent the images of other objects, that are placed before them. See REFLECTION *of* LIGHT.

7. In its paffage from one body into another, or from a vacuum into any fubftance, and *vice verfâ*, light is often bent in its direction; and that bending is called the *refraction of light*. See REFRACTION *of* LIGHT.

8. Light is likewife bent in its direction, when it paffes clofe by the furfaces of bodies; and this bending is called the *inflection of light*, which fee.

The fources of light are various, but they may be comprifed under the following enumeration.

1. The celeftial bodies, which fhine either by their own light, as the fun and the ftars; or by reflected light, like the moon and the fatellites.

2. The *aurora borealis*, and other meteors, whofe nature is not as yet diftinctly known.

3. Bodies that are in a ftate of *combuftion*, and emit heat as well as light.

4. The *electrical light*; and,

5. The *phofphorefcent bodies*, of which there are feveral fpecies, *viz*. 1. The *phofphorus* properly fo called, which is confidered as an elementary fubftance. 2. The living animals which have the property of fhining in the dark, fuch as glow-worms, lantern-flies, &c. 3. Thofe bodies which abforb light when expofed to it, and then emit it in the dark; fuch are feveral precious ftones, calcareous bodies, Canton's phofphorus, the Bolonian ftone after due preparation, &c. 4. The bodies which emit light when they are heated to a certain degree; fluoric ftones, feveral marbles, calcareous earth, &c. have this property. 5. The fubftances which emit a light either quite white, or tinged with different fhades of red or blue, by attrition; *viz*. by being rubbed or ftruck againft each other. Moft ftones of the filicious kind poffefs this property. 6. And laftly; thofe bodies which emit light without any fenfible heat, whilft they actually are under a ftate of decompofition; and of this fort are moft animal matters, and fome vegetable fubftances, efpecially rotten wood.

The doubtful nature of the *ignis fatuus*, or *jack-a-lantern*, may perhaps alfo be reckoned amongft the phofphori. See AURORA BOREALIS, ELECTRIC *light*, METEORS, PHOSPHORUS, PHOSPHORESCENT BODIES, and IGNIS FATUUS.

EMITES, in *Natural Hiftory*, a name ufed by fome authors for the chermites, a beautiful fpecies of white marble, of which the tomb of Darius, and many other of the great works of antiquity, were made. It was valued for its fine polifh.

EMLY, in *Geography*, a village of the county of Tipperary, province of Munfter, Ireland, the fee of a bifhop; which was united to Cafhel in 1568. It is 15 miles W. from Cafhel.

EMLYN, THOMAS, in *Biography*, an eminent nonconformift divine, was born at Stamford, in the county of Lincoln, in the year 1663. His parents, though accuftomed to attend the religious fervice of the eftablifhed church, thought fo favourably of the principles of the Proteftant diffenters, that they determined to educate their fon for the miniftry among perfons of this defcription. Accordingly he was placed for academical inftruction in the year 1678, under the care of Mr. Shuttleworth, who refided at Sulby, near Welford, in Northamptonfhire. In the following year he was admitted at Emanuel college, in the univerfity of Cambridge; but afterwards returned to Mr. Shuttleworth, under whofe tuition he remained for four years. With a view to the enjoyment of fuperior advantages, he removed, in 1682, to the academy of Mr. Doolittle in the vicinity of London, and in this fituation he diligently availed himfelf of the collateral means and opportunities of improvement, afforded him by an accefs to books, and intercourfe with literary perfons; and made fuch improvement in the knowledge, connected with his profeffion, that he was encouraged to commence the exercife of his profeffion in December, 1682. His mind, at this early period, difdained the fhackles of eftablifhed fyftems of theology; and he determined to inquire freely, and to exercife, independently of the controul of authority, the right of private judgment. It was favourable to his future improvement, that he was not under a neceffity of immediately connecting himfelf with a congregation, and of devoting his whole time to neceffary preparation for the public fervices of his profeffion. In the year 1683, he became chaplain to the countefs of Donegal, and accompanied her to Belfaft in Ireland, where he had a liberal appointment, and was treated with refpect and kindnefs. The countefs married fir William Franklin, a gentleman of confiderable property in the weft of England, who offered our young divine a valuable living in that country; but not approving the terms of minifterial conformity, he declined the acceptance of it. His fentiments, however, were fo liberal, that he regularly attended the public fervices of the eftablifhed church, and was himfelf attended in the evening, when he officiated in the countefs's hall, by the minifter of the parifh, with whom he cultivated an intimate acquaintance. He likewife occafionally officiated in the parifh church, having obtained, without fubfcription, a licence to preach from the bifhop of the diocefe. At this time he vifited Dublin, and

and his services were so acceptable to the congregation, of which Mr. Daniel Williams and Mr. Joseph Boyce were pastors, that he was afterwards induced to settle among them. In the mean while a variety of circumstances occurred in the agitated state of the north of Ireland, and the domestic disunion of the family of his patroness, which rendered it expedient for Mr. Emlyn to remove to England. Accordingly in the year 1688, he came to London, where he renewed his acquaintance with Mr. (afterwards Dr.) Daniel Williams, who had relinquished his pastoral connection with the congregation at Dublin. As he passed to and fro from Ireland to London, he was accustomed to preach in several parish churches; and at Liverpool in particular, where he had accidentally officiated, his preaching was so much approved, that upon the decease of the parish minister, whose place he had supplied, several of the inhabitants expressed their wishes, that they might be allowed to procure for him the living. But this offer, however respectful on their part, his principles would not permit him to accept. In 1689, Mr. Emlyn, being altogether unemployed, was invited by sir Robert Rich, one of the lords of the admiralty, to his residence near Beccles in Suffolk; and he was induced to officiate to a dissenting congregation at Lowestoff, where he continued about a year and a half; though he declined complying with their invitation to undertake the pastoral office. The liberality of his sentiments and conduct, during his abode in this place, served to promote a perfect harmony between the members of the established church and the dissenters. Here he became acquainted with Mr. William Manning, a respectable non-conformist minister in the neighbourhood; and their mutual intercourse led them both to adopt sentiments, with regard to the doctrine of the Trinity, in vindication of which Dr. Sherlock's treatise had just appeared, very different from those which they had hitherto entertained. Mr. Manning became a Socinian; but Mr. Emlyn adopted what has been generally called the Arian opinion, believing the pre-existence of our Saviour, as the Logos, and that by him God had created the material world. To this opinion he adhered through life. Upon the abdication of king James II., the turbulence of Ireland in some degree subsided; and Mr. Boyce urged Mr. Emlyn, to join him in the pastoral care of the dissenting congregation in Wood street, Dublin. After much previous deliberation, he accepted the proposal, and, in 1691, removed to Dublin. Here he soon acquired distinguished reputation as a preacher. His discourses were rational, persuasive, and pathetic; his voice was clear and strong, and his delivery dignified and graceful; the devotional services were conducted with great propriety; controversial subjects were avoided; and all the private duties of a Christian pastor were discharged in an exemplary manner. In 1694, Mr. Emlyn married Mrs. Esther Bury, a widow lady, with a handsome jointure; and he was thus enabled to maintain a respectable appearance. After considerable hesitation and suspence, he determined, when a proper occasion offered, to avow his opinion concerning the doctrine of the Trinity. But before the formal execution of his purpose, he met with various domestic troubles. In 1701, he lost both his son and his wife; the latter affliction deeply wounded his feeling, and led him to that admirable train of meditation, which is pursued in the funeral sermon preached on the occasion, and which was printed under the title of "Funeral Consolations." Soon after he was bereaved of his wife, and whilst his mind was in an unfit state to encounter new conflicts, his opinion concerning the Trinity became the subject of investigation. Dr. Cummins, a physician of Dublin, and a member of his congregation, communicated his suspicions to Mr. Boyce; and they determined to apply to Mr. Emlyn for a declaration of his real sentiments. Having explicitly avowed his opinion, that the God and father of Jesus Christ is alone the Supreme Being, and that the son derives his excellence and authority from him, he offered to withdraw quietly from the congregation, and thus to prevent the disturbance that was likely to ensue. But this pacific measure was unsatisfactory. Mr. Boyce, in a manner that reflects disgrace on his memory, brought the matter before the Dublin ministers, who, after a candid declaration of his sentiments on the part of Mr. Emlyn, immediately forbade him to preach any more. His congregation, during this precipitate course of proceedings, was never consulted on the occasion. Mr. Emlyn avowed his sentiments to the deacons and principal managers of the church; and after respectfully acknowledging their kindness to him, requested his dismission. The conduct of his accusers was the cause of much surprise and concern to the congregation, and Dr. Cummins himself regretted the part which he had acted. However, it was at length determined that Mr. Emlyn should retire for an interval to England; and such was the violence of the Dublin ministers, that, notwithstanding the great inconvenience and expence, to which he was constrained to submit, two of their number were deputed to "charge him not to preach any where when he went thither." These persecutors followed him with their letters of accusation to London, and endeavoured to deprive him of the benefits of that candour and charity which he experienced on his arrival. Whilst he remained in London, he published a short account of his case; and after an absence of 10 weeks, he resolved to return to his family in Dublin. In order to obviate the prejudices that were entertained against his person and doctrine, he wrote his "Humble Inquiry into the Scripture account of Jesus Christ, or a short Argument concerning his Deity and Glory, according to the Gospel." He then determined to return to England; but his purpose was prevented by the persecuting spirit of his enemies, who obtained a special warrant from the lord chief justice to seize our author and his books. At first the chief justice refused bail; but afterwards allowed it, when two sufficient persons became bound in a recognizance of 800*l.* for Mr. Emlyn's personal appearance. In the next term the grand jury found a bill against him, in which he was indicted of blasphemy. The trial came on in June 1703; and it was conducted in a manner no less disgraceful and tyrannical than the proceedings of a board of popish inquisitors. The jury were intimidated to deliver their verdict, and to bring in the defendant guilty, for which some of them afterwards expressed their concern. After the verdict was pronounced, the attorney-general moved, that the author might have the honour of the pillory; but sentence was deferred till the last day of the term. In the mean time Mr. Emlyn was committed to the common gaol. Mr. Boyce now began to relent, and used all his interest to prevent the passing of the cruel sentence threatened by the attorney-general. Mr. Emlyn also, in deference to the advice of his friends, wrote a letter to the lord chief justice, which was indited with a spirit, and in a style which ought to have influenced his mind. When he appeared to receive judgment, one of the queen's council moved that he should retract; but Mr. Emlyn would not consent. The lord chief justice, therefore, sentenced him to suffer a year's imprisonment; to pay a fine of 1000*l.* to the queen, and to lie in prison till it should be paid; and to find security for his good behaviour during life. He was given to understand, that though the pillory was due to his crime, this punishment was not inflicted, as he was a man of letters. After sentence was pronounced, he he was led round the four courts with a paper on his breaſt, to be expoſed. For more than a quarter of a year, he was kept a cloſe priſoner in the under-ſheriff's houſe; and after the expiration of this term he was hurried away to the common gaol, where he lay among the priſoners in a cloſe room, filled with ſix beds, for about five or ſix weeks; and then he was removed upon his petition, by *habeas corpus*, to the Marſhalſea, on account of his health. In this priſon he wrote, in 1704, a treatiſe, entitled "General Remarks on Mr. Boyce's Vindication of the true Deity of our Bleſſed Saviour." In this ſtate of impriſonment, he remained until the month of July 1705, viſited by few of his former friends, and altogether neglected by his ſavage brethren, the Dublin miniſters. Mr. Boyce, indeed, ſhould be excepted; and to his zealous and repeated ſolicitations, to the generous interference of Thomas Medlicote, eſq., the humane interpoſition of the duke of Ormond, and the favourable report of the lord chancellor, that the exorbitant fine paſſed upon him was illegal, his releaſe from confinement was owing. By their exertions the fine was reduced to 70*l.*, which was actually paid into her majeſty's exchequer; but the archbiſhop of Armagh, the queen's almoner, who had a claim of 1 *s.* in the pound upon the whole fine, inſiſted on the whole ſum, nor would he extend his charity to a conſcientious ſufferer till he received 20*l.* by way of compoſition for the 50*l.* to which the ſentence entitled him. During Mr. Emlyn's confinement in the Marſhalſea, he conſtantly preached on ſundays to ſome of the impriſoned debtors, and ſeveral of the lower claſs of his former hearers. Soon after his releaſe Mr. Emlyn removed to London, where he preached once every ſunday to a ſmall congregation of perſons of ſentiments ſimilar to his own, but without receiving any ſalary. Attempts were made to reſtrain him by Charles Leſlie, the famous non-juror, and alſo by the lower houſe of convocation, but by the moderation of archbiſhop Teniſon, and the interference of government, they were unſucceſsful. Mr. Emlyn's congregation gradually declined by the death of his hearers, and was at length diſſolved; upon which he retired to obſcurity, and employed himſelf in vindicating, by various publications, the principles he had adopted, and the cauſe to which he was devoted. One of his moſt elaborate productions was entitled, "A Vindication of the Worſhip of the Lord Jeſus Chriſt, on Unitarian principles," and publiſhed in the year 1706. One of his moſt curious works was publiſhed in 1710, and was entitled "The Previous Queſtion to the ſeveral Queſtions about valid and invalid Baptiſm, lay Baptiſm, &c. conſidered, *viz.* whether there be any neceſſity, (upon the principles of Mr. Wall's Hiſtory of Infant Baptiſm) for the continual uſe of Baptiſm among the poſterity of baptiſed Chriſtians." In 1715, he publiſhed his "Full Enquiry into the original Authority of the Text, 1 John, v. 7, &c. containing an account of Dr. Mill's evidence from antiquity, for and againſt its being genuine, &c." In this controverſy there appeared, pro & con, ſeveral tracts, the titles of which we cannot recite in this place, nor can we mention the various publications of Mr. Emlyn on the ſubject of the Trinity. In 1719, he publiſhed "A true Narrative of the proceedings of the Diſſenting Miniſters of Dublin, againſt Mr. Thomas Emlyn, and of his Proſecution, (at ſome of the Diſſenters' Inſtigation,) in the ſecular court, &c." Mr. Emlyn, though himſelf unpopular, had the ſatisfaction to obſerve, that the opinion for which he ſuffered excited attention, and gained advocates, both in England and Ireland. Although none of the diſſenting miniſters in London could dare to aſk him to preach for them, except Mr. Burroughs, and Dr. James Foſter, he was honoured with the eſteem and friendſhip of many perſons, diſtinguiſhed by their ſtation and learning; and particularly by Dr. Samuel Clarke, and Mr. Whiſton. Upon the death of Mr. James Pierce of Exeter, about the year 1726, it was propoſed to invite Mr. Emlyn to be his ſucceſſor; but he wiſhed them to decline all thoughts of him, as his advanced age, and increaſing infirmities would not permit him to accept the office. The gout had much impaired Mr. Emlyn's conſtitution, and he at length fell a martyr to it, on the 30th of July, 1743, in the 79th year of his age. A complete collection of his works was made in 1746, and is compriſed in two vols. 8vo.; to which are added memoirs of his life, written by his ſon Sollom Emlyn. His ſermons are ſeparately publiſhed in one volume.

EMMA, in *Biography*, daughter of Richard II. duke of Normandy, wife of Ethelred king of England, and mother of Edward the Confeſſor, had a conſiderable ſhare of power during her ſon's reign. The duke of Kent, who was jealous of her great aſcendancy, and deſirous of getting rid of her as a rival, cauſed her to be accuſed of ſeveral high crimes, to which the king her ſon too readily liſtened, and not only deprived her of all thoſe immenſe treaſures which ſhe had amaſſed, but confined her for life in the monaſtery of Wincheſter. Some hiſtorians go much farther, and contend that ſhe was accuſed of murder, and of incontinence with the biſhop of Wincheſter, but Mr. Hume conſiders ſuch reports, and the ſtory of her being obliged to juſtify herſelf by walking over the nine red-hot plough-ſhares, as the inventions of Monks, and propagated for the ſake of exciting the ſilly wonder of poſterity. Bayle, however, gives full credit to the facts, and adds that the king, now ſenſible of the complete innocence of his mother, and penitent for the ſufferings he had inflicted on her, ſubmitted his back to the ſcourge. Hume. Bayle.

EMMAUS, in *Ancient Geography*, a village of Paleſtine, 60 furlongs N. of Jeruſalem; mentioned, Luke xxiv. 13, as the place whither two of our Lord's diſciples retired on the day of his reſurrection, and where he joined them in the form of a traveller, and demonſtrated to them, that the Meſſiah was to ſuffer death and to riſe again; and where he diſcovered himſelf to them at ſupper, while he was breaking bread. At this place were hot baths; and a church was erected on the ſpot where Cleopas, one of the fore-mentioned diſciples, ſtood. Joſephus informs us, that Veſpaſian left 800 ſoldiers in Judea, to whom he gave this village.

EMMAUS, a city of Judea, 22 miles from Lydda, afterwards called *Nicopolis*, and different from the village of Emmaus, though often confounded with it. Mr. Reland proves theſe to be different places from the teſtimonies of Joſephus, St. Jerom, the Maccabees, and the Talmudiſts. In this Emmaus, or Nicopolis, there were hot baths, in which, as the tradition of the inhabitants reports, our Lord waſhed his feet, and communicated a healing virtue to them. Julian, the apoſtate, from enmity to Chriſt, gave orders for ſtopping up this fountain.—Alſo, a town near Tiberias, in which were hot waters. Joſeph. de Bell. l. iv. c. 1.

EMME, in *Geography*. See EMMENTHAL.

EMMELIA, Εμμελεια, in *Antiquity*, a dance peculiar to tragedy, which had all the gravity and dignity that were ſuitable to the action then repreſenting, and was deſigned to inſpire the audience with ſentiments of compaſſion and benevolence for the unfortunate and oppreſſed, with indignation againſt the guilty, and with the love of virtue, and abhorrence of vice. The happy mixture of noble and elegant concords, together with an exquiſite modulation in the action of the perſonages, denoted by emmelia, is ſtrikingly exemplified in that piece of Æſchylus, in which king Priam offers a ranſom a ranfom for the body of his fon. The chorus of Trojans, proftrate with him at the feet of the conqueror of Hector, and like him uttering, amid their dignified emotions, expreffions of grief, fear, and hope, communicate to the foul of Achilles, and thofe of the fpectators, the fentiments with which they are penetrated.

The movements of fuch a dance as this muft have been very folemn and majeftic, and have bore a great affinity to the action of an orator; it was the only one, excepting the military dances, that had the approbation of Plato. Mem. Acad. Infcript. vol. ii. p. 160. See DANCE.

EMMELIA, in *Mufic*, tuneful founds among the Greeks, fuch as were fit for melody.

EMMELOORT, in *Geography*, a town in the north part of the ifland of Schockland, in the Zuyder fea; 10 miles E. of Vollenhove.

EMMENAGOGUES, MENAGOGA, in *Medicine*, are fuch fubftances as are underftood to poffefs the power of exciting the menftrual difcharge in the female fex.

Both the ancient and modern writers on the Materia Medica, but efpecially the former, mention a great number of medicines, to which they attribute this power, and fpeak of it with confiderable confidence. But the articles, to which an emmenagogue quality has been thus afcribed, have not fucceeded in the hands of the phyficians of cautious obfervation in our own times; fo that it is now generally admitted, that we are not in poffeffion of a medicine, which has any fpecific power in ftimulating the veffels of the uterus. Dr. Gregory afks, in his Lectures, "What effect a medicine, poffeffed of fuch a power, could have upon men?" which he feems to confider as an unanfwerable refutation of the notion of emmenagogues. But may we not equally difprove the exiftence of a diuretic medicine, by inquiring what effect fuch a medicine would produce in animals which have no kidney? Experience, however, amply corroborates the opinion; and the operation of thofe fubftances, which have occafioned the catamenia to flow, is explicable on other principles than that of a fpecific ftimulus to the uterine veffels. But it is alfo to be remarked, that there is great room for deception with refpect to the operation of medicines, in reftoring or exciting the menftrual difcharge; and that the fallacious conclufion of "poft hoc, ergo propter hoc," has given a character of efficacy to many medicines, (in all departments of practice, but in this moft eminently,) which in truth poffefs no fuch power. The catamenia frequently appear fpontaneoufly, after long retention or fuppreffion; and whatever medicine happens to be under adminiftration at that time gains the credit of the cure.

There is an error almoft univerfally prevalent among the women themfelves, and fanctioned by goffiping medicafters, that the fuppreffion of the menfes is the *caufe* of almoft every diforder which the female conftitution can fuffer; and confequently, that its reftoration, in thefe cafes, is the moft important point to be attended to in their treatment. Now the converfe of this pofition is much nearer the truth. The fuppreffion of the catamenia is moft commonly the *effect* of a previoufly difordered ftate of the conftitution, and will be removed, as a matter of courfe, when the health in general is reftored. Hence, fuch a fuppreffion is one of the fymptoms of almoft all chronic difeafes, and debilitated conditions of the body: it is fometimes the confequence of the oppofite ftate, of a plethoric or inflammatory diathefis. The remedies, therefore, which poffefs an emmenagogue power, operate indirectly upon the uterine fyftem, through their effects upon the fyftem at large; and are confequently of oppofite qualities, as they apply to two oppofite conditions of the conftitution: or, they operate locally upon the adjoining parts, and affect the uterus from its contiguity.

The retention of the catamenia in young women, about the age of puberty, is generally connected with extreme debility of the fyftem, often with that morbid change of complexion which defignates the green-ficknefs, or CHLOROSIS, which fee. It is in fuch cafes, that preparations of iron, bark, and other tonic medicines, may be deemed emmenagogues, by reftoring the general tone of the habit: the chalybeates have been particularly extolled for their emmenagogue powers. But in full florid habits, when the catamenia are fuddenly fuppreffed, laxatives, diaphoretics, and even blood-letting, moft effectually contribute to reftore the difcharge. Many other reputed emmenagogues operate as local ftimuli to the contiguous parts: hence aloes, and other warm purgatives, which irritate the lower portion of the inteftines, have been celebrated for their emmenagogue powers. Electricity, applied through the pelvis to the hips and back, has fometimes been an efficacious emmenagogue. Savine, caftor, the fœtid gums, the warm-bath, and pediluvium, may be deemed ftimulants to the uterus, as a part of the general fyftem: the efficacy of the warm-bath, or flipper-bath, when employed about the expected period of menftruation, is often very great. Dr. Mead highly extolled the tincture of black hellebore, which, he fays, feldom failed in his practice; and he attributed to it fuch a ftimulative power over the blood-veffels, that when it did not produce the menfes, he affirms, the blood was driven through other outlets, as from the nofe, bowels, &c. But Dr. Home, and many other phyficians, have ufed it largely in vain. Dr. Home attributes fome powers to the favine, and much to madder (rubia tinctorum); which, however, has appeared to others to be altogether inert. Cullen Mater. Medica, vol. ii. Home Clinical Exper. p. 377. See AMENORRHOEA.

EMMENDINGEN, in *Geography*, a fmall town of Germany, in the grand duchy of Baden Durlach, fituated on the river Eltz, in the diftrict of Hochberg, the neighbourhood of which produces excellent wine; but it is chiefly remarkable for a fruitlefs conference, which was held here in the year 1590, between the Roman Catholic and Lutheran divines of Germany. Emmendingen is on the high road from Switzerland to Francfort, on the Mayn.

EMMENTHAL, one of the fineft and richeft valleys of Switzerland, in the canton of Aarau, deriving its name from the river Emme, by which it is irrigated. The principal towns are Signau, Trachelwald, Soumifwald, and Brandis. Its cheefe is known all over Europe under the name of "fromage de Gruyères."

EMMERAN, SAINT, formerly a rich imperial abbey of Germany, in the town of Ratifbon. Its poffeffions form now a part of the territory of the prince primate of the Confederation of the Rhine.

EMMERICH, or EMMERICK, a fmall town of Germany, in the grand duchy of Berg, fituated on the Rhine, in the former duchy of Cleves; 9 miles E. of the town of Cleves, and 24 miles S.E. of Nimeguen. N. lat. 51° 39'. It has a confiderable trade with Holland, and was anciently one of the Hanfeatic towns. Its origin dates from the year 1247, when it was firft furrounded with walls.

EMMIELLURE, in the *Manege*, a kind of compofition of honey, and other ingredients, ufed for fprains and fhoulder-fplaits of horfes. See CHARGE.

The word is French, derived from *miel*, honey, which is a part of the compofition.

EMMIUS, UBBO, in *Biography*, a learned philologift and hiftorian, was born in 1547, at Gretha, a village in

Eaſt Frieſland, of which his father was the paſtor. In his ſtudies he was diligent and remarkably ſucceſsful. His natural timidity and baſhfulneſs prevented him from undertaking the office of miniſter; and in 1579, he engaged as maſter of the ſchool of Norden, in Eaſt Frieſland, which he conducted with great reputation, till he was haraſſed by bigots for refuſing to ſubſcribe the confeſſion of Augſburg; and at length not only deprived of his ſalary, but prohibited from teaching. From Norden he went to Leer, where he undertook the ſame office, to the great injury of his late ſchool. When Groningen aſſociated itſelf with the United Provinces, and planned the re-eſtabliſhment of its college, Emmius was choſen its director, with the full power of forming ſuch ſtatutes for its government as he ſhould think proper. In this office he continued 20 years, when the college was erected into an univerſity; and Emmius was appointed profeſſor of hiſtory and Greek, in which he gave lectures to a very advanced period of life. He died at Groningen, in 1625, in the 79th year of his age, highly reſpected by all with whom he was connected; and his memory was ſo much honoured, that the magiſtrates, to whom he had been an able counſellor on all important occaſions, placed his portrait in the town-houſe. He publiſhed many valuable works on hiſtory, chronology, and antiquities: among theſe are, "Decades Rerum Friſicarum;" "Vetus Grecia illuſtrata," in three volumes, which is highly eſteemed as a valuable ſummary of the geography, hiſtory, polity, &c. of ancient Greece. It is recorded of him in his life, that he was ſo thoroughly verſed in the hiſtories of all kingdoms and countries, that, at the requeſt of his friends, he could at any time, and without previous conſideration, ſpeak upon the hiſtory of all kingdoms and countries, beginning with any period that might be fixed on, and give a complete detail of all the places, times, and circumſtances of perſons, as if he had come prepared expreſsly to explain thoſe hiſtories. Eulogies were pronounced on his memory by Thuanus, Scaliger, Douza, Heinſius, David Chytræus, and others. By Scaliger his hiſtory of Frieſland is called "divine." Bayle.

EMO, or Emo *Inn*, in *Geography*, in the Queen's county, province of Leinſter, Ireland, has been made a poſt-town, and is much frequented by travellers, as a convenient ſtage. Adjoining it is Emo-park, the ſeat of the earl of Portarlington. Emo is 35 miles S.W. from Dublin, and 5 E. from Maryborough.

EMODI Montes, or *Emodi Mons*, in *Ancient Geography*, part of a chain of mountains in Aſia. Pliny ſays, that the Emodus, the Imaus, the Paropamiſus, and the Caucaſus, were connected together; and that the Serres inhabited the country beyond theſe mountains. Dionyſius Periegetes places the ſprings of the Oxus in the Emodian mountains, and extends this chain as far as the Eaſtern ocean. The mountains Emodus and Imaus, according to major Rennell, are the mountains which extend from the Ganges, above Sirinagur, to Caſhmere: ſeparating the dependencies of Hindooſtan from thoſe of Great Thibet. This ingenious geographer ſuſpects Emodus and Imaus to be different readings of the ſame name; and Emaus or Himaus are, without doubt, derived from the Sanſcrit word *Himmaleh*, ſignifying ſnowy. That vaſt ridge bears the ſame name at preſent; and Pliny (l. vi.) well knew the circumſtance. The mountains of Rimola, ſo called in the Lama's map, to which the territories of Napaul extended, were anciently denominated Emodus; and they are a continuation of the chain between Taſſudon and Paridrong.

EMODIA, Αιμωδια, of *αιμα*, *blood*, and *οδους*, *tooth*, in *Medicine*, a word uſed by ſome authors to expreſs a ſtupor of the teeth.

EMOLLIENTS, are medicines which, when externally applied, have the power of relaxing or ſoftening the fibres, when too rigid. They have all been ſuppoſed to act mechanically, but this may be doubted. The commoneſt form of emollient is a cataplaſm or poultice of bread and milk, or other mucilaginous vegetable matter, applied to the ſkin as warm as can be borne without pain. The relaxation and conſequent eaſe which warm cataplaſms produce is very great; but as none of the materials can be readily abſorbed through the cuticle, when unbroken, the emollient effect has with great probability been attributed chiefly, if not entirely, to the relaxing effect of warmth and moiſture upon the extreme veſſels of the living ſurface, unconnected with any ſuppoſed interpoſition of moiſture between the moving fibres.

The other claſs of emollients comprehends unctuous bodies of all kinds, when aſſiſted by friction; and as there is no doubt of a conſiderable abſorption taking place in this method, it is not improbable that the fibres may be actually ſoftened, and rendered more flexible by mechanical operation. No comparative experiments have yet been fairly made to decide whether one unctuous body is more penetrating, that is to ſay, more readily abſorbed by the ſkin, than another; ſo that, as mere emollients, they all have equal claim to uſe.

EMOLUMENT, is properly applied to the profits ariſing daily from an office or employ.

The word is formed of the Latin *emolumentum*, which, according to ſome, primarily ſignifies the profits redounding to the miller from his mill; of *molo*, *molere*, *to grind*.

The patent, or other inſtrument, whereby a perſon is preferred to an office, gives him a right to enjoy all the dues, honours, profits, and emoluments, belonging thereto.

In our law-books, emolument is uſed in a ſomewhat greater latitude, for profit, or advantage, in the general.

EMOTION, in *Elocution*, a mode of utterance applied to appropriate paſſages and on proper occaſions, expreſſive of diſturbance and agitation in the mind of the ſpeaker, reader, or reciter, and calculated to produce the like diſturbance and agitation in the minds of the auditors. Under proper regulation of the judgment, this is one of the higheſt graces of elocutionary expreſſion; nay, ſo eminently is it calculated to produce the effects at which the higheſt ſpecies of elocution principally aim, that it may ſometimes be ſaid moſt completely to attain its end, when the judgment of the ſpeaker becomes for a while ſuſpended, or is at leaſt ſurrendered to its influence and domination. By ſome, however, it is diſputed whether the elocutioniſt (eſpecially the actor) ought really, (for the moſt perfect production of the effect deſired,) to be under the poſitive influence of the emotion exhibited, or ought only to imitate, by the ſtrong operation of judgment and recollection, ſo much of the actual emotion of real life, as appears calculated to excite the general or particular ſympathy deſired; and the writer of this article remembers an inſtance in which a public lecturer was much cenſured by a critical auditor, for having ſuffered himſelf to be overpowered by his own emotions, in deſcribing the tragical fate of Virginia, under the tyranny of the Roman decemviri, that the laſt ſyllable of the ſentence "he ſaved his honour, but he loſt his child," expired in an almoſt inarticulate ſob, and the orator, choaked with tears, was unable to proceed any farther. The effect produced was, however, the beſt anſwer to this hypercriticiſm. The orator had already proceeded far enough; for although one perſon remained cold enough to criticiſe, a ſhriek of horror had run through the audience, one half of whom had burft into tears of fympathy, and fome of whom had actually fwooned away, overpowered by contagious agitation. So fuperior is nature and reality, to the boafted mechanifm of fophiftication and art. Art, however, and the fevereft exercife of judgment, are neceffary both to the actor and the orator, (efpecially to the latter,) in the direction and regulation of thefe emotions; that it may be known when, and how far they are to be indulged; the cafes being very rare in which it can be fafe and proper to throw the reins on the neck of feeling, and leave it to make its way to the goal, by its own independent energies. Emotion is partly expreffed by change of time or momentum, in the action of the organs of enunciation, and by different degrees of irregularity in the fucceffion and proportions of the cadences; and partly by the modulations of the voice; the intonations of which become modified by the different character of the paffion to be expreffed; while, in fome inftances, a tremulous expreffion, and in others frequent interruptions and abrupt tranfitions in the tune, confiderably heighten the effect. Two things are principally to be avoided in the purfuit or cultivation of this excellence;—the unreftricted indulgence of fuch feelings as might hurry into coarfenefs, indecorous vehemence, or bombaft; and that frigid affectation which aims at impreffion by unnatural or unappropriate tones; extremes, which though they may extort *applaufe* from "the unfkilful," always difguft "the judicious," and difappoint completely the legitimate end which genuine emotion muft have in view,—the excitement of a correfpondent fympathy.

Phyfiognomical expreffion, or the play and fympathy of the features, and the language of gefticulation, muft not be overlooked: for, as Mr. Sheridan has obferved, it is a palpable "delufion," to fuppofe, "that by the help of words, alone, we can communicate all that paffes in the mind of man. The paffions and the fancy have a language of their own, utterly independent of words, by which only their exertions can be manifefted and communicated." Lect. on Eloc.

In the recommendation of thefe accompaniments of elocution to any but the profeffed actor, the profeffor, however, muft be aware that he has many and obftinate prejudices to encounter. The dullnefs and indolence of modern elocutionifts having confpired, with other caufes, to reduce almoft all public fpeaking, but that of the ftage, to one fympathetic monotony of tone, and look, and attitude, the fuperftition of criticifm (miftaking fanction for propriety, and eftablifhed ufage for the law of nature) has raifed a fort of hue and cry, againft all expreffion of attitude and feature; as if thefe were mere theatrical affectations and meritricious artifices.

But this fubject will be further purfued under the proper heads Gesticulation and Oratory; for the prefent it is only neceffary to obferve, that as effential to the perfection of that particular branch of the art, accompaniments of gefticulative and phyfiognomical emotion are univerfally admitted to be legitimate portions of the art of theatrical recitation, to the judicious application of which the elocution of the ftage is indebted for a confiderable part of its effect.

Emotion, in the *Theory of the Mind*, is applied by Dr. Cogan (Treatife on the Paffions) to the external marks, or vifible changes produced by the impetus of paffion upon the corporeal fyftem. Thus he diftinguifhes it from paffion, which denotes the violent impreffion made upon our minds by the perception of fomething very ftriking and apparently interefting, and from affections, which are applicable to the lefs violent, more deliberate, and more permanent impreffions, by caufes which appear fufficiently interefting. The ftrong impreffion, fays this writer, of vivid fenfation, immediately produces a re-action, correfpondent to its nature; either to appropriate and enjoy, or to avoid and repel the exciting caufe. This re-action he diftinguifhes by the term *emotion*. The fenfible effect produced at the firft inftant by the caufe of the paffion greatly agitates the frame; its influence is immediately communicated to the whole nervous fyftem, and the commotions excited in that, indicate themfelves both by attitudes and motions of the body, and particular expreffions of the countenance. It is alone by thefe vifible effects, that the fubject is difcovered to be under the influence of any paffion; and it is merely by the particular changes produced, or kind of emotion, that we are enabled to judge of the nature of the paffion. Thus, although the paffion exifts prior to the emotions, yet as thefe are its external figns, they muft indicate its continued influence as long as they continue to agitate the fyftem.

Sheridan, in his "Art of Reading," difcriminates between ideas and emotions. The former, he fays, denote all thoughts which rife and pafs in fucceffion in the mind. Emotions fignify all exertions of the mind in arranging, combining, and feparating its ideas, as well as all the effects produced on the mind itfelf by thofe ideas, from the more violent agitation of the paffions to the calmer feelings produced by the emotion of the intellect and the fancy. Thought is the object of the one, internal feeling of the other. That which ferves to exprefs the former Sheridan calls the language of ideas; and the latter the language of emotions. Words are the figns of the one, tones of the other. Without the ufe of thefe two forts of language, it is impoffible to communicate through the ear all that paffes in the mind of man.

EMOY, or Hia-men, in *Geography*, an ifland near the S.E. coaft of China, within the jurifdiction of the province of Fo-ken, about 15 miles in circumference. The port of Emoy is properly an anchoring-place for fhips, inclofed on one fide by the ifland from which it takes its name, and on the other by the main land; but it is fo extenfive, as to be capable of containing feveral thoufand veffels; and its water is fo deep, that the largeft fhips may lie clofe to the fhore without danger. About a century ago it was much frequented by European veffels; but few vifit it at prefent, as all the trade is carried on at Canton. The emperor keeps here a garrifon of fix or feven thoufand men, commanded by a Chinefe general. At the mouth of the road is a large rock, vifible feveral feet above the furface of the water; and three leagues from it is a fmall ifland, with a natural arch in the middle which admits light from the oppofite fide; and hence it obtained the name of the "Perforated ifland." The ifland of Emoy is particularly celebrated on account of the magnificence of its principal pagoda confecrated to the deity "Fo." This temple is fituated on a plain, terminated by the fea on one fide, and on the other by a lofty mountain. The front of the edifice is 180 feet in length, and its gate is adorned with figures in relief, the ufual ornaments of the Chinefe architecture. At the entrance is a large portico, with an altar in the middle, on which is placed a gigantic ftatue of gilt brafs, reprefenting the god "Fo," fitting crofs-legged. Four other ftatues, 18 feet high, though reprefenting perfons fitting, occupy the four corners of the portico. Each of them is formed from a fingle block of ftone, and bears in its hands appropriate fymbols; *e. g.* one bears a ferpent in its arms, twifted round its body in feveral folds; another has a bent bow and quiver; the two others prefent, one a kind of battle-axe, and the other a guitar, or fome fimilar inftrument. Beyond this portico is an outer

 court,

court, having at its four fides four pavilions, terminating in domes, and communicating with one another by a gallery. In one is a bell ten feet in diameter: in another a drum of enormous fize, ufed by the bonzes for proclaiming the days of new and full moons. The two other pavilions contain the ornaments of the temple, and often ferve to lodge travellers, whom the bonzes are obliged to receive. In the middle of the court is a large tower, terminating in a dome, with a beautiful ftone ftair-cafe winding round it. The dome contains a neat temple, the cieling of which is ornamented with mofaic work, and the walls covered with figures in relief, reprefenting animals and monfters. The pillars that fupport the roof are framed of wood, varnifhed, and on feftivals are ornamented with differently coloured flags. The pavement of the temple is formed of fmall fhells, prefenting in different compartments birds, butterflies, flowers, &c. The bonzes continually burn incenfe upon the altar, and keep the lamps fufpended from the cieling always lighted. At the extremity of the altar is a brazen urn, which, when ftruck, emits a mournful found, and on the oppofite fide is a hollow machine of wood, ufed for the fame purpofe, which is to accompany with its found their voices, when they fing in praife of the tutelary idol of the pagoda. The god "Pouffa" is placed on the middle of this altar, on a flower of gilt brafs, which ferves as a bafe, and holds a young child in his arms; feveral idols, which are without doubt fubaltern deities, are ranged around him, and by their attitudes fhew their refpect and veneration. Behind the altar is a kind of library, containing books which treat of the worfhip of idols. Acrofs the court is a kind of gallery, containing 24 ftatues of gilt brafs, reprefenting philofophers, who were the ancient difciples of Confucius. At the end of the gallery is a hall, which is the refectory of the bonzes; and beyond a fpacious apartment is the temple of "Fo," to which there is an afcent by a large ftone ftair-cafe. This temple is ornamented with vafes, full of artificial flowers, and in it are mufical inftruments, fuch as we have already mentioned. The ftatue of this god is feen through a piece of black gauze, which forms a fort of veil or curtain before the altar. The reft of the pagoda confifts of feveral large chambers; the gardens and pleafure-grounds are on the declivity of the mountain, and a number of delightful grottos are cut out in the rock, and afford an agreeable fhelter from the exceffive heat of the fun. There are feveral other pagodas in the ifland of Emoy; one of which is called the "Pagoda of 10,000 ftones," which is built on the brow of a mountain, in which there is a like number of little rocks, under which the bonzes have formed grottos and pleafant covered feats. Grofier's China, vol. i.

EMPALEMENT, or IMPALEMENT, a cruel kind of punifhment, whereby a fharp pale or ftake, is thruft up the fundament and through the body.

The word comes from the French, *empaler*, or the Italian, *impalare;* or rather, they are all alike derived from the Latin, *palus*, *a ftake*, and the prepofition *in*, *in*, *into*.

We find mention of empaling in Juvenal. It was frequently practifed in the time of Nero, and continues to be fo in Turkey.

EMPALEMENT, or *Calyx*, in *Botany*, denotes the termination of the cortex, or outer bark of a plant; which, after accompanying the trunk or ftem through all its branches, breaks out with the flower, and is prefent in the fructification in this new form. Its chief ufe is to enclofe and protect the other parts. It has received different appellations, according to the circumftances that attend it; as *Perianthium*, or flower-cup, *Involucrum*, or cover, *Amentum*, or catkin, *Spatha*, or fheath, *Glume*, or hufk, *Calyptra*, or veil, and *Volva*, which fee refpectively. See CALYX.

EMPANELLING, or IMPANELLING, in *Law*, fignifies the writing and entering into a parchment fchedule, or roll of paper, by the fheriff, the names of a jury fummoned by him to appear for the performance of fuch public fervice as juries are employed in. See JURY.

EMPARLANCE, or IMPARLANCE, *Interlocutio*, or *licentia loquendi*, in *Law*, a defire, or petition, in court, of a day to confider, or advife, what anfwer the defendant fhall make to the action of the plaintiff.

The civilians call it *petitio induciarum*. Kitchen mentions emparlance *general*, and *fpecial;* the firft feems to be only that made in one word, or in general terms without any fpecial claufe. This is of courfe where the defendant is not bound to plead the fame term; and it is without faving to the defendant any exception, which is always to another term. It is granted to the defendant before he pleads by confent of the court; to fee if he can end the matter amicably without farther fuit, by talking with the plaintiff:—a practice, which is fuppofed (Gilb. Hift. Com. Pl. 55.) to have arifen from a principle of religion in obedience to that precept of the gofpel "agree with thine adverfary quickly, whilft thou art *in the way* with him." (Matt. v. 25.) It may be obferved, that this gofpel precept has a plain reference to the Roman law of the twelve tables, which exprefsly directed the plaintiff and defendant to make up the matter while they were *in the way*, or going to the prætor;—*in via, rem uti pacant orato.* Emparlance *fpecial*, is where the party requires a day to deliberate, adding thefe words, "Salvis omnibus advantagiis tam ad jurifdictionem curiæ, quam ad breve et narrationem."

This emparlance is had on the declaration of the plaintiff; and it is of ufe where the defendant is to plead fome matters, which cannot be pleaded after a general emparlance. (5 Rep. 75.) This fpecial emparlance is with a faving of all exceptions to the writ or count which may be granted by the prothonotary; or they may be ftill *more fpecial*, with a faving of all exceptions whatfoever, which are granted at the difcretion of the court. (12 Mod. 529.)

Imparlance is generally to the next term; and if the plaintiff amend his declaration after delivered or filed, the defendant may imparl to the next term, if the plaintiff do not pay cofts, but if he pay cofts, which are accepted, the defendant cannot imparl. Alfo, if the plaintiff declares againft the defendant, but doth not proceed in three terms after, the defendant may imparl to the next term. (2 Lill. Abr. 35.) If the writ be returnable on the laft day of term, the defendant is of courfe entitled to an imparlance, but muft plead in four days of the next term, provided a rule be given either in a town or country caufe. On a declaration delivered of *Hilary*, there may be an imparlance to *Trinity* term, if the defendant has not pleaded before; for it is the courfe of the court to give imparlance or declaration till the day of pleading. If a writ be returnable in one term, and the declaration is not delivered *before* the effoign day of the *fecond* term, the defendant is not obliged to plead in the *fame* term, but is entitled to an imparlance. (Impey, K. B.) The caufes of imparlance are as follow. The not delivering a declaration in time is fometimes the caufe of imparlance of courfe, and where the defendant's cafe requires a fpecial plea, and the matter which is to be pleaded is difficult, the court will, upon motion, grant the defendant an imparlance, and longer time to put in his plea, than otherwife by the rules of the court he ought to have: if the plaintiff keeps any deed or other thing from the defendant, whereby he is to make his defence, imparlance may be granted till the plaintiff delivers

delivers it to him, or brings it into court, and a convenient time after to plead. (Hil. 22 Car. I. B. R.) There are many cafes in which imparlances are not allowed. No imparlance is granted in an *homine replegiando;* or in an affife, unlefs on good caufe fhewn; nor fhall there be an imparlance in an action of fpecial *claufum fregit*, though it is allowed in general actions of trefpafs. (Hil. 9 W. III. 3 Salk. 186.) Where an attorney, or other privileged perfon of the court fues another, the defendant cannot imparl, but muft plead prefently: if the plaintiff fues out a fpecial original, wherein the caufe of action is expreffed, and the defendant is taken on a fpecial capias, he fhall not have imparlance, but fhall plead as foon as the rules are out. (2 Lil. 35, 36.) In cafe of pleadings afterwards, a plea to the jurifdiction may not be pleaded after general imparlance. (Raym. 34.) Dilatory pleas cannot be pleaded after a general imparlance, which is an acknowledgment of the propriety of the action. After imparlance the defendant cannot plead in *abatement;* however, if it appear by the record that the plaintiff hath brought his action before he had any caufe, the court *ex officio* will abate the writ. (2 Lev. 197.) Although a fpecial imparlance fhall not be allowed the defendant without leave of the court firft obtained (R. E. 5 Ann.); yet if the writ be returnable *before the laft return of any term*, and the declaration not filed, and notice given four days exclufive before the end of fuch term, the defendant is entitled to an imparlance. (R. Trin. 22 Geo. III.) Blackft. Com. vol. iii. Jacob's Law Dict. by Tomlins. Art. *Emparlance*.

Britton alfo ufes emparlance for the conference of a jury upon a caufe committed to them.

EMPASMA, Εμπασμα, from εμπασσο, *I fprinkle*, in *Pharmacy*, a powder thrown or fprinkled over the body, to correct fome ill fmell thereof, or to prevent unneceffary fweats.

EMPASTING, or IMPASTING, a term ufed in *Painting*, for the laying on of colours thick and bold, or applying feveral lays of colours, fo that they may appear thick. See COLOURING.

It is formed of the French, *empafter*, which has the fame fignification of *pafte*, or *pâte*, *pafte*.

A painting is faid to be well empafted with colours, when the colours are beftowed plentifully, or it is well foaked, and faturated with colours.

The term is alfo ufed when the colours are laid diftinct, and afunder, and not foftened and loft in each other: *e. g.* this head is not painted, it is only empafted.

EMPATTEMENT, French, from *empater*, *to thicken*, in *Fortification*, a term ufed by fome to denote the fame with talus.

EMPEDOCLES, in *Biography*, a native of Agrigentum, in Sicily, was a difciple of Telauges, a fcholar of Pythagoras, and diftinguifhed for his knowledge in every department of fcience and philofophy, as a poet, an orator, an hiftorian, and a phyfician. He adopted the Pythagorean doctrine of the tranfmigration of fouls, and wrote a poem on the fubject, which the ancients have highly praifed. He ftated the hiftory of the different changes which his own foul had undergone during its tranfmigrations, as follows; it commenced its career in the perfon of a girl, next appeared in that of a boy, afterwards it animated a fhrub, then a bird, a fifh, and laftly Empedocles. In the fame poem, the title of which was, "On the Nature of Things," he explained his doctrine refpecting the elements. He contended that "there were four of thefe elements, which are at continual war with each other, without the power of deftroying each other; and that all bodies were produced by this conflict." The fragments of his verfes, which are difperfed through various ancient writers, have been, in part, collected by Henry Stephens. (In Poefi Phil. 1574, 8vo.) This circumftance affords fome ground for the opinion of Fabricius, (Bib. Græc. v. i. p. 466.) that Empedocles was the real author of that ancient fragment, which bears the title of "The golden Verfes of Pythagoras." From thefe fragments his philofophical opinions have been collected. Befides his hypothefis of four elements, the firft material principles of which were indefinitely fmall, round, and fimilar atoms, he maintained, that it is impoffible to judge of truth by the fenfes without the affiftance of reafon; which is led, by the intervention of the fenfes, to the contemplation of the real nature, and immutable effences, of things. The firft principles of nature are of two kinds, active and paffive; the active is unity, or God; the paffive, matter. The active principle is a fubtle, ethereal fire, intelligent and divine, which gives being to all things, and animates all things, and into which all things will be at laft refolved. Many dæmons, portions of the divine nature, wander through the region of the air, and adminifter human affairs. Man, and alfo all brute animals, are allied to the divinity; and it is therefore unlawful to kill or eat animals. The world is one whole, circumfcribed by the revolution of the fun, and furrounded, not by a vacuum, but by a mafs of inactive matter. In the formation of the world, ether was firft fecreted from chaos, then fire, then earth; by the agitation of which were produced water and air. The heavens are a folid body of air, cryftallized by fire. The ftars are bodies compofed of fire, they are fixed in the cryftal of heaven; but the planets wander freely beneath it. The fun is a fiery mafs, larger than the moon, which is in the form of a hollow plate, and twice as far from the fun as from the earth. The foul of man confifts of two parts, the fenfitive, produced from the fame principles with the elements; and the rational, which is a dæmon fprung from the divine foul of the world, and fent down into the body as a punifhment for its crimes in a former ftate, where it tranfmigrates till it is fufficiently purified to return to God.

The ftyle of Empedocles, if we may believe the account of Ariftotle, as quoted by Diogenes Laertius, very much refembled that of Homer; it was extremely energetic and enriched with metaphor, and every variety of poetical figure. His talents drew upon him the eyes of all Greece: his verfes were fung at the Olympic games, with thofe of Homer, Hefiod, and the moft famous poets; and at the games, and on all other public occafions, he is faid to have been himfelf the moft attractive part of the fpectacle, fo anxious were the people to behold him. He was greatly diftinguifhed too as an orator, and is faid to have been the firft of the philofophers who gave leffons on rhetoric in Sicily. He ufefully employed this talent of oratory in reforming the licentious manners of the Agrigentines, whom he reproached "for purfuing pleafures, with as much eagernefs as if they were to die before to-morrow; and for building houfes as if they believed that they fhould live for ever."

Empedocles was likewife celebrated as a phyfician, and wrote a poem "On Medicine," confifting of fix hundred verfes. In this work he is faid to have boafted, that he was able not only to cure difeafes, but alfo to drive away old age, and even to reftore the dead to life; and to have intimated that the fick would hereafter inveft him with divine honours. Pliny affirms that he fucceeded in reftoring a female, who had lain thirty days, without any figns of refpiration: and

Paufanias,

Paufanias, one of his difciples, and a phyfician, wrote a treatife refpecting the difeafe and recovery of this woman, whom he termed ἄπνους. He was greatly fkilled in mufic, which, after the example of Pythagoras, he employed as a remedy, not only againft the difeafes of the mind, but even againft thofe of the body. Being lodged in the town of Gela, with his friend Auchitus, he was informed that a young man in a great rage was determined to kill this friend, who had fentenced his father to capital punifhment. Empedocles endeavoured to calm his mind by perfuafive difcourfe; but his eloquence producing no effect, he took his lyre, and combined its melodious founds with the flowing numbers of poetry; and fo employed the modulations, which made the greateft impreffion on the heart of the young man, that by degrees he was entirely foftened, and afterwards became his conftant difciple. As a phyfician, he is related to have been eminently ferviceable to his country on many occafions. He paid great attention to meteorology, and not only predicted ftorms, but propofed remedies againft their effects. He counteracted the blighting influence of the Etefian winds, by conftructing walls in the narrow paffages of the mountains, through which they blew, and occafioned fterility in the neighbouring land: hence, according to Jamblichus and Diogenes Laertius, he was called *Alexanemos* and *Colyfanemos*, or repeller of the winds. Pliny relates that he allayed a peftilence at Agrigentum, by means of fumigation (ignium fuffitu); and Plutarch mentions another inftance, in which he fuppreffed a plague, which raged with extreme violence and fatality, by clofing an aperture or chafm of the earth, in the vicinity of the mountains, from which he alone obferved that peftilential effluvia iffued.

For thefe various fervices to his country, the Agrigentines offered him the government; which he refufed, preferring a philofophical tranquillity to regal honours. He is faid, by fome of his hiftorians, to have been ever generous, humane, and moderate, and ready at all times to ftand forth as the declared enemy of tyrants; and to have vigoroufly purfued all thofe who feemed to afpire at the fovereign power. An anecdote is handed down to us in confirmation of this fact. A citizen of Agrigentum having invited him home to fupper, and the hour of the repaft being arrived, he inquired why it was not ferved up; "becaufe," faid the hoft, "we wait for the minifter of the council." At length this officer appeared, and he was made mafter of the feaft; during which he gave himfelf fo many infolent airs, that Empedocles began to fufpect that fome fecret project was concerted between the mafter of the feaft and his inviter, with a view to re-eftablifh the tyranny. The fufpicion was but too well founded. The philofopher next day citing the two perfons before the council, they were condemned to death.

A very different character, however, is afcribed to Empedocles by many other writers. He is faid to have conducted himfelf with the utmoft pride and haughtinefs towards his fellow-citizens, and to have afpired to divine honours; walking pompoufly about the country, and through the cities, habited like the gods, and feeking the plaudits of the people. He wore a golden crown on his head, with Delphic chaplets in his hands, and brazen fandals on his feet, and was clothed in a robe of purple and gold, his hair being long and flowing.

The accounts of his death are not lefs various and contradictory. Some authors affirm, that thinking to pafs himfelf for a deity, and to perfuade the people that he had been taken directly up into heaven, he afcended Ætna in the night, and threw himfelf head-long into the burning crater of the mountain, imagining that his death would remain for ever concealed from mortals; but that the treacherous mountain threw up one of his brazen fandals, and thus expofed the folly of the vifionary, who difdained to be thought man.

> " —— Deus immortalis haberi
> Dum cupit Empedocles ardentem frigidus Ætnam
> Infiliit." Hor. Ars Poet. v. 465.

Others, however, admitting that he perifhed in mount Ætna, affert that, impelled by his paffion for the ftudy of nature, he refolved to examine the crater of that volcano, and that having ventured too far, he accidentally fell into the burning gulf. Some authors, again, have affirmed, that he broke his leg, by falling from a chariot, which brought on a difeafe that proved fatal. Others pretend that he terminated his own exiftence, fome fay by throwing himfelf into the fea, and fome by ftrangulation with a rope: while others maintain that he died a natural death, at the age of 77 years. But the moft commonly received opinion, notwithftanding thefe contradictions, is, that this philofopher, being extremely advanced in years, accidentally fell into the fea, and was drowned, about 440 years before Chrift, or in the 84th Olympiad. Timæus relates, that, towards the clofe of his life, Empedocles went into Greece, and never returned, and on this account, the exact time and manner of his death remain unknown. According to Ariftotle, he died at the age of 60 years. Some writers make a diftinction between Empedocles the philofopher, and another who was a poet. Caftellani, upon what authority we know not, ftates that Empedocles, the philofopher and poet, was the fon of Meto, and grandfon of Empedocles, who was an excellent poet.

A ftatue was erected to the memory of Empedocles at Agrigentum. See Caftellani Vit. Medicor. Illuft. Mangeti Bibliotheca Scriptor. Med. Haller. Bibl. Med. Pract. Dict. Hiftorique. Brucker's Hift. Philof. by Enf. vol. i.

EMPERESS, Empress, *Imperatrix*, the feminine of emperor; the wife or widow of an emperor; or a princefs who is the fupreme ruler of an empire in her own right.

Emperess, is alfo ufed in the *Ancient French Poetry*, for a particular kind of rhime, thus denominated by way of excellence.

The "rhime emperiere" was a fort of crowned rhime, wherein the fyllable that made the rhime was immediately preceded by two other like fyllables of the fame termination; which made a kind of echo, called the *triple crown*; and which, to the fhame of the nation, (as fome of their late authors exprefs it,) their beft ancient poets took for a wonderful beauty and excellence.

Fa. Mourgues, in his treatife on French poetry, gives us an inftance very proper to raife contempt of the miferable tafte of that age, which knew no way of expreffing that the world is impure, and fubject to change, fo excellent, as by faying,

> "Qu'es tu qu'un imonde, monde, onde."

EMPEREUR, Constantine, L', in *Biography*, a learned divine, was a native of Holland, where he took the degree of doctor of theology, and became diftinguifhed in oriental literature and Jewifh antiquities. He was profeffor of theology and Hebrew at Harderwyck during eight years, and then was appointed profeffor of Hebrew at Leyden in 1627. He died in 1648, a fhort time after he had been appointed theological profeffor at Leyden. He obtained the character of a zealous defender of the Chriftian religion,

religion, againſt the objections of the Jews. He was the friend of the moſt learned men of his age, *viz.* of Heinſius, Buxtorf, &c. and offered to ſuperintend an impreſſion of their Talmudical dictionary in Holland. His works were chiefly theological, and highly eſteemed by his contemporaries. Moreri.

EMPERICHORESIS. See CIRCUMINCESSION.

EMPEROR, as far as this word denoted formerly the head of the German empire. See GERMANY.

EMPEROR, *Imperator*, among the *Ancient Romans*, ſignified a general of an army, who, for ſome extraordinary ſucceſs, had been complimented with this appellation. It was emphatically beſtowed by the ſoldiers, when, on the field of battle, they proclaimed their victorious leader worthy of that title. When the Roman emperors aſſumed it in that ſenſe, they placed it after their name, and marked how often they had taken it. Thus Auguſtus having obtained no leſs than twenty famous victories, was as often ſaluted with the title emperor; and Titus was denominated emperor by his army, after the reduction of Jeruſalem. See AUGUSTUS and TITUS.

Afterwards it came to denominate an abſolute monarch, or a ſupreme commander of an empire; a Roman emperor, &c. In this ſenſe Julius Cæſar was called emperor, and the title deſcended with the dignity to Octavius Auguſtus, and the ſucceeding emperors.

In ſtrictneſs, the title emperor does not, and cannot add any thing to the rights of ſovereignty; its effect is only to give precedence and pre-eminence above other ſovereigns; and as ſuch, it raiſes thoſe inveſted with it to the ſummit of all human greatneſs.

The emperors, however, pretend, that the imperial dignity is more eminent than the regal; but the foundation of ſuch prerogative does not appear: it is certain, the greateſt, moſt ancient, and abſolute monarchs, as thoſe of Babylon, Perſia, Aſſyria, Egypt, Macedonia, &c. were called by the name of *kings*, in all languages, both ancient and modern. See KING.

It is diſputed, whether or not emperors have the power of diſpoſing of the regal title. It is true, they have ſometimes taken upon them to erect kingdoms; and thus it is that Bohemia and Poland are ſaid to have been raiſed to the dignity; thus alſo, the emperor Charles the Bald, in the year 877, gave Provence to Boſon, putting the diadem on his head, and decreeing him to be called *king*, "Ut more priſcorum imperatorum regibus videretur dominari." Add, that the emperor Leopold erected the ducal Pruſſia into a kingdom, in favour of the elector of Brandenburg; and though ſeveral of the kings of Europe refuſed for ſome time to acknowledge him in that capacity, yet by the treaty of Utrecht, in 1712, they all concurred.

In the Eaſt, the title and quality of emperor are more frequent than they are among us; thus, the ſovereign princes of China, Japan, Mogul, Perſia, &c. are all emperors of China, Japan, &c.

In the year 1723, the czar of Muſcovy aſſumed the title of emperor of all Ruſſia, and procured himſelf to be recognized as ſuch by moſt of the princes and ſtates of Europe. See RUSSIA.

In the Weſt, the title has been a long time reſtrained to the emperors of Germany. The firſt who bore it was CHARLEMAGNE, who had the title emperor conferred on him by pope Leo III. though he had all the power before. His empire, however, was of no long duration. When the German branch of his family became extinct, the Germans exerciſed the right inherent in a free people, and, in a general aſſembly of the nation, elected Conrad count of Franconia emperor. After him Henry of Saxony, and his deſcendants, the three Othos, were placed, in ſucceſſion, on the imperial throne, by the ſuffrages of their countrymen: the extenſive territories of the Saxon emperors, their eminent abilities, and enterpriſing genius, not only added new vigour to the imperial dignity, but raiſed it to higher honour and pre-eminence. (See OTHO.) But while the emperors, by means of new titles and new dominions, gradually acquired additional authority and ſplendour, the nobility of Germany went on at the ſame time extending their privileges and juriſdiction. Upon the whole, the imperial prerogatives were formerly much more extenſive than they are at preſent. At the cloſe of the Saxon race, A.D. 1024, they exerciſed the right of conferring all the great eccleſiaſtical benefices in Germany; of receiving the revenues of them during a vacancy; of ſucceeding to the effects of inteſtate eccleſiaſtics; of confirming or annulling the elections of the popes; of aſſembling councils, and of appointing them to decide concerning the affairs of the church; of conferring the title of king on their vaſſals; of granting vacant fiefs; of receiving the revenue of the empire; of governing Italy as its proper ſovereigns; of erecting free cities, and eſtabliſhing fairs in them; of aſſembling the diets of the empire, and fixing the time of their duration; of coining money, and conferring the ſame privilege on the ſtates of the empire; and of adminiſtering both high and low juſtice within the territories of the different ſtates. But in the year 1437, at the period of the extinction of the emperors of the families of Luxemburgh and Bavaria, they were reduced to the right of conferring all dignities and titles, except the privilege of being a ſtate of the empire; of *preces primariæ*, or of appointing once during their reign a dignitary in each chapter, or religious houſe; of granting diſpenſations with reſpect to the age of majority; of erecting cities, and conferring the privilege of coining money; of calling the meetings of the diet, and preſiding in them.

In the one period, the emperors appear as mighty ſovereigns, with extenſive prerogatives; in the other, as the heads of a confederacy, with very limited powers. The revenues of the emperors decreaſed ſtill more than their authority. The early emperors, particularly thoſe of the Saxon line, beſides their vaſt patrimonial or hereditary territories, poſſeſſed an extenſive domain both in Italy and Germany, which belonged to them as emperors. Italy belonged to the emperors as their proper kingdom; and the revenues which they drew from it were very conſiderable. But the firſt alienations of the imperial revenue were made in this country. The Italian cities, having acquired wealth, and aſpiring at independence, purchaſed their liberty from different emperors. Many diſtricts, poſſeſſed by the emperors, which were intermixed with the eſtates of the dukes and barons, were ſeized by the nobles, during the conteſts that took place between the emperors and the court of Rome. The emperors were alſo almoſt entirely robbed of their caſual revenues; the princes and barons appropriating to themſelves taxes and duties of every kind, which had been uſually paid to them. From the reign of Charles IV., whom Maximilian called the peſt of the empire, the emperors were reduced to the neceſſity of depending entirely on their hereditary dominions, as the only ſource of their power, and even of their ſubſiſtence. Pfeffel Abregé de l'Hiſt. d'Allem.

One principal cauſe of the degradation of the emperors was the aggrandizement of the clergy. The popes, before the firſt period above mentioned, A.D. 1024, had been dependent on the emperors, and indebted for their power as well as dignity to their beneficence and protection. But they afterwards began to claim a superior jurisdiction; and in virtue of authority, which they pretended to derive from heaven, tried, condemned, excommunicated, and deposed their former masters. Pope Gregory VII. combined political discernment and sagacity with his presumption and violence; and commenced his rupture with Henry IV. upon a pretext that was popular and plausible. He complained of the venality and corruption with which the emperor had granted the investiture of benefices to ecclesiastics. All the censures of the church were denounced against Henry; and the most considerable of the German princes and ecclesiastics were excited to take arms against him. So successful was the court of Rome in inflaming the superstitious zeal, and conducting the factious spirit of the Germans and Italians, that an emperor, distinguished not only for many virtues, but possessed of considerable talents, was at length obliged to appear as a supplicant at the gates of the castle in which the pope resided, and to stand there three days, bare-footed, in the depth of winter, imploring a pardon, which was at length obtained with difficulty. This act of humiliation degraded the imperial dignity. Nor was the depression momentary. The contest between Gregory and Henry gave rise to the two powerful factions of the Guelfs and Ghibellines; the former of which supporting the pretensions of the popes, and the latter defending the rights of the emperor, kept Germany and Italy in perpetual agitation during three centuries. A regular system for humbling the emperors, and circumscribing their power, was formed and uniformly adhered to during that period. The decline of the imperial authority may partly be ascribed to the change which took place with regard to the mode of their election. During a long period, all the members of the Germanic body assembled, and chose the person whom they appointed to be their head; but amidst the violence and anarchy which prevailed for several centuries in the empire, seven princes, who possessed the most extensive territories, and who had obtained an hereditary title to the great offices of the state, acquired the exclusive privilege of nominating the emperor. This right was confirmed to them by the golden bull; the mode of exercising it was ascertained; and they were dignified with the appellation of *Electors*. These electors, by their extensive power, and the distinguishing privileges which they possessed, became formidable to the emperors, with whom they were placed almost on a level in several acts of jurisdiction. See ELECTOR, and DIET.

To the privileges and powers formerly belonging to the emperors, and which have been above enumerated, some have added, 1. That all the princes and states of Germany are obliged to do them homage, and swear fidelity to them. 2. That they, or their generals, have a right to command the forces of all the princes of the empire, when united together. 3. That they receive a kind of tribute from all the princes and states of the empire, for carrying on a war which concerns the whole empire, which is called the *Roman month*. As to the present mutilated state of the German empire, see ELECTOR and GERMANY.

The kings of France were anciently also called emperors, at the time when they reigned with their sons, whom they associated to the crown: thus, Hugh Capet having associated his son Robert, took the title of emperor, and Robert that of king; under which titles they are mentioned in the history of the council of Rheims, by Gerbert, &c. King Robert is also called emperor of the French, by Helgau of Fleury. Lewis le Gros, upon associating his son, did the same. In the first register of the King's Charters, fol. 166, are found letters of Louis le Gros, dated in 1116, in favour of Raymond, bishop of Maguelonne, wherein he styles himself "Ludovicus, Dei ordinante providentia, Francorum imperator Augustus." The kings of England had likewise anciently the title of emperors, as appears from a charter of king Edgar: "Ego Edgarus Anglorum basileus, omniumque regum insularum oceani quæ Britanniam circumjacent, &c. imperator & dominus."

We also say the king of England, "Omnem habet potestatem in regno suo quam imperator vindicat in imperio:" whence the crown of England has been long ago declared in parliament to be an imperial crown.

EMPEROR, among *Hebrew Grammarians*, is an appellation given to a species of accents serving to terminate a sense completely, and answers to our point. See ACCENT.

EMPEROR *Elect*. See ELECT.

EMPETRON, in *Botany*, a name by which some authors, as Dodonæus, &c. have called the kali or glass wort. Ger. Emac. Ind. 2. See KALI.

EMPETRUM, from εν, *in* or *upon*, and πετρος, *a rock*, or *stone*, expressing its stony barren places of growth. Linn. Gen. 515. Schreb. 676. Sm. Fl. Brit. 1072. Mart. Mill. Dict. v. 2. Juss. 162. Gærtn. t. 106. Class and order, *Dioecia Triandria*. Nat. Ord. *Ericis affine*, Juss.

Gen. Ch. Male. *Cal.* Perianth in three deep, ovate, permanent divisions. *Cor.* Petals three, sometimes more, ovate-oblong, contracted at their base, larger than the calyx, withering. *Stam.* Filaments three, sometimes nine, capillary, very long, pendulous; anthers erect, short, deeply cloven.—Female. *Cal.* and *Cor.* as in the male. *Pist.* Germen superior, depressed; style short, simple; stigmas nine, spreading, a little reflexed. *Peric.* Berry orbicular, depressed, of one cell, larger than the calyx. *Seeds* three or nine, ranged circularly, gibbous at the outer edge, angular at the other. The flowers are commonly dioecious, but sometimes the two sexes are found on the same plant, and even both organs united in one flower.

Eff. Ch. Male, Calyx deeply three-cleft. Petals three. Stamens capillary, from three to nine. Female, Calyx deeply three-cleft. Petals three. Stigmas nine. Berry superior, with three to nine seeds.

The species are two.

1. E. *album*. Linn. Sp. Pl. 1450. (Erica coris folio decima; Clus. Hist. v. 1. 45. E. baccifera tenuifolia; Ger. em. 1381.) "Stem erect." Observed by Clusius on sandy heaths near Lisbon, bearing fruit early in November. He compares the berries, which are white, acid, and transparent, to pearls of an inferior kind. He generally found but three seeds in each, which accords with Gærtner's account of this species. The *stems* are shrubby, a foot and half high, erect, branched in a determinate order. *Leaves* ternate, evergreen, linear, obtuse, revolute, smooth above, resembling those of many heaths. *Flowers* not observed. *Berries* lateral, solitary, the size of a moderate pea, resembling those of Misseltoe.

2. E. *nigrum*. Linn. Sp. Pl. 1450. Sm. Fl. Brit. 1072. Engl. Bot. v. 8. t. 526. (E. montanum, fructu nigro; Raii Syn. 444. Erica baccifera procumbens; Ger. em. 1383.) "Stems procumbent." Black Crow-berry, or Crake-berry. Plentiful on mountainous heaths in the north of England, as well as in Sweden, Lapland, Denmark, &c. blossoming in May, and ripening fruit in August. It differs from the former in its more humble and procumbent growth, and in having black berries, with nine seeds. *Flowers* reddish, axillary, plentiful about the tops of the last-year's branches. The fruit has a mild flavour of elder-

berries,

berries, and "affords fuftenance to ptarmigans, groufe, partridges, and even to the hardy highlander himfelf."

EMPHASIS, in *Elocution*, a term generally, but abfurdly, ufed by modern writers, exclufively in the *fingular* number. "Emphafis," fays Mr. Sheridan (Lecture iv.), "difcharges in fentences the fame kind of office that accent does in words. As accent is the link which ties fyllables together, and forms them into words; fo emphafis unites words together, and forms them into fentences, or members of fentences. As accent dignifies the fyllable on which it is laid, and makes it more diftinguifhed by the ear than the reft; fo emphafis ennobles the word to which it belongs, and prefents it in a ftronger light to the underftanding. Accent is the mark which diftinguifhes words from each other, as fimple types of our ideas, without reference to their agreement or difagreement. "Emphafis is the mark which points out their feveral degrees of relationfhip," and the rank which they hold in the mind. Accent addreffes itfelf to the ear only; emphafis, through the ear, to the underftanding. Were there no accents, words would be refolved into their original fyllables: were there no emphafis, fentences would be refolved into their original words. And in this cafe, the hearer muft be at the pains himfelf, firft, of making out the words, and afterwards their meaning: and as this could not be done, without fuch length of paufes at the end of fentences, and their feveral members, as would allow him time to revolve in his memory the founds which have been uttered, it would make the action of liftening to difcourfe laborious and difguftingly tedious. Whereas, by the ufe of accent and emphafis, words, and their meaning, being pointed out by certain marks, at the fame time that they are uttered, the hearer has all trouble faved, but that of liftening; and can accompany the fpeaker at the fame pace that he goes, with as clear a comprehenfion of the matter offered to his confideration as the fpeaker himfelf has if the fpeaker delivers himfelf well."

It is not very eafy to difcover what Mr. S. means, (even with his interpretation of the word accent,) when he fays, that "were there *no accent*, words would be refolved into their *original fyllables*;" fince monofyllables, though denied the property of what is here called accent, are neverthelefs admitted by Mr. S. and the grammarians in general to be words; and fince, as will be fhewn hereafter, the ear alone (unaffifted by the memory of impreffions received through the eye) has even yet (with all the affiftance derived from that *poife* and that *percuffion* of particular fyllables, fo abfurdly confounded in the popular abufe of the term accent) no poffible means of diftinguifhing polyfyllabic words from fucceffive monofyllables, when properly pronounced. Certainly he is not at all more intelligible, when he adds, "were there *no emphafis*, fentences would be refolved into their *original words*;" or again, when he informs us, that "by the ufe of accent and emphafis, *words, and their meaning*, are pointed out by certain marks, *at the fame time* that they are uttered." That fhifting the percuffion, or varying the poife of fimilar affociations of fyllables, will effentially change the meaning even of words in their feparate capacity, (as *díffer, defér; défert, defért; préfent, prefént; réfufe, refúfe; óbject, objéct; íncenfe, incénfe*, &c. fee B. Jonfon's Gram.) and ftill more of fuch affociated fyllables as may occafionally be brought together in the compofition of fentences, muft be readily allowed; and that the fenfe of *all fentences* would be much obfcured by the omiffion, and of *many* entirely inverted by a tranfpofition of the emphafes: but ftill the words, as words, and their meanings as words, (though not their fpecific relations to the other words of the fentence,) would be recognized "*at the fame time* they were uttered," whether they were accompanied with emphafes or not: and as for what is here mifcalled the accent, the *poife* at leaft muft of phyfical neceffity be fomewhere placed; and *fpeech* without it could not be conducted at all. But Mr. S. never feems to have dreamed of fubmitting either the procefs or the nomenclature of elocution to phyfiological or critical analyfis. He ufed the terms of his art as he found them in the works of the grammarians and rhetoricians of modern times; and as their phrafeology was all confufion and contradiction, his elucidations were not likely to be very fatisfactory. The Lecture on Emphafis, however, is by far the moft valuable portion of this work.

"The neceffity of obferving propriety of emphafis," fays he, "is fo great, that the true meaning of words cannot be conveyed without it. For the fame individual words, ranged in the fame order, may have feveral different meanings, according to the placing of the emphafis. Thus, to ufe a trite inftance, the following fentence may have as many different meanings as there are words in it, by varying the emphafis: "Shall you ride to town to-morrow?" If the emphafis is on fhall, as, *Shall* you ride to town tomorrow? it implies, that the perfon fpoken to had expreffed before fuch an intention, but that there is fome doubt in the queftioner whether he be determined on it or not; and the anfwer may be, Certainly, or, I am not fure. If it be on you, as, Shall *you* ride to town to-morrow? the queftion implies that fome one is to go, and do you mean to go yourfelf, or fend fome one in your ftead? and the anfwer may be, No, but my fervant fhall. If on ride, as, Shall you *ride*, &c.? the anfwer may be, No, I fhall walk, or go in a coach. If on town, as, Shall you ride to *town* to-morrow? the anfwer may be, No, but I fhall ride to the foreft. If on to-morrow, as, Shall you ride to town *to-morrow?* the anfwer may be, No, not to-morrow, but the next day."

Thefe obfervations and illuftrations may ferve to fhew the importance of emphafes in general; but they do nothing towards illuftrating the fpecific characteriftics of fuch emphafes. Indeed, in all that Mr. S. has faid upon this fubject, it fhould feem as if he had no clear conception of any other fpecies of emphafis, than the emphafis of force; and it is evident, indeed, that the conceptions of the generality of readers and reciters, practically, go no farther. Mr. S. does indeed fay, in another place, "that emphafis is of two kinds," (furely, then it fhould have been that emphafes are of two kinds,) "fimple or complex. Simple, when it ferves only to point out the plain meaning of any propofition; complex, when, befides the meaning, it marks alfo fome affection or emotion of the mind; or gives a meaning to words, which they would not have in their ufual acceptation, without fuch emphafis. In the former cafe, emphafis is little more than a ftronger accent, with but little change of tone; when it is complex, befides force, there is always fuperadded a manifeft change of tone. Simple emphafis belongs to the calm and compofed underftanding; complex, to the fancy and the paffions." But the concluding remark fufficiently evinces how little the nature of thefe varieties was underftood by this author, and how imperfectly the terms of his art were defined in his own mind; for it will prefently be fhewn, that even without any neceffity of appeal to the fancy and the paffions, a much more complex fyftem of emphafes is neceffary fully to elicit, and agreeably to illuftrate, the fenfe of many paffages. Mr. Cockin, in his "Art of delivering written Language," animadverts upon the want of clearnefs in this diftinction, and upon the

the apparent confufion between the fignificant power of emphafis and the various "tones, fimply confidered, of all the emotions of the mind;" and feems to imagine he has remedied the confufion by contradiftinguifhing emphafes into "emphafis of fenfe, and emphafis of force;" and Mr. Walker, (Elements of Elocution, p. 190.) confiders this diftinction as having "thrown great light upon this abftrufe fubject." But as the emphafis of force is moft affuredly as indifpenfable to the full expreffion of the fenfe, as any of the other *feveral* fpecies of emphafes, it is very queftionable whether this pretended diftinction does any thing more than render confufion worfe confounded. Mr. Cockin proceeds; "now from the above account of thefe two fpecies of emphafis it will appear, that in reading, as in fpeaking, the firft of them muft be determined entirely by the fenfe of the paffage, and always made alike: but as to the other, tafte alone feems to have a right of fixing its fituation and quantity." Farther, "fince the more effential of thefe two energies is folely the work of nature, (as appears by its being conftantly found in the common converfation of people of all kinds of capacities and degrees of knowledge,) and the moft ignorant perfon never fails of ufing it rightly in the effufions of his own heart, it happens very luckily, and ought always to be remembered, that provided we underftand what we read, and give way to the dictates of our own feeling, the emphafis of fenfe can fcarce ever avoid falling fpontaneoufly upon its proper place." That mere tafte has any thing to do with fixing the *fituation* of the emphafis of force (whatever it may have to do with its *quantity* or *degree*) we utterly deny; or that, in juft reading or recitation, it can be determined by any thing but the *fenfe* alone. And as for what is faid of even the moft ignorant perfon never failing, in common converfation and the effufions of his own heart, in the right application of the *emphafis of fenfe*, it is true of all the kinds of emphafes; for, in fpontaneous fpeaking, all emphafes are emphafes of fenfe; and in all other kinds of fpeaking (reading or reciting) whatever emphafes are not fo, muft be emphafes of nonfenfe. Mr. Walker, indeed, has himfelf fuggefted a much more rational fpecies of diftinction, and has made fome confiderable advances towards a juft fyftem or theory upon this fubject, by drawing a clear line of demarcation between what, perhaps, might very properly have been called the inherent or *grammatical powers* of particular claffes of words, and the arbitrary or *fignificant emphafes* of fpecific words in a fentence. Perhaps had Mr. W. fo denominated them, not only his diftinctions, fo far as they go, might have been rendered more obvious, but the denomination itfelf would have led him to difcover that there are ftill diftinct fpecies of actual emphafes, properly fo called, which have efcaped his obfervation. He would not then, perhaps, have told us, that "emphafis, in the moft ufual fenfe of the word, is that ftrefs with which certain words are pronounced, fo as to be diftinguifhed from the reft of the fentence." He would have perceived that fuch a definition was much too vague to meet even the full fignification of the term in popular ufage: for no one does in reality apply the term emphafis to the mere grammatical or inherent force that diftinguifhes, in all diftinct and intelligible fpontaneous fpeech, the nouns and verbs above the articles, conjunctions, and prepofitions. The term, on the contrary, always fuppofes fome fuperadded diftinction given to a word or words of what defcription foever, and conferring upon fuch words a degree of importance in the fentence, beyond what is inherent in their mere grammatical quality. Mr. W. proceeds, "among the number of words we make ufe of in difcourfe, there will always be fome which are more neceffary to be underftood than others: thofe things with which we fuppofe our hearers to be pre-acquainted (he might have added, 'or which are neceffary only for the mere grammatical connection of the more important words,') we exprefs by fuch a fubordination of ftrefs as is fuitable to the fmall importance of things already underftood; while thofe of which our hearers are either not fully informed, or which they might poffibly mifconceive, are enforced with fuch an increafe of ftrefs, as makes it impoffible for the hearer to overlook or miftake them. Thus, as in a picture, the more effential parts of a fentence are raifed, as it were, from the level of fpeaking; and the lefs neceffary are, by this means, funk into a comparative obfcurity." This is both juft and pertinent, and the fimile at the conclufion is even more appofite, than Mr. Walker feems himfelf to have been aware; for, to purfue the metaphor in elocution as in picture, it is not merely by the force of a line or the depth of a fhadow, that all the varieties of emphatic effect are to be expected to be produced. "From this general idea of emphafis," continues Mr. W., "it will readily appear of how much confequence it is to readers and fpeakers not to be miftaken in it; the neceffity of diftinguifhing the emphatical words from the reft, has made writers on this fubject extremely folicitous to give fuch rules for placing the emphafis as may, in fome meafure, facilitate this difficult part of elocution; but few have gone farther than to tell us that we muft place the emphafis on that word in reading which we fhould make emphatical in fpeaking; and though the importance of emphafis is infifted on with the utmoft force and elegance of language, no affiftance is given us to determine which is the emphatic word, where feveral appear equally emphatical, nor have we any rule to diftinguifh between thofe words which have greater, and thofe which have a leffer degree of ftrefs; the fenfe of the author is the fole direction we are referred to, and all is left to the tafte and underftanding of the reader."

He then proceeds to ftate with high commendation the above-mentioned diftinction of Mr. Cockin, whofe definition he quotes as follows: "Emphafis of force," he tells us, "is that ftrefs we lay on almoft every fignificant word: emphafis of fenfe is that ftrefs we lay on one or two particular words, which diftinguifhes them from all the reft of the fentence. The former ftrefs," he obferves, "is variable, according to the conception and tafte of the reader, and cannot be reduced to any certain rule: the latter," he fays, "is determined by the fenfe of the author, and is always fixed and invariable. This diftinction, it muft be owned," continues Mr. Walker, "is, in general, a very juft one, and a want of attending to it has occafioned great confufion in this fubject, even in our beft writers. Thus, when the emphatical words were to be marked, by being printed in a different character, we find in feveral of the modern productions on the art of reading, that fometimes more than half of the words are printed in italics, and confidered as equally emphatical. The wrong tendency of fuch a practice," continues Mr. W., "was never pointed out till the publication of the effay above-mentioned;" by the affiftance of which Mr. W. profeffes to endeavour to pufh his inquiries ftill farther; "not only to eftablifh the diftinction he has laid down, but to draw the line between thofe two kinds of emphafis, fo as to mark more precifely the boundaries of each. To this diftinction of emphafis he accordingly adds another, making a diftinction of each into two kinds, according to the inflexion of voice they adopt; which, though of the utmoft importance in conveying a juft idea of emphafis, had never been noticed by any of our writers on the fubject." The diftinction thus added is that

that which relates to the application of the rifing and falling inflexion, and which, though in reality fuch inflexions apply not only to emphatic words, but in a fmaller or greater degree to all the words and fyllables of which language, properly delivered, is compofed, (every fyllable not delivered in a *monotone*, *i.e.* not fung, having of neceffity either an acute, a grave, or a circumflex accent,) is affuredly a diftinction of much importance, in what relates to the practical adjuftment of the emphafis, and for the comprehenfion of Mr. Walker's theory, relative to which (imperfect as that theory, perhaps, may be) the ftudent will do well to refer both to the "Elements" and to the "Rhetorical Grammar" of that elaborate profeffor. "This," fays Mr. W., "brings us to a threefold diftinction of words, with regard to the force with which they are pronounced; namely, the conjunctions, particles, and words underftood, which are obfcurely and feebly pronounced; the fubftantives, verbs, and more fignificant words, which are firmly and diftinctly pronounced; and the emphatical word, which is forcibly pronounced: it is the laft of thefe only which can be properly ftyled emphafis; and it is to a difcovery of the nature and caufe of this emphafis that all our attention ought to be directed. And firft, we may obferve, that if thefe diftinctions are juft, the common definition of emphafis is very faulty. Emphafis is faid to be a ftrefs laid on one or more words to diftinguifh them from others: but this definition, as we have juft feen, makes almoft every word in a fentence emphatical."

Mr. W. then adds, "the principal circumftance that diftinguifhes emphatical words from others, feems to be a meaning which points out, or diftinguifhes, fomething as diftinct or oppofite to fome other thing. When this oppofition is expreffed in words it forms an antithefis, the oppofite parts of which are always emphatical. Thus, in the following couplet from Pope:

> 'Tis hard to fay, if greater want of fkill
> Appear in writing or in judging ill.

The words *writing* and *judging* are oppofed to each other, and are therefore the emphatical words.

But this defcribes only the emphafis of antithefis, which is certainly not the only fpecies of emphafis, properly fo called, that is requifite to well delivered fpeech; for words are rendered important by appofition, as well as by oppofition; by their relative, and their abfolute confideration in the fentence, and by their reflective, as well as their antagonift meaning, and to afcertain and exemplify all the varieties and circumftances of emphafes, were almoft to illuftrate the whole theory of the actual and practicable melody of fpeech. The threefold diftinction above quoted does, however, furnifh a clue to a part of this mazy labyrinth; and Mr. W.'s concluding definition, though imperfect, as excluding fome effential claffes of emphafes, is ftrictly applicable to the full extent of his view, which was certainly the moft comprehenfive that had then been taken of the fubject. "Emphafis," fays he, "when applied to particular words, is that ftrefs we lay on words, which are, in contradiftinction to other words, either expreffed or underftood. And hence will follow this general rule; wherever there is contradiftinction in the fenfe of the words, there ought to be emphafis in the pronunciation of them; the converfe of this being equally true, wherever we place emphafis we fuggeft the idea of contradiftinction." Now though it is not true, that all emphafis has an antithefis, either expreffed or underftood, yet as the emphafes of antithefis conftitute a very large and material clafs of thefe rhetorical diftinctions, the following rules may be regarded as highly important. "If the emphafis excludes the antithefis, the emphatic word has the falling inflexion; if the emphafis does not exclude the antithefis, the emphatic word has the rifing inflexion. The grand diftinction, therefore, between the two emphatic inflexions is this; the falling inflexion affirms fomething in the emphafis, and denies what is oppofed to it in the antithefis; while the emphafis with the rifing inflexion, affirms fomething in the emphafis without denying what is oppofed to it in the antithefis; the former, therefore, from its affirming and denying abfolutely, may be called the ftrong emphafis; and the latter from its affirming only, and not denying, may be called the weak emphafis."

They who purfue Mr. W. through all his diftinctions of fimple, double, and triple emphafis, will undoubtedly, upon the whole, be much edified, though even with refpect to the application of the inflexions they may not agree with him in every inftance. But if Sheridan attempted nothing more than a practical elucidation of the application and mifapplication of emphafis, without laying down any general principles, or rules of extenfive and perfpicuous application, or difcriminations of the characteriftic varieties of emphafes; and if Cockin only fuggefted without properly defining the differences between the grammatical import, and the emphatic diftinction of words; Mr. W. while he has in fome inftances well defined the principle of the application of the rifing, and the falling inflexions to emphatic words, has left it to more recent difcovery to define, and to claffify the feveral fpecies of emphafes, (properly fo called,) and to point out the diftinct properties, or actions both of the voice and the enunciation by which thofe fpecies are to be contradiftinguifhed. "All emphafes," it is maintained by the lecturer on the fcience and practice of elocution, "affect the words upon which they fall in the three predicaments, of time, of tune, and of force, but as fome fpecies of emphafes require a preponderancy of one, and other fpecies of another of thefe properties, emphafes may properly be contradiftinguifhed into three kinds; emphafis of time, or the condition of words rendered emphatical, by the encreafed quantity affigned to the refpective fyllables; emphafis of tune, or the condition of words rendered emphatical, by the diftinction of a fuperior degree of inflexion, or by a higher or lower pitch in the mufical fcale; and emphafis of force, or the condition of words rendered emphatical by the fuperior energy with which they are uttered. And the adjuftment of thefe refpective varieties of emphafes, to their refpective occafions, it is contended, is of equal importance with the felection of the proper fituations for placing an emphafis at all; fince the fenfe may be as completely perverted, or at leaft the ear may be as much fhocked by inferting the emphafis of force (a very common error in theatrical recitation,) where that of tune, or of quantity was required, as by placing it altogether on a wrong word. To elucidate this fyftem fatisfactorily, would require more fpace than can conveniently be fpared, in a general dictionary of the circle of fciences; but as there at prefent exifts no printed copy of the lectures in queftion, nor any book upon the fubject to which the ftudent can be referred, part of a column will not perhaps be mifapplied, by being devoted to the fubject. The kinds of emphafes enumerated are principally as follows. 1. The objective emphafis, or emphafis of import, *i.e.* the ftrefs of voice by which proportionate importance is given to the word or words, conveying the fubftantive matter, or leading object of the fentence, as "I am defirous of being acquainted with *the nature of Man.*" That is to fay, "the nature of man is a fubject to which I am defirous of directing fome enquiry;" an idea which may be expreffed either with or without any

 reference

reference to any other subject, either as associated or rejected. In which latter case, no antithesis is either expressed or implied, and the simple emphasis of import is expressed, by an increased stress of the voice, thrown upon the whole of the syllables, composing the amalgamated substantive, or compound name of that object, to wit, "the nature of man." 2. Emphasis of antithesis, or that characteristic stress and inflexion of the voice by which the opposition between two ideas, or parts of a compound idea, is pointed out, and emphatically impressed upon the mind. The antithesis may be either expressed or understood. Thus, if the preceding passage be requoted with an emphasis upon the word nature only, and that emphasis be principally specified by a strong circumflective accent (that is to say, by a partial increase of quantity and a specific peculiarity of time) I am desirous of becoming acquainted with the *nature* of Man;—the words have changed to a certain degree their signification; an antithesis is understood; and the interpretation becomes "It is not the *history*—it is not the outward *form* and *complexion*, or any other particular incident relative to man, but his general nature, his physical and moral attributes that I am desirous of knowing." Again, if the single word Man be rendered emphatic by superadding to the customary energy of the closing poise or final heavy syllable a certain portion of the same species of time, "I am desirous of becoming acquainted with the nature of *man*," will then by another implied antithesis come to signify, "It is not with the nature of stones, and earths, and shrubs, and herbs, and brute animals, that I am desirous of becoming acquainted, but with that of man." Of the direct or expressed antithesis we have an illustration in the following sentence. "It is not with the nature of *Màn*, but with the nature of *Gód*, that I am desirous of being acquainted." Upon this species of emphasis little need be added to what has already been said by Mr. Walker. 3. The emphasis of coincidence, or the level and equal stress of the voice upon two or more words either in the same or different members of a sentence; by which the relationship, agreement, and equal importance of the annexed ideas are indicated: as—"The *stature*, the *form*, and the *complexion* of man, as well as his *moral* and *physical attributes* are parts of his nature; and his *history* must be studied that his nature may be understood." In this instance all the words distinguished by italics demand the emphasis of coincidence: a species of emphasis which is expressed more by its time, or quantity, than either by its inflexion or its force. As this is the species of emphasis that is least obtrusive, it is that which may be used with the greatest frequency and freedom. 4. Complicated emphases. Sometimes all the different kinds of emphases are mingled in one sentence; so that several different words, or pairs of words, require to be discriminated in all the varieties and degrees of time, tune, and force. "It is not the NATURE of **Man** that I am *desirous* of STUDYING; but the LAWS of **God** that I am *anxious* to COMPREHEND." Here NATURE, LAWS; **Man**, **God**; *desirous*, *anxious*; STUDYING, COMPREHEND, require to be respectively balanced and coupled in the mind by appropriate responses of quantity, tune, and force; which if the sentence flowed spontaneously would as spontaneously be adjusted in all propriety, but the due application and apportioning of which to written language constitutes one of the most difficult parts of the art of reading.

There is one thing more which it is necessary to observe on the subject of emphasis, and then we have done with this long article. It has been mistakenly supposed, that the distinction of emphasis necessarily belongs to single words; nay some there are, who, confounding emphasis with mere percussion, would confine it to single syllables; but the fact is, that emphasis (properly so called) belongs not either to the syllabic separation, or grammatical structure of words, but to the idea; and whether the substantive idea be expressed by a simple or by a compound name, the *whole* name of that idea, not a part only of that name, must bear the equal impress of that emphasis:—thus, for example, in the famous reply of the first William Pitt to Mr. Walpole,—"But youth it seems is not my only crime; I have been accused of acting a theatrical part." Here neither the word *acting*, nor the word *theatrical*, nor the word *part*, taken separately, designates the jut of the accusation, or constitutes the name of the idea included in the accusation: for if we read, "I have been accused of *acting* a theatrical part," placing the emphasis only on the word acting; may it not properly be asked—Why, what would you do with a theatrical part but *act it?* If the emphasis be placed on theatrical, "I have been accused of acting *a theatrical* part:"—what part should be *acted*, but one that is theatrical?—if upon the word part alone—I have been accused of acting a theatrical *part?*—what that is theatrical can be acted but a *part?* The whole latter member of the sentence constitutes therefore the jut or object of the accusation.—"I have been accused"—(of what?)—*of acting a theatrical part!*" These words therefore constitute, accordingly, the amalgamated substantive, or compound name of the indivisible, accusatory idea, and must receive throughout an equal portion of *objective emphasis*. Not that the syllables are thereby to be rendered equally forcible, or to be otherwise reduced to one monotonous level. They are only to receive one common superaddition of emphatic force; and as independently of such superaddition, they would have differed among themselves in pause, quantity, accent, and grammatical, or inherent force; in all those particulars they will still continue to differ.

Such is the present state of discovery and ascertainment to which enquiries had been conducted upon the subject of emphasis: by which it should seem, that it constitutes an essential part of the theory and practice of the melody of speech; to which we refer the reader; concluding the present article with the following definition. "Emphases consist in the superadditional importance given to particular words or parts of a sentence, by an increased stress, tune, quantity, or force in the pronunciation of such words or parts of a sentence; and by which their relative importance is pointed out, and the contrasts and assimilations of different members of a description, argument, or position, are discriminated to oral perception." Whether it be possible, or even desirable that a system of notation (the want of which is lamented by Sheridan and others) should be invented and applied to the indication of these varieties, is a question that may belong to the article NOTATION; but which shall not be here discussed.

EMPHATICAL, is used by the *Ancient Philosophers*, to express those apparent colours which are often seen in clouds before the rising or after the setting of the sun; or those in the rainbow, &c.

These, because they are not permanent and lasting, they will not allow to be true colours; but, since these emphatical colours are light modified chiefly by refractions and with a concurrence of reflections, and some other accidental variations; and since they are the proper objects of sight, and capable as truly to affect it as other permanent colours are, there is no reason for excluding them from the number of true and genuine colours, since all other colours are only modifications of light, as these are.

EMPHEREPYRA, in *Natural Hiſtory*, a genus of ſiderochita, compoſed of various cruſts or coats, ſurrounding a nucleus of the ſame matter and ſtructure with themſelves. See Siderochita.

Of this genus we have five ſpecies. Hill's Hiſt. Foſſils, p. 532.

EMPHRACTIC, in *Pharmacy*, the ſame with *emplaſtic*. The word is formed from the Greek εμφρακτικ, *I ſtop.*

EMPHRAXIS, in *Medicine*, an obſtruction in any part.

EMPHRUE, in *Botany*, the name given by the people of Guinea to a ſpecies of tree, the leaves of which they boil in wine, and give as a great reſtorative in caſes of weakneſs and decay. Its leaves are exactly of the ſhape of thoſe of the common mulberry but they are not indented at the edge. Petiver has thence called it "arbor Guineenſis mori folio non crenato." Phil. Tranſ. N° 232.

EMPHYSEMA. The common meaning of this word, in *Surgery*, is an inflation of the texture parts, in conſequence of air getting out of a breach in the lungs, and paſſing into the communicating cavities of the cellular ſubſtance on the outſide of the cheſt, through another breach exiſting at the ſame time in the pleura coſtalis, or membrane lining the thorax. However, there are ſome leſs frequent caſes of emphyſema, which are not comprehended in the preceding definition, as will be explained in the courſe of the preſent article. The term is derived from the Greek εμφυσαω, *to inflate*. Dr. Halliday, in a late ingenious eſſay on the ſubject under conſideration, deſcribes the following as the ſymptoms of an emphyſema, when the affection proceeds from an injury of the thorax. A conſtant pain takes place in the ſide, that has been hurt. At firſt, the ſuffering is not increaſed even by a very full inſpiration; but, no great length of time elapſes, before a very conſiderable difficulty of breathing occurs, and the patient complains of a ſenſation, as if cords were drawn acroſs the cheſt, and of a peculiar tightneſs at the ſcrobiculus cordis. If the part, where the pain and uneaſineſs were firſt felt, is now examined, a ſoft puffy tumour may be noticed, which is ſo very prominent as to prevent the ribs immediately under it from being felt. This tumour increaſes very rapidly, and is ſoon diffuſed over all the cheſt; but is particularly conſpicuous on the neck, breaſt, and face. The rapidity, with which it now ſpreads over the whole ſurface of the body, is amazing, and, in many places, the ſkin is elevated ſeveral inches from the ſubjacent bones and muſcles. When the ſwelling has become general, the patient finds it extremely difficult both to expire and inſpire; the motion of the extremities is very much impeded, and, indeed, when the ſkin is conſiderably elevated, ſuch motion is almoſt entirely prevented. The integuments crackle under the hand; the ſkin is much paler than natural, feels cold, and when ſtruck, ſounds like a wet drum. The air may, in general, be eaſily preſſed from any part; but it returns to the ſame place again as ſoon as the preſſure is removed. The reſpiration is exceedingly laborious, and quick. The patient inſpires with a ſudden effort, and the air, in paſſing the epiglottis, makes a peculiar noiſe. Expiration follows inſpiration almoſt inſtantaneouſly, and is performed with a deep ſigh, or rather groan. The patient is incapable of lying with comfort on either ſide of his body, and feels moſt eaſe, and breathes beſt, when ſitting half erect in bed. The ſkin and extremities feel very cold. The pulſe is ſometimes quick and hard; at other times, it is hard and full; but it can only be felt with ſome difficulty. The eye-lids are frequently ſo puffed up that the patient cannot ſee; the features are very much deformed; and the lips aſſume a purple, or rather a livid hue. At the beginning of the caſe there is generally a ſhort tickling cough, which increaſes with the other ſymptoms, ſo as to become almoſt inceſſant. What the patient ſpits up is generally very frothy and mixed with blood. The tongue is dry, and the patient complains of a conſtant thirſt. The voice becomes very weak, and unleſs the effuſed air is ſpeedily let out, ſo as to reduce the ſwelling and preſſure, the patient dies ſuffocated. (See obſervations on Emphyſema, 1807.) It is utterly impoſſible for any one to underſtand the ſubject of emphyſema, without previouſly having ſome idea of the manner in which the function of reſpiration is naturally carried on. He muſt at leaſt know, that, in the perfect ſtate, the ſurface of the lungs always lies in cloſe contact with the membrane lining the ribs, both in inſpiration and expiration. The lungs themſelves are only paſſive organs, and are quite incapable, by any action of their own, of expanding and contracting, ſo as to maintain their external ſurface conſtantly in contact with the inſide of the thorax, which is continually undergoing an alternate change of dimenſions. Every muſcle that has any concern in producing an enlargement, or diminution, of the cheſt, muſt contribute to the effect of adapting the volume of the lungs to the ſize of the cavity in which thoſe organs are contained. This muſt happen while there is no communication between the cavity of the pleura and the external air, and while there is no breach of continuity in the ſurface of the lungs themſelves. In the act of inſpiration, the thorax becomes enlarged in every direction, the lungs are proportionally expanded, and the air entering through the windpipe, into the air-cells of theſe organs, prevents the occurrence of a vacuum. On the other hand, in the act of expiration, certain muſcles diminiſh the capacity of the thorax, and the lungs being of courſe compreſſed, a large portion of the air, which had juſt before been inhaled in the preceding inſpiration, is again expelled from the trachea.

The few obſervations, already made, muſt render it obvious to every reader, that by the conſtant continuance of the ſurface of the lungs in cloſe contact with the inſide of the cheſt, both in its enlarged and diminiſhed ſtate, the air is regularly drawn into, and expelled out of the air-cells of thoſe important viſcera. It muſt alſo be manifeſt, that immediately a free and direct opening is made through the ſkin and muſcles into the cavity of the cheſt, ſome air muſt enter through the wound, and inſinuate itſelf into this laſt ſituation, on the dimenſions of the thorax being enlarged by the action of the muſcles of inſpiration. The lungs on the wounded ſide, of courſe, remain collapſed, and leſs air is drawn into the trachea, in proportion as a larger quantity accumulates between the inſide of the cheſt and the outſide of the lungs. In this manner, the expanſion of theſe latter organs on one ſide becomes gradually more and more obſtructed. A certain part of the accumulated air, it is true, is forced out of the wound again in each expiration; but a larger quantity enters at every inſpiration, and the lungs on the injured ſide become at laſt quite collapſed.

Caſes of this kind, by which we imply wounds, attended with a free and direct opening into the cavity of the cheſt, can never be attended with any ſerious degree of emphyſema. If the wound be not quite ample and ſtraight, a certain quantity of air, expelled at each expiration, inſtead of getting out of the external orifice, may undoubtedly inſinuate itſelf into the adjoining cellular ſubſtance, and occaſion ſome emphyſematous ſwelling. However, this never ſpreads, under ſuch circumſtances, to any conſiderable extent.

The emphyſema alſo, abſtractedly conſidered, is never productive of much danger, when there is a free and direct opening into the cheſt; for it will be preſently underſtood that

that the danger, in emphyſematous caſes, depends on the manner in which the air is confined in the cavity of the cheſt, ſo as to produce ſuch a degree of preſſure on the mediaſtinum and diaphragm, as obſtructs the function of the oppoſite lung, and occaſions a fatal ſuffocation. Now the very exiſtence of a free opening removes the poſſibility of the air accumulating in ſuch a manner in the cheſt, as to cauſe any dangerous degree of preſſure on the diaphragm and other lung. This latter ſupports life, while the lung on the wounded ſide lies quietly collapſed, till the wound in the parietes of the cheſt has healed, and the air has been abſorbed.

The foregoing remarks muſt make us percieve what wiſdom there is in the arrangement, of having the cheſt divided into two cavities, which have no communication with each other. If things were not ſo ordained, ſuffocation would be a common conſequence of every large wound, that extended into the cheſt. Bertrandi informs us, that whenever a free opening is made into each ſide of an animal's thorax, the lungs collapſe, and ſuffocation is always the conſequence.

However, wounds which merely penetrate the cheſt, without wounding the lungs, are never attended with any conſiderable degree of emphyſema. Whatever emphyſematous ſwelling does ariſe is alſo produced by the external air, which paſſes into the thorax through the wound, in the act of inſpiration, and out of the orifice of the injury again, when the patient diminiſhes the capacity of the cheſt in expiration.

The caſes of emphyſema, moſt apt to be attended with alarming ſymptoms, interrupted reſpiration, and an extenſive diffuſion of air in the cellular ſubſtance of the body, are commonly produced by narrow oblique ſtabs, which penetrate the parietes of the cheſt, the pleura coſtalis, and pleura pulmonalis, ſo as to make an opening into the air-cells of the lungs. Emphyſema alſo frequently aſſumes the ſame urgent and dangerous form, in caſes of fractured ribs, the ſharp ſpiculæ of which, being driven inward, tear the pleura coſtalis, pleura pulmonalis, and ſurface of the lungs themſelves. The latter inſtances differ from wounds in the circumſtance of there being no breach of continuity in the integuments. We have already explained, that whatever air inſinuates itſelf into the cellular ſubſtance, in wounds, which ſimply enter the cheſt without injuring the lungs, muſt be derived from without; that is, it firſt paſſes into the thorax through the wound. But when emphyſema ariſes from narrow oblique ſtabs, which enter the cheſt and injure the lungs; or when the affection originates from the pleura coſtalis, pleura pulmonalis, and part of the ſubſtance of the lungs being torn by the ſharp points of a broken rib; whatever air becomes diffuſed in the cellular ſubſtance, firſt eſcapes from the breach in the air-cells of the lungs into the cavity of the thorax, and thence is expelled through the wound, or laceration in the pleura coſtalis, into the common cellular ſubſtance, ſituated on the outſide of this latter membrane. In wounds, which ſimply enter the thorax, without injuring the lungs, the air paſſes through the opening, into the cavity of the pleura in inſpiration, at the ſame time, and from the ſame cauſes, that the air alſo enters the lungs through the trachea. Circumſtances, however, are exceedingly different, when emphyſema ariſes from narrow oblique ſtabs, or fractures of the ribs, attended with an injury of the lungs. In the firſt of theſe caſes the air cannot enter the cavity of the cheſt in the ſame manner as it does when there is a free and direct opening made in the parietes of the thorax. In the ſecond inſtance, (namely, fractured ribs,) there is no external orifice at all. Both theſe latter kinds of caſes, being alſo accompanied by a wound of the lungs, are eſſentially different, in many reſpects, from ſuch examples of emphyſema as proceed from a wound, which only enters the cheſt without doing any miſchief to the lungs. When the ſurface of theſe organs is wounded, no ſooner does the cheſt become expanded in the act of inſpiration, than ſome of the air eſcapes from the breach in the ſubſtance of the lungs, gets into the cavity of the pleura, and afterwards inſinuates itſelf, through the opening in the pleura coſtalis, into the common cellular ſubſtance.

We ſhall next endeavour to make the reader underſtand more clearly the cauſe of the air collecting in the cheſt, and becoming effuſed in ſuch caſes of emphyſema as proceed from wounds, or injuries, which cauſe a breach either in the pleura pulmonalis alone, the pleura pulmonalis and pleura coſtalis together, or in the integuments, muſcles, and pleura coſtalis, without the pleura pulmonalis being at all concerned. We ſhall enter into this part of the ſubject rather fully, becauſe it is by no means well underſtood by the generality of ſurgeons, and, without a clear comprehenſion of it, the practitioner muſt feel completely in the dark, in regard to the right mode of treating the affection.

Dr. Halliday notices, that the lungs in the thorax have often, and not unaptly, been compared to a bladder in a cloſe pair of bellows; but, if we ſuppoſe the bellows to be divided into two compartments, and each of theſe to contain a bladder, which mutually communicate with each other, and with the external air by means of a tube, which is exactly adapted to the nozzle of the bellows, and which admits the air only into the cavity of the bladders, and not into the ſpace betwixt the bladders and bellows, we ſhall then have a perfect repreſentation of the mechanical ſtructure of the thorax. The bellows will repreſent the thorax divided in the middle by the mediaſtinum; the bladders will repreſent the lungs of the right and left ſides; and the tube, which communicates with the bladders and the external air, will repreſent the trachea. The only thing which is wanting to render this mechanical repreſentation perfect is, that the bladders ſhould exactly fill the bellows, ſo as to leave no air betwixt them and the bellows.

It is evident, ſays Dr. Halliday, that when we lift up the handle of the bellows, the bladders will be filled by the external air ruſhing in through the tube, which communicates with both, and that, when we depreſs the handle, the air will be again expelled. Dr. Halliday conceives that this is exactly the way in which the lungs are filled and emptied in reſpiration. The cavity of the thorax being enlarged, by the contraction of the diaphragm and intercoſtal muſcles, &c. a vacuum is formed, into which the air ruſhes through the trachea, and we perform what is called *inſpiration;* whereas, by the contraction of the abdominal muſcles, and relaxation of others, the cavity of the thorax is diminiſhed, and the air is expelled, or we *expire.*

The bellows and bladders, continues Dr. Halliday, will alſo ſerve to illuſtrate the caſes of injury mentioned as giving riſe to emphyſema, and firſt as occaſioned by the pleura pulmonalis of one ſide being wounded, or ulcerated. This caſe is, in many reſpects, the ſame as if an opening were made in one of the bladders, and which opening would form a communication with the ſpace betwixt the bellows and bladder on one ſide. Now, ſuppoſe that this takes place while the handle of the bellows is depreſſed, as ſoon as the handle is raiſed, air will ruſh into the ſpace betwixt the bladder and bellows, and, if you keep the handle up for a little time, the bladder will collapſe altogether, and the place which it naturally occupied, when diſtended, will

now

now be occupied by the air. If we attempt to force out the air by depreffing the handle of the bellows, we fhall find that this cannot be done; for there is no direct communication betwixt the bellows and external air; and, as the effufed air preffes equally on all parts of the collapfed bladder, it cannot efcape through it. Dr. Halliday next explains, that by the action of the mufcles of infpiration, the preffure is removed from the furface of the wounded lung, and the air, which fhould have rufhed in and diftended the lung, now paffes through the wound, into the fpace betwixt the pleura pulmonalis and pleura coftalis. In the living body the whole of the air infpired will not be thus effufed; but, as it muft pafs through the lung, it will alfo at firft diftend it, more or lefs, according to the fize of the opening in the pleura pulmonalis, and this partial dilatation of the wounded lung will always happen while air continues to be infpired on that fide. As foon as expiration begins, the general cavity of the thorax being thereby diminifhed, the effufed air will be compreffed againft the wounded lung; but none of the air which has efcaped can re-enter the lung again, becaufe the whole of the air contained in the lung muft be forced out, and the preffure againft every part of the collapfed lung being equal, will prevent the effufed air from feparating any part, fo as to make a paffage for itfelf into the trachea. In this manner frefh air is accumulated in the fpace betwixt the pleura at every infpiration, while none is allowed to efcape during expiration, and the quantity accumulated at laft will be equal to that which was received into the other lung, during the moft powerful infpiration after the accident. Dr. Halliday next notices, that this kind of accumulation of air in the cheft has been denominated *thoracic emphyfema*, and has been fuppofed to have fometimes proved fatal, without any more extenfive diffufion of the air.

Dr. Halliday afterwards informs us, that when an opening exifts both in the pleura pulmonalis and pleura coftalis, the fame circumftances happen as in the foregoing cafe, till the lung has collapfed; but, that if the patient now attempt to expire, the injured fide of the thorax muft continue diftended, notwithftanding every effort. However, in general the air makes a way for itfelf through the cellular membrane, and as the paffage of air into the cavity of the thorax, during infpiration, is eafier than the return of that which has been already effufed into the cellular membrane, this effufion continues to go on with great rapidity, while the patient lives, fo as to occafion what has been termed *fubcutaneous emphyfema*.

The above writer alfo obferves, that in the cafe of a wound which fimply penetrates the cheft, without hurting the lungs, if the accefs of air be more free by the wound than by the trachea, more air will enter during infpiration into the cavity of the thorax than into the lungs; and that if the accefs of air be, on the contrary, lefs free, then alfo lefs air will enter the thorax than the lungs. However, Dr. Halliday remarks, that in the fame proportion as air enters into the lungs, or into the cavity of the thorax, it will likewife be expelled from thefe cavities during expiration. Hence, air would not accumulate in the thorax, did not the lungs always tend to collapfe from their natural gravitation. Perhaps no author has offered a more accurate and fpirited defcription of an emphyfema arifing from a fractured rib than Mr. John Bell, of Edinburgh. This gentleman remarks, that when a rib is broken, the point of the broken bone is preffed down upon the furface of the lungs, fo as to lacerate them. It is often from the flighteft and moft fuperficial wound of this kind, that the emphyfematous tumour proceeds, the laceration of the lungs extending to fo inconfiderable a depth in the lungs, that it does not even occafion the leaft fpitting of blood, or any other fymptom of a deep wound; and Mr. John Bell obferves, that if the patient die, the wound cannot be feen even after diffection; but can only be difcovered by inflating the lungs. Yet, fays this gentleman, the furface of the lungs being touched even in this flight way, the air efcapes from them at every infpiration; the air which is then within the cavity of the thorax is of courfe compreffed, fo that at the next expiration this compreffion muft force the air either back again into the lungs, or elfe out of the wound in the parietes of the thorax, and thence among the cellular fubftance furrounding the broken rib. Thus, obferves Mr. John Bell, in every infpiration there is a fuction of fome air, which is drawn through the wounded lungs, the air expands in the cavity of the thorax, the lung which gave out that air fubfides again, and lies almoft entirely quiefcent, partly from the wound in it, which, like a rent in a bladder, prevents it from being inflated, and partly from the preffure of the air in the cavity, in which there ought to be a vacuum to make the lung expand. Every new infpiration draws more air from the wounded lung, and every new expiration drives more air out into the cellular fubftance. There is no further outlet for the air, which makes its way forwards, and (to ufe Mr. John Bell's expreffion) undermines the common fkin with wonderful rapidity. Thus, the emphyfematous crackling tumour appears firft over the broken rib, or over the wounded point of the thorax; then extends over the whole cheft, attended with great oppreffion of the breathing; then over the neck and face, and filling the eye-lids particularly, fo that the eyes are abfolutely clofed. Next it fpreads over the belly, and down the thighs. At laft, the private parts become enormoufly fwollen, and no part efcapes this tumour, except the palms of the hands and foles of the feet. More air, fays Mr. John Bell, is every moment drawn out from the wound of the lungs, and driven under the fkin; the patient is every moment more and more oppreffed; till, at laft, the breathing is quite interrupted, the pulfe flags, the extremities grow cold, and the patient, if he be not relieved by fome operation, muft die.

According to the fame writer, the wounded lungs collapfe, and continue in this ftate until the breach in them has healed, which happens in a very few days. From the moment when the lungs are wounded, the ufe of the wounded lobe is loft, fo that if the right lung be the one injured, the breathing is entirely carried on by the left, only half the quantity of air is infpired, and the refpiration is attended with difficulty. Mr. John Bell confiders this collapfe of the injured lung, which muft inevitably continue for at leaft a few days, a chief means of fafety, at the fame time that it is a caufe of diftrefs. He obferves, that when the lungs are unfolded their veffels have their full diameter, they hold their full proportion of blood, and, if they were not collapfed, their wounded veffels would be in a condition to emit a confiderable quantity of blood. But, the fact is, when one of thefe organs is wounded, it collapfes towards the fpine, and can no more be filled than a torn bladder can be inflated. The lung is alfo oppreffed by whatever air or blood may be effufed in the cavity of the thorax. The collapfe of the lung caufes lefs blood to be extravafated in the cheft, and lefs to be thrown into the bronchiæ, which latter kind of hemorrhage is even more dangerous than that which takes place in the cavity of the pleura, becaufe it may not only affect the wounded lung, but obftruct the entrance of air into the other one, fo as to produce a fatal fuffocation.

Mr.

Mr. John Bell very judiciously remarks, that, if the injured lung were not to collapse, it would be difficult to conceive, how the breach could ever be healed; for, the air would be continually streaming through the wound, which becoming alternately dilated and contracted, like that of an artery, could never close. However, since the wounded lung lies in a collapsed state, the edges of the wound are in contact with each other. We find by dissection, that a slight effusion of blood, a degree of livor, a swelling, thickening, and inflammation, take place round the wound, and thus, in two days, the breach is closed. The lung becomes again entire, and capable of resuming its functions.

Mr. John Bell also takes notice, that the blast of air, from a wound in the thorax, is often so strong, that at every breath it is capable of extinguishing a candle, and rushes out with a considerable noise. This stream of air, so far from being a sign of wounded lungs, is often most remarkable, when the lungs are absolutely entire. It is a sign of a free and open wound in the chest; but, by no means of wounded lungs; for whether these organs be wounded or not, the air enters so freely by the outward wound, when ample and direct, that there is no vacuum formed to give the lung play, and it must collapse, till the external wound has healed. Wounds of the thorax, therefore, are totally different cases from wounds of the lungs. When the chest has a large free opening made into it, it is (as Mr. John Bell describes) like a pair of bellows, having a large air-hole, which admits the air every time the breast rises; and expels it again as often as the breast falls down. The air is alternately drawn in, and thrown out at every respiration, with a strong blast; but, whatever air issues through the wound, had been drawn in by the wound, and had never passed through the lungs. Hence, when there is a free opening made in the thorax, no vacuum can form so as to lead to the expansion of the lung, and whether entire, or injured, it must be in a collapsed state.

We may be convinced, that the lung, on the side opposite the wound, is adequate to the temporary support of life, by the recollection of several kinds of cases. When a large free opening has been made into the chest by some accident, or by the surgeon's knife, the lungs on the injured side of course collapse; yet, the patient has often been known to live with tolerable ease in this condition, until a perfect recovery has followed. When the right or left lung has been utterly prevented from becoming expanded, in consequence of the pressure of air in emphysema, water in hydrops pectoris, or pus in empyema, the patient has often lived a considerable while in this state, and ultimately got well. Persons have lived so long with disease in the chest, that when they have died, and their bodies have been opened, only a small knob, or tubercle of the lungs on one side, has been found remaining. See Koelpen de Empyemate Observatio, p. 135, 136.

When the lungs are wounded by the point of a broken rib, or when they are injured by a narrow stab in the thorax, the air cannot readily escape from the cavity of the chest, while at every inspiration more and more is drawn out from the lungs, till at last such a quantity accumulates, that it not only oppresses the lung, which is on that side, but by hindering the free action of the diaphragm, and loading the mediastinum, it oppresses the other lung also. In this manner, the breathing becomes gradually more and more interrupted; the pulse sinks; the extremities grow cold; and after great tossing, and undescribable anxieties, the patient dies. All this may happen, even when a part of the air escapes through the breach in the pleura costalis, so as to inflate a great part of the common cellular membrane of the body. See Discourses on the Nature and Cure of Wounds by John Bell, vol. ii.

From what has been stated, it must be evident, that the emphysematous swelling itself, or, in other words, the diffusion of air in the cellular substance, is a matter of secondary consequence, and, that the great peril of an emphysema depends on the manner in which one side of the chest may become so distended with air, that the pressure produced on the diaphragm, mediastinum, and opposite lung, occasions a fatal interruption of respiration.

However, in cases in which there is a free and open wound in the parietes of the chest, or when the surgeon has made an ample and direct incision into the thorax, the opening, in fact, does not relieve the lung on the same side, but the opposite one, by obviating the pressure of any confined air on it. In the mean while, the lung on the wounded side lies in a collapsed state, till the wound in it has healed.

It is curious to observe, how few of our best modern surgical writers have had accurate notions concerning emphysema. Hewson, Benjamin Bell, and Bromfield, have all fallen into the mistake of supposing it possible to make the wounded and collapsed lung immediately expand again by exhausting the air from the cavity of the pleura. Mr. Bromfield writes, "in case an opening is made between the ribs, and a cannula introduced, whose diameter is larger than the wound of the lungs, the air will be forced out as fast as it escapes from the lungs, therefore the lungs will have room for their *expansion*," &c. See Chirurgical Cases and Observations.

Mr. Hewson observes, "it is natural to suppose, that the wound of the pleura and intercostals may sometimes be too small to suffer the air to get readily out into the cellular membrane, and to inflate it, but may confine a part of it in the cavity of the thorax, so as to compress the lungs, *prevent their expansion*, and cause the same symptoms of tightness of the chest, quick-breathing, and sense of suffocation, which water does." Mr. Hewson seems to have no idea of the danger of suffocation proceeding from the pressure on the opposite lung, and though he wrote professedly to recommend paracentesis thoracis in these cases, he advises making a small incision, rather than a large one, *lest the air should enter, and hinder the expansion of the lungs*. Med. Obs. and Inq. vol. iii.

Mr. Benjamin Bell has undoubtedly run into most strange absurdities in the description in his System of Surgery, of plans for expelling the air from the surface of the lungs. "While the wound yet remains open," says he, "let the patient, in a slow gradual manner, make a full *inspiration*, by which a considerable quantity of the collected air will be discharged. This being done, the skin must be instantly drawn over the *sore*, so as to cover it completely during *expiration*; and if the wound be moderately opened during *inspiration*, the whole quantity will be soon expelled."

In this passage, the author has obviously confounded the words expiration and inspiration, besides displaying ignorance in thinking it practicable to make the collapsed wounded lung rise up again by such proceedings.

The same author remarks: "the other means which we wish to propose for drawing off air from the thorax, is suction; an exhausting syringe may be fitted with such a mouth of ivory or metal, as will allow it to be closely applied over the orifice in the pleura:" He adds, that "as much distress has, on some occasions, ensued from both cavities of the chest being at the same time laid open, it ought never to be attempted." He afterwards imputes the danger, not to the collapse of both the lungs, but to the inflammation likely

likely to arife from the admiffion of air into the two cavities of the cheft at once. The fact is, a free opening made into each fide of the cheft at the fame time would be inftantly followed by a collapfe of both lungs, and immediate fuffocation. There would neither be time for any inflammation to arife, nor for relieving the patient with exhaufting fyringes.

There is certainly a poffibility of making the lungs expand again, by fyringes, &c. as foon as the breach in them has healed, or the injured air-cells have been clofed with coagulating lymph; but, the propriety and utility of the plan may be juftly called in queftion. The introduction of pipes into the cheft cannot be done without irritation; no more air can efcape from the lung now the air-cells are clofed; what is already effufed in the cheft will be abforbed, and the lung expand again, in proportion as this is effected; and fhould the diaphragm and oppofite lung fuffer dangerous preffure from the large quantity of accumulated air, relief may be derived from making an opening in the diftended fide of the cheft, fufficient for letting out a certain quantity of the confined air. In this inftance, a fmall puncture in the pleura would fuffice: the cafe is not like fome others, in which the breach in the lung is not clofed, and a very free and direct opening is required, in order to let the air efcape from the thorax, as faft as it paffes out of the wound in the lung itfelf. By this ftep, and no other, can we prevent the fpreading of the emphyfematous fwelling over the whole body, and what is of ftill higher moment, a perilous degree of preffure on the diaphragm and oppofite lung.

Some of the moft remarkable cafes of emphyfema, on record, are related by M. Littre, M. Mery, Dr. Hunter, and Mr. Chefton, in the Mem. de l'Acad. Royale des Sciences for 1713, Medical Obfervations and Enquiries, vol. ii, and Pathological Enquiries.

With refpect to the treatment of emphyfema, when the air becomes effufed in the cellular fubftance round a wound, which merely injures the parietes of the cheft, the beft plan muft be to direct the patient to expel as much of the air from the thorax as he can, by making long expirations, the opening being regularly clofed when the patient enlarges his cheft in infpiration. After getting as much air as poffible out of the thorax in this manner, the edges of the external wound may be carefully brought together, and well covered with adhefive plaifter, compreffes, &c. fo as to prevent the ingrefs of any more air into the cheft. The emphyfematous fwelling can now no longer increafe, or, at all events, can only do fo as long as whatever air is ftill in the cheft continues unexhaufted; and in proportion as it becomes effufed, or is abforbed, the lung muft expand and refume its function again. In this particular inftance, as there is no breach in the lung, the practitioner, if he thinks proper, may endeavour to make the vifcus expand again at once, by drawing the air out of the cavity of the pleura with a fyringe. However, fince all examples of emphyfema, which are attended with urgent fymptoms of fuffocation, are accompanied by a wound or laceration of the air-cells of the lung, we cannot rationally attempt to make this organ immediately expand again by means of fuction. The thing is not practicable, becaufe how can we exhauft the air from the cheft, as long as more is capable of paffing out of the opening in the lung itfelf. We have likewife already explained, that the collapfed ftate of the injured lung is the moft favourable for the clofure of the wound in it, and for the prevention of hemorrhage from its veffels.

In all confiderable cafes of emphyfema, the air, effufed in the cavity of the thorax, and common cellular membrane, is derived from a rent, or wound in the fubftance of the lungs. The worft fymptoms in thefe inftances, as we have already repeatedly infifted upon, depend on the preffure of the air confined in the injured fide of the thorax, on the diaphragm, and oppofite lung. Both this accumulation of air, and the diffufion of another portion of it in the cellular texture of the body, are entirely owing to one circumftance, *viz.* there being no free and direct paffage through which the air can efcape outward, as faft as it paffes out of the breach in the lung.

The inflation of the external parts with air, a thing which often takes place in an enormous degree, is not itfelf a cafe of urgent danger, and, indeed, it is fo far a favourable event, as it proves, that the air effufed from the lung can efcape from the cavity of the pleura in a certain meafure. If it could do fo with fufficient celerity, no oppreffion of the diaphragm and oppofite lung would be occafioned.

In cafes of emphyfema, Mr. John Bell recommended the following treatment to be adopted. 1ft. Upon obferving the crackling tumour begin to form over a fractured rib, fmall punctures fhould be made with the point of a lancet, and, if the inftrument be carried deeply enough, the air will rufh out in an audible manner. As this air was in the thorax before it came into the cellular fubftance, it is plain, that the thorax is ftill full, and that the lung of that fide is already collapfed and ufelefs, and muft continue fo for a certain time; that is until the breach in it is clofed. The purpofe, therefore, of making thefe fcarifications, and efpecially of making them fo near the fractured part, is not to relieve the lungs, but merely to keep the air from fpreading more widely beneath the fkin.

When the emphyfema proceeds from a narrow ftab in the cheft, the practice fhould of courfe be the fame, in the fame ftage of the cafe, or, in other words, at the period when the external emphyfematous fwelling is in an incipient ftate. The two examples refemble each other, inafmuch as the lungs and pleura coftalis are wounded in both cafes, and the air, which paffes through the breach in the pleura, cannot make its way completely outward; but becomes diffufed in the cellular membrane.

2dly. If, before the furgeon arrives, the air fhould have fpread to very remote parts of the body, as to the fcrotum and down the thighs, it will be eafier, fays Mr. John Bell, to make fmall punctures in thofe parts, in order to let out the air directly, than to prefs it along the whole body, till it arrives at the punctures, made on the cheft, over the wounded part.

3dly. If, notwithftanding free punctures, and preffing out the air in this way, it fhould be found by the oppreffion, that either air or blood is accumulating within the cavity of the thorax, fo as to oppress not the wounded lung only, which, from the firft, is of courfe collapfed and ufelefs, but, alfo, fo as to opprefs the diaphragm and other lung; then a freer incifion muft be made through the fkin and mufcles, and a fmall one in the pleura coftalis, in order to let the confined air out of the thorax.

In the courfe of a few days the wound in the collapfed lung becomes clofed by the adhefive inflammation, in which procefs the breach in the air-cells is fhut up with coagulating lymph, and the air can no longer get out of them into the cavity of the cheft. The air, which is already there, is alternately abforbed, and the lung, expanding in proportion, refumes its original functions.

Emphyfema has been known to arife from the burfting of a vomica, and ulceration of the furface of the lungs; but the air, which efcapes in this inftance, cannot find its way into the cavity of the thorax, becaufe the inflammation, which precedes the abfcefs and ulceration of the air-cells, clofes closes those which are adjacent, and produces an adhesion of the edges of the vomica, or ulcer, to the inner surface of the chest, so as entirely to separate the cavity of the abscess from that of the thorax. We do not know of any example, in which the symptoms imputed to the confinement of air in the chest, originated in consequence of suppuration and ulceration of the surface of the lungs. However, Palfyn, Dr. Hunter, and the author of the article "Emphysema" in the French Encyclopædia, have seen cases, in which emphysema has arisen from abscesses of the lungs, attended with adhesion to the pleura, and ulcerations in the situation of such adhesion. In these cases, the pus having made its way through the pleura, and intercostal muscles, the air escapes also through the same tract, so as to get into the cellular membrane on the outside of the chest.

A certain degree of emphysema has been observed to be occasionally produced by a violent effort of respiration. In the instances referred to, the air is said first to make its appearance about the clavicles, and afterwards to spread over the neck and adjacent parts. The violent efforts of parturition have also been remarked to occasion a similar symptom; but without being followed by any bad consequences. See Medical Communications, p. 176.

In the fourth volume of the Mémoires de l'Academie de Chirurgie, 4to. M. Louis has described an emphysema of this latter sort, which, on account of its cause, and the indication which it affords the practitioner, is highly important. M. Louis had occasion to remark the occurrence in a young girl, who died suffocated, from a bean falling into her wind-pipe, and he considers the kind of emphysema in question as a pathognomonic symptom of such an accident. If this opinion be correct, a knowledge of the circumstance must be of great importance to the practical surgeon; for, if making an opening into the trachea, and attempting to extract the foreign body be delayed, from any doubt concerning the nature of the case, the patient will inevitably die of suffocation. In the case which first attracted the attention of M. Louis to the subject, the emphysema made its appearance on both sides of the neck above the clavicles, and came on suddenly, on the third day after the foreign substance had fallen into the trachea. On examining the body, after death, the lungs and mediastinum were also found to be in an emphysematous state. The retention of air by the extraneous substance produced, according to M. Louis, at every attempt to expire, and, particularly, during the violent fits of coughing, a strong propulsion of this fluid towards the surface of the lungs into the spongy substance of these viscera. The air next insinuated itself into the cellular texture, which unites the surface of the lung to the pleura pulmonalis; and, by communications from cells to cells, it occasioned a prodigious swelling of the cellular substance, between the two layers of the mediastinum. The emphysema increasing, at length made its appearance above the clavicles. This tumefaction of the lungs and surrounding parts, in consequence of air getting into their spongy and cellular texture, is an evident cause of suffocation, and M. Louis observes, that the swelling seems to be so natural an effect of the presence of a foreign body in the trachea, that one can hardly fail to think it an essential symptom, though no author has made mention of it.

An emphysema of the head, neck, and chest, has also been noticed in some typhoid fevers. Dr. Huxham relates an instance of this sort, which took place in a sailor of a scorbutic habit. Medical Observations and Inquiries, vol. iii. art. 4.

Surgical practitioners have frequent occasion to remark the occurrence of a partial emphysema in cases of gangrene. Emphysema, arising from wounds in the thorax, is very often a case, complicated with large extravasations of blood in the chest, and inflammation of the pleura and lungs; circumstances which must greatly increase the danger, and ought materially to influence the mode of treatment.

The adhesions, so frequently met with between the pleura costalis and pleura pulmonalis, must obviously have the effect of preventing the collapse of the lung, in circumstances under which it would otherwise happen. Were a wound to enter through the middle of any adherent parts, it is plain that no air could find its way out of the lung into the cavity of the thorax.

EMPHYTEUSIS, in the *Civil and Canon Law*, the letting out of poor barren lands for ever, or at least for a long term of years, on condition of the tenants cultivating, meliorating, or mending them, and paying a certain yearly consideration.

The word is formed of the Greek, εμφυτευσις, which signifies *an engraftment*, and by metaphor, a *melioration* or *amendment;* for as we only graft trees to mend them, so a man only alienates his land by emphyteusis, on condition of having it amended.

Emphyteuses are a kind of alienations, differing from sales, in that they only transfer the *dominium utile*, the benefits of the ground, not the property, or fee-simple. Among the Romans they were at first temporary, afterwards perpetual.

The twentieth canon of the council of Carthage prohibits the bishops seizing the church's emphyteusis out of the hands of private persons, unless they have been three years without paying rent.

EMPIRE, the territory or extent of land under the command and jurisdiction of an emperor. See Emperor.

We say the Roman empire, the empire of the East, the empire of the West, or the western empire, the empire of the Great Mogul, &c.

Antiquaries distinguish between the medals of the *upper* and *lower*, or *bas empire:* the curious only value those of the upper empire, which commences with Cæsar or Augustus, and ends in the year of Christ 270.

The lower empire comprehends nearly 1200 years, reckoning as low as the destruction of Constantinople, in 1453.

They usually distinguish two ages, or periods of the lower empire; the first beginning where the upper ends, *viz.* with Aurelian, and ending with Anastasius, including about 200 years; the second beginning with Anastasius, and ending with the Palæologi, which includes about 1000 years. See Medal.

In ancient history we read of four great monarchies or empires, *viz.* that of the Babylonians, Chaldeans, and Assyrians; that of the Medes and Persians; that of the Greeks; and that of the Romans. The first subsisted from the time of Nimrod, the same with Belus, or, as others say, from the time of Ninus, the son of Belus, who founded it in the year B.C. 2059, according to Blair's tables, to Sardanapalus their last king, B.C. 820, and consequently lasted about 1239 years. But chronologers differ much concerning both the commencement and duration of the Assyrian empire. (See Assyria.) The empire of the Medes commenced under Arbaces in the year B.C. 821, and was united to that of the Babylonians and Persians under Cyrus, in the year B.C. 538, and it closed in the 5th year of Darius Codomannus, who was conquered by Alexander B.C. 331. The dominion of Persia, after the death of Darius, was transferred to the Greeks. The Grecian empire lasted only during the reign of Alexander the Great, beginning in the year B.C. 336, and terminating with the death of this conqueror B.C. 323, his conquests being divided

vided among his captains. The Roman empire commenced with Julius Cæfar, when he was made perpetual dictator, after the battle of Pharfalia, in the year of the city 706, 48 years B.C. Some, however, date the commencement of the Roman empire after the battle of Actium, with the firft year of Auguftus, A.U C. 723, B.C. 31. The decline of the Roman empire may be confidered as principally owing to the defpotifm of Severus, and the paffive obedience of the people. From this period we behold a train of emperors vicious, or impotent, either wilfully guilty, or unable to affert the dignity of their ftation. The empire itfelf gradually decayed, harraffed on all fides by powerful invaders, and convulfed by the furious contefts of domeftic foes. During the reign of Gallienus, 30 pretenders contended for the fupreme power, and added all the calamities of civil war to the misfortunes of this devoted empire. The power and influence of the emperors were likewife diminifhed by the adoption of feveral colleagues, and by the divifion of the empire between the two fons of Theodofius the Great, A.D. 295. Arcadius was proclaimed emperor of the Eaft, and Honorius emperor of the Weft. The weftern empire contained all Italy, Spain, France, Britain, Germany, Pannonia, and Africa. The eaftern empire comprehended Afia the Lefs, Arabia, Syria, Egypt, Lybia, and the feveral regions on the Danube. The feat of the empire was removed to Byzantium by Conftantine, in the year of our Lord 328: the Eaft and Weft were then united under the title of the Roman empire, till the Romans proclaimed Charlemagne emperor, A.D. 800. From this epocha the Eaft and Weft formed two feparate empires; that of the Eaft, governed by Greek emperors, commenced under Nicephorus, A.D. 802, or, rather, was continued; but being gradually weakened, terminated under Conftantine Palæologus, in 1453, when the Saracens, having fubdued Syria, Paleftine, Egypt, Cilicia, and other neighbouring countries, and having ravaged the reft of the Roman territories in the Eaft, befieged Conftantinople under Mahomet II. and became mafters of it. From this period the city has been the imperial feat of the Turkifh or Ottoman emperors. The weftern empire, properly fo called, terminated with Auguftulus, fon of Nepos, A.D. 476, but being revived under Charlemagne, it ended with Charles Le Gros, who poffeffed all the dominions of Charlemagne, A.D. 887, and it was afterwards known by the appellation of the *empire* or German empire.

Empire, or *the* Empire, ufed abfolutely, and without any addition, long fignified the empire of Germany, called alfo in juridical acts and laws, the *holy Roman empire*, *S. R. I.* q. d. *facrum imperium Romanum*, which conftituted what was otherwife called the *Germanic body*.

The empire had its beginning with the ninth century; Charlemagne being created firft emperor by pope Leo III. who put the crown on his head in St. Peter's church on Chriftmas day, in the year 800.

Authors are at a lofs under what form of government to range the empire; fome fuppofe it to have been a monarchical ftate, becaufe all the members thereof are obliged to afk the inveftiture of their ftates of the emperor, and to take an oath of fidelity to him.

Others maintain that it was a republic, or ariftocratic ftate, becaufe the emperor could not refolve or determine any thing without the concurring fuffrages of the princes. It is added, that if they required inveftiture from, and fwore fealty to him, it was only as head of the republic, and in the name of the republic, and not in his own; juft as at Venice, every thing is tranfacted in the name of the doge. See Doge.

Laftly, others will have the empire to have been a monarcho-ariftocratic ftate, *i. e.* a mixture of monarchy and ariftocracy; becaufe, though the emperor in many cafes feemed to act fovereignly, yet his decrees and refolves had no force, in cafe the ftate refufed to confirm them.

In fine, we fhould rather choofe to call it an arifto-democratic ftate, becaufe the diet, wherein the fovereignty is lodged, was compofed of princes, and the deputies of the cities, and was divided into three orders, or bodies, called *colleges*, *viz.* the college of electors, the college of princes, and the college of cities.

We fay, diet of the empire, circles of the empire, fiefs of the empire, princes of the empire, eftates of the empire, members of the empire, capitulations of the empire, receffus of the empire, &c. See College, Diet, Circle, Prince, Capitulation, and Recessus.

The ftates or eftates of the empire were of two kinds, *mediate* and *immediate*. The *immediate* ftates were thofe who held immediately of the empire, whereof, again, there were two kinds; the firft, fuch as had feats and voices in the imperial diet; the fecond, fuch as had none. The *mediate* ftates were thofe who held of the *immediate*.

The ftates which afterwards compofed the empire were the princes of the empire, the counts of the empire, the free barons of the empire, the prelates of the empire, the princeffes or abbeffes of the empire, the nobles of the empire, and the imperial cities. For an account of the fubfequent changes which this empire has undergone, fee Electors, Emperor, and Germany.

EMPIRIC, in *Medical Hiftory*, from the Greek word ἐμπειρία, *experience*, an appellation affumed by a fect of phyficians, who contended that all hypothetical reafoning refpecting the operations of the animal economy was ufelefs, and that obfervation and *experience* alone were the foundation of the art of medicine.

The origin of this fect is varioufly ftated by different writers of antiquity, who have attributed it to three different perfons. The empiric phyficians themfelves feem to have confidered Acron of Agrigentum, who was a contemporary and rival of Empedocles, (a pupil of Pythagoras,) in the 70th olympiad, as their founder; and Pliny has afferted the fame opinion, in his fketch of the hiftory of medicine. (Nat. Hift. lib. xxix. cap. 1.) "Alia factio, ab experimentis fe cognominans *Empiricen* cæpit in Sicilia, Acrone Agrigentino, Empedoclis phyfici auctoritate, commendato." This account of the rife of their fect was maintained by the empirics, in order to obtain the advantage over the rational or dogmatic phyficians, who could only date their origin from the time of Hippocrates. But it has been juftly remarked, that the phyficians, who lived between the time of Æfculapius, and the period, when philofophy and reafoning were applied to medicine, were empirics in fact, though not in name, in confequence of the rude and imperfect ftate of the art, and cannot be regarded as fectaries, fince all were at that time equally empirical.

The beft hiftorians refer the eftablifhment of this fect to a much later period; namely, to about the 123d olympiad (A. C. 260); but they are not agreed as to the individual, who firft promulgated the doctrine of empiricifm. Galen and others have afcribed the origin of the fect to Philinus of Cos, who was a difciple of Herophilus, to whom he was faid to be indebted for the firft hints of his fyftem. Herophilus was doubtlefs more attentive to the ufe of drugs than any of his predeceffors, and the empirics directed their views particularly to the difcovery of medicines: his numerous difcoveries in anatomy likewife led him, and ftill more his difciples, to queftion the value of the reafoning of their predeceffors, in whofe ftatements of fact they found fo much error,

error, particularly in regard to the ſtructure of the human body. Little, however, is known with certainty reſpecting this Philinus. Galen quotes him, when writing on the ſubject of the compoſition of medicines; and he is ſaid to have written on the nature of plants, and to have commented on the writings of Hippocrates.

Celſus, however, aſſerts, that Serapion was the firſt who maintained the doctrine, that the application of reaſoning and philoſophy to the art of medicine was of no avail, and confined the ſtudy of it to practice and experience. (De Medicina, Præf.) Serapion was born, and practiſed medicine at Alexandria, and appears to have been contemporary with Philinus, and the diſciples of Herophilus. Galen accuſes him of having ſhewn a contempt for Hippocrates and all his predeceſſors, in his writings, and of praiſing himſelf on all occaſions. (Galen. de ſubfigurat. Empir. Cap. ult.) Apollonius, Glaucias, Heraclides of Tarentum, and others of no ſmall note ("non mediocres viri") followed in the ſteps of Serapion, according to Celſus. Heraclides was one of the moſt famous of the empirics, and appears to have been the firſt to employ that valuable ſubſtance, opium, in the practice of medicine. Many other names are on record, as belonging to this ſect, antecedent and poſterior to Heraclides: one of the lateſt was Marcellus, who lived in the time of Theodoſius, and appears to have held ſome office in the court of that emperor, and was probably therefore a Chriſtian. He has left a treatiſe on medicines, compiled from various writers, and adapted to the cure of all diſeaſes. The art of medicine, indeed, is indebted to the empirical phyſicians for many important additions to the Materia Medica. With reſpect to the doctrines of the ſect, however, and the principles on which they defended themſelves againſt the dogmatics, we have no other accounts, than thoſe which their adverſaries have given, in quoting them with a view to their refutation; all their works upon theſe topics have periſhed. Celſus and Galen have ſtated probably the greater part of the leading points of their tenets.

The *empiric* ſyſtem, as the term imports, was founded altogether upon *experience:* and thoſe, who belonged to this ſect have remarked, that there are three modes by which we learn, from experience, to diſtinguiſh what is advantageous and what is prejudicial, in regard to our health. The firſt of theſe, and the moſt ſimple, ariſes from *accident*. A perſon, for example, having a violent pain in the head, happens to fall, and divides a veſſel in the forehead; and it is obſerved that, having loſt blood, his pain is relieved. Under the ſame mode, they include the experience which is acquired by obſerving the ſpontaneous operations of the conſtitution, where no remedy has been applied, as in the following caſe: a perſon labouring under a fever, finds his diſeaſe mitigated, after a hemorrhagy from the noſe, a profuſe perſpiration, or a diarrhœa. The ſecond mode of gaining experience, is, that, in which ſomething is done by *deſign*, with a view to aſcertain what will be the ſucceſs of it: as, for inſtance, when a perſon, having been bitten by a ſerpent, or other venomous creature, applies to the bite the firſt herb that he finds; or when a man attempts to alleviate the ſymptoms of an acute and burning fever, by drinking as copiouſly as he is able of cold water; or when a perſon tries a remedy, ſuggeſted to him by a dream, as was frequently done in heatheniſh times. The third mode of experimenting, is that which the empirics termed *imitative;* which is purſued in caſes, when, after having remarked the effects reſulting from *accident*, or the ſpontaneous actions of the ſyſtem, on the one hand, or from *deſign* on the other, we make an attempt to accompliſh a ſimilar reſult, by imitating that which was done on thoſe occaſions.

This laſt ſort of experience, they contend, is that which peculiarly conſtitutes the art of medicine, when it has been frequently repeated. They call that *obſervation*, (τήρησις,) or *autopſia* (αὐτοπσια,) which each individual ſees himſelf; and uſe the term *hiſtory*, or *record*, (ἱστορία) for ſuch obſervation when committed to writing; that is, the autopſia, or perſonal experience, conſiſts of the obſervations which each perſon has made, by his attention to the progreſs of a diſeaſe, whether in regard to its ſymptoms and changes, or to the remedies employed; while the record is a ſort of narration or regiſter of all that was obſerved by thoſe individuals; which regiſter being completed, (*i. e.* including all the diſeaſes, incident to mankind, and the remedies adminiſtered for their alleviation,) the art of medicine would be eſtabliſhed with a conſiderable degree of certainty. But as new diſeaſes ſometimes occur, in regard to which neither our perſonal experience, nor the obſervations of others, can furniſh us with any aſſiſtance; and we meet with diſorders in particular ſituations, where the means of relief, ſanctioned by experience elſewhere, are not within our reach; we muſt neceſſarily have recourſe to ſome other expedient in order to alleviate the ſufferings of the patient. The empirics were provided againſt this particular difficulty, in what they termed *a ſubſtitution* of ſimilar means, (*tranſitus ad ſimile*, as the Latins have tranſlated it.) This was a new experiment, which they inſtituted, after having compared one diſeaſe with another; or one part of the body with another, of ſimilar ſtructure; or, laſtly, one remedy, the nature of which was aſcertained by experiment, with another which reſembled it. "They tried, for example, in *herpetic* eruptions the remedies which had relieved *eryſipelas;* in the diſeaſes of the *arms*, they employed the expedients which had been practiſed in thoſe of the *legs;* and if they could not procure *quinces*, which are an auſtere fruit, they uſed *medlars*, which are not ſo."

Obſervation, then, *record*, and the *ſubſtitution* of ſimilar means, were the three fundamental reſources of the art of medicine; according to the empirics; and theſe were denominated by Glaucias, and others, the *tripod of medicine* (τρίπες της ἰατρικῆς.)

There is obviouſly a great deal of good ſenſe and ſound philoſophy in this doctrine of empiriciſm. It points out the true mode of inveſtigating the phenomena of nature, by unwearied experiment; the mode which Bacon laboured to inculcate on the dogmatiſts, and hypotheſis-mongers of his age, which Newton ſucceſsfully purſued, and which has led the philoſophers of later times to the developement of that fund of natural knowledge in the ſciences of electricity, chemiſtry, mechanical, and every branch of natural philoſophy, by which modern inquiry is diſtinguiſhed. Compared with this ſpecies of inveſtigation, how futile are the ſpeculations, miſnamed philoſophy in the ſchools, relative to elements, and eſſences, which had no exiſtence, except in the imagination of the diſputants. For it muſt be obſerved, that the ancient empirics did not diſregard the dictates of reaſon and reflection; they only deprecated the application of them to circumſtances out of the reach of the ſenſes, and beyond the ſcope of experiment. Thoſe miſchievous principles and practices, which their ſucceſſors or at leaſt thoſe who have ſubſequently aſſumed the title, have made the refuge of ignorance and craft, cannot be alleged againſt them. This is evident, from the clear and explicit ſtatement of their tenets, which Celſus has tranſmitted to us: in order to underſtand which, it will be neceſſary to attend to the tenets of their opponents, the rationaliſts or dogmatics, as ſtated by the ſame elegant writer.

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The dogmatic phyficians maintained the neceffity of a knowledge of the four following fubjects, in order to be able to cure difeafes; namely, 1, of the occult and effential caufes of difeafe; 2, of the evident caufes; 3, of the natural actions of the conftitution, (or phyfiology;) and, laftly, of the internal parts, or anatomy. 1. By the *occult* caufes, they meant the effential principles of the conftitution, or of animal life, under its various conditions of health and difeafe. And they held, that it was impoffible to cure difeafe, if we are ignorant of the circumftances in which it confifts; for that different methods of cure muft neceffarily be requifite, if a redundancy or deficiency of the *four elements* were the effential caufe of difeafe, according to the hypothefis of fome philofophers; or if all difeafe confift in depravations of the fluids, as was the opinion of Herophilus; or, in difordered refpiration, as Hippocrates imagined; or in the paffage of the blood into thofe veffels, which naturally convey air, caufing inflammation, and that inflammation exciting the commotion obferved in fever, according to the fuppofition of Erafiftratus; or in the obftruction of the invifible pores, by the corpufcles, or atoms, as Afclepiades contended. Againft this fyftem of reafoning by hypothefis, beyond the bounds of experimental inquiry, the empirics objected upon the moft irrefragable principles. "The attempt," fay they, "to fcrutinize the occult principles of animal life is fruitlefs; for 'nature is incomprehenfible:' we may afcertain *what* fhe performs; but *how* fhe performs it, is to us infcrutable. And the very diffenfions among the theorifts, and the difference of their accounts of thofe operations, evince the infcrutability of the fubject. They cannot all be right; and why fhould we believe the ftatement of one, rather than that of another? Why is Hippocrates more entitled to credit than Herophilus, or Herophilus than Afclepiades? It is obvious that we cannot decide in favour of the opinion of any of them, either from their arguments, or their practical authority; for the arguments of each may be fufficiently plaufible and confiftent with probability; and their practice may have been equally fuccefsful. Indeed this very fact, that phyficians of the moft oppofite theoretical opinions have equally fucceeded in reftoring health to the fick, proves the independence of the art of medicine upon fuch difquifitions, and that their fuccefs is to be afcribed to their principles of cure having been deduced, not from their fpeculations about occult effential caufes, nor even about the natural actions, but from experiment, from what actual practice had taught them. And fuch is the cafe in all other arts. The hufbandman and the pilot are not qualified for their refpective occupations by theory and difcuffion, but by practice and experiment. Indeed if reafoning could enable a perfon to cure difeafes, the philofophers would neceffarily be the beft phyficians; whereas, we obferve that they are gifted with an abundance of words, but poffefs very little fkill in the art of healing."

2. With refpect to the *evident* caufes, the dogmatifts underftood, by that term, the obvious exciting caufes of difeafes, fuch as heat and cold, fafting and excefs in eating, &c., to the operation of which difeafes are often obferved immediately to fucceed. The empirics admit the utility and importance of attending to thefe caufes; but they contend that, however obvious they may be in many inftances, the method of cure is neverthelefs not apparent from them, as in ophthalmia, or in a wound; but is afcertained only from experience.

3. The *natural actions* of the body, a knowledge of which the dogmatifts maintain to be abfolutely neceffary to the phyfician, are thofe operations of the conftitution, which the moderns comprehend under the term phyfiology; namely, the nature of refpiration; of the concoction or digeftion of our food and drink, and its diftribution to the different parts of the body, which it nourifhes; of the "rife and fall" of the arteries; of fleeping and waking, &c. "Without an acquaintance with the caufes of thefe actions," fay the rationalifts, "it muft be impoffible for any one either to fupprefs incipient difeafes, or to cure them when they are completely eftablifhed." But of all thefe actions, they deem the digeftion of the food the moft important, and infift more particularly upon the neceffity of its being underftood. But in this point again there is great diffenfion among them: fome of them, following the hypothefis of Erafiftratus, maintain that the food is concocted by mechanical attrition; others, after Pliftonicus, the difciple of Praxagoras, affert that digeftion is produced by the putrefaction of the food; while others prefer the opinion of Hippocrates, and contend that it is effected by heat. The difciples of Afclepiades, again, affirm that all thefe hypothefes are idle and futile, for that there is no fuch thing as concoction, but that the alimentary matter, crude as it is received, is diftributed through the whole body. Various as thefe opinions are, however, they do not difpute the neceffity of accommodating the food of the fick to the nature of the function; that is, if the concoction be the refult of attrition, then fuch food fhould be felected as is moft eafily broken down; if it be effected by putrefaction, then fuch food is to be chofen as is moft readily putrefcent; if by heat, fuch as moft effectually cherifhes heat: but if there be no fuch procefs as that of concoction, then all thefe kinds of aliment are improper, and fuch only fhould be taken as moft completely refifts all change. In the fame manner, they contend, when a difficulty of breathing occurs, or a morbid degree of fleep or watchfulnefs, that phyfician will be the moft capable of curing them, who is acquainted with the nature of thefe functions.

Againft this doctrine of the dogmatifts, it is evident that the arguments of the empirics were equally conclufive, as againft their preceding hypothefes, refpecting the occult caufes. Their ftatements, that the very difference of the theories of the dogmatifts implies their want of foundation, and that the mode in which nature operates being incomprehenfible, we muft be content with learning what fhe operates, are obvious refutations of the futility of thefe, and indeed of all other hypothefes. "It is of no importance," fay the empirics, "to inquire in what manner the diftribution of the aliment through the body is accomplifhed; our only ufeful inquiry is, what fort of aliment is moft eafily diftributed; and whether digeftion is performed by heat or putrefaction, or whether it is not a digeftion, but a diftribution only, is altogether immaterial, provided we know, from experience, what is moft eafy of digeftion, or the contrary. For," they continue, "the art of medicine, even in its infancy, was not deduced from fuch hypothetical reafoning, but from experiments. Whence it was obferved, among thofe who were fick, and without phyficians, that fome, prompted by appetite, had immediately taken food at the beginning of their illnefs; while others, loathing victuals, had fafted altogether; and that the difeafe in thofe who had abftained from food had been alleviated. It would be remarked, too, that fome took food in the paroxyfm of a fever, others a little before it came on, and others again after its remiffion; and that it would agree the beft with thofe who ate after the removal of the fever. In like manner, it would be feen, that thofe who took food freely in acute difeafes, fuffered an aggravation of their fymptoms, while the abftemious would not thus fuffer. Thefe and fimilar circumftances, occurring daily, would be noted

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by diligent obfervers; and what had been feen to fucceed moft generally, that they afterwards prefcribed to the fick. Such was the origin of the art of medicine, which, in confequence of the recovery of fome, and the death of others, taught us to difcriminate the ufeful expedients from thofe that were pernicious: and when remedies were difcovered by fuch experiments, then men began to reafon about their operation; for the art of employing remedies was obvioufly not the refult of reafoning, but explanatory hypothefes were fought for after the remedies were afcertained.

4. The dogmatifts contend, in the laft place, that as pains and various diforders attack the *internal parts*, no perfon, in their opinion, can apply proper remedies to them, when difeafed, if he is ignorant of their fituation and appearance. Hence, they affirm, that it is neceffary to diffect the bodies of the dead, and to examine the vifcera and inteftines: and they extol the method of Herophilus and Erafiftratus, who procured criminals out of prifon, by royal permiffion, and, having diffected them alive, contemplated, even while they were breathing, the parts which nature had before concealed; and remarked their pofition, colour, figure, fize, arrangement, foftnefs, hardnefs, fmoothnefs, and connection, as well as their proceffes and depreffions, or what is inferted into and received by each part. "For," fay they, "when any internal pain occurs, the feat of that pain cannot be afcertained by one who is ignorant of the fituation of the vifcera and inteftines; nor can he cure any part difeafed, who does not know what the part is. Befides, if the vifcera happen to be expofed in confequence of a wound, if the obferver be unacquainted with the natural appearance of each part, he cannot difcover what is found, and what injured or corrupted, and therefore is not qualified to cure that part which is difeafed. Even external remedies are applied with much more judgment by one who knows the fituation, figure, and fize of the internal parts. Nor can it be juftly deemed cruel (although it is generally fo reprefented) to put a few guilty individuals to torture, with a view to afcertain means of relief for all the innocent among mankind in all fucceeding ages.

To thefe arguments the empirics reply, that "the preceding doctrines of the dogmatifts were only idle and frivolous, but in this there is the addition of exceffive cruelty: for what can be more cruel than to cut open the abdomen and cheft of living men, and thus to render that benign art, which is the guardian of the health of mankind, the inftrument of torture, and that of the moft atrocious kind? more particularly when it is confidered, that fome of the information, which is fought after with fo much barbarity, cannot be thus acquired at all, and that the reft may be afcertained without committing murder. For the colour, fmoothnefs, foftnefs, hardnefs, and other fuch qualities, are not the fame in the body, when diffected, as when it was found: even in bodies that have fuffered no violence, thefe qualities externally are often changed by fear, grief, hunger, indigeftion, fatigue, and a thoufand other inconfiderable affections. Whence it is ftill more probable, that the internal organs, which are ftill more delicate than the external, and to which even expofure to the light is new, muft be changed by the fevereft wounds, or rather by fuch fatal mangling. Nothing can be more abfurd than to fuppofe that appearances are the fame in a dying man, nay, in one already dead, as during life. The abdomen, indeed, may be opened, while a man yet breathes; but no fooner does the knife reach the thorax, and divide the tranfverfe feptum, which feparates the upper cavity from the lower, (which the Greeks call the *diaphragm*, διαφραγμα,) than he immediately expires: it is, therefore, the præcordia and vifcera of a dead man which alone the butchering phyfician brings to his view; and which neceffarily have the appearance of the organs of the dead, and not of thofe of the living. Thus all that is gained by the phyfician is the opportunity of committing a barbarous murder, and not that of witneffing the condition of the vifcera in a living man. If, however, any information can be obtained, as to the appearances of the internal parts while the individual yet breathes, accident often gives the practitioner opportunities for fuch obfervation: for it frequently happens that a gladiator in the *arena*, a foldier in battle, or a traveller attacked by robbers, is wounded in fuch a manner as to expofe fome internal organ to view; whence a fagacious phyfician will learn the fituation, pofition, connection, figure, and other circumftances belonging to each, while he is endeavouring to relieve, and not to murder the patient; and thus will acquire, through compaffion, that knowledge which others have obtained by the moft horrid cruelty. Moreover, it is clear, from the arguments already ftated, that it is not neceffary to mangle even dead bodies; which, though not cruel, is loathfome to the fight, as are moft of the circumftances connected with the dead; and whatever can be learned, refpecting the living, may be acquired during the treatment of their difeafes and wounds." See Celfus, De Medicina, in Præf.

The concluding obfervations, which deny the neceffity of anatomical knowledge, acquired by the diffection of dead bodies, appear to be the only point in the tenets of the empiric phyficians which is liable to difpute. But even in this point, we are fatisfied, there is a great portion of truth, fo far as relates to the knowledge and treatment of thofe internal difeafes, to which the knife of the furgeon cannot reach; for the knowledge of the appearances and connection of the vifcera does not enable us to fuggeft the practical means of relief, when they become difeafed: experience and obfervation alone, as the empirics contend, have taught us to apply the remedies. See an Effay on the Importance of Anatomical Knowledge to Medicine, in the Edinburgh Med. and Surg. Journal for Jan. 1809.

After having thus ftated the doctrines of the empiric phyficians, in oppofition to thofe of their opponents, Celfus has fubjoined a fenfible and judicious criticifm refpecting the merits of both. But this is not the place to enter more fully into the fubject; we muft therefore refer thofe, who wifh for the opinion of that claffical phyfician, to his work already quoted.

There is one point, which could not be well introduced under any of the preceding heads, which the dogmatifts conftantly threw out againft the empirics, namely, that *new* difeafes occafionally occur, for the cure of which, confequently, practice and experience have afforded no rules or information; whence, they fay, it is neceffary to inveftigate their caufes, both evident and occult, without a knowledge of which no mortal can find out why one curative expedient ought to be adopted rather than another. But the reply of the empirics to this point is not lefs accurate and fatisfactory than in the preceding parts of the difpute. "New difeafes," they fay, "requiring new remedies, feldom if ever occur; but if any unknown diforder fhould appear, the phyfician would not require the hypothetical doctrines about occult caufes to direct him in his method of treatment: he would immediately obferve to what known difeafe it was moft nearly allied in its nature and fymptoms, and employ the remedies which experience had fhewn to be fuccefsful in the fimilar malady; and by fuch refemblance he would be able to difcover a proper remedy." Celfus.

It

It is evident, then, that both the dogmatic and empiric phyficians appealed to experience, and that neither excluded altogether the dictates of reafon and reflection. The principal difference in their tenets appears to have confifted chiefly in this: that the empirics reafoned only from the facts afcertained by obfervation, without attempting to explain their effential and infcrutable nature by hypothefes; and that the latter fpeculated upon the mode and nature of every action and phenomenon in the animal body, and took thefe fpeculations as the bafis of their reafoning:—an error in the inveftigation of nature, which, as we have before faid, was fo well expofed by lord Bacon, in modern times; and which was practically illuftrated in the triumph of Newton's *empiric* doctrines, over the hypothefes of Des Cartes.

No longer engaged in ftudying fyftems, and averfe to fpeculation, even in regard to the fymptoms of difeafes, the empirics exerted their whole faculties in inveftigating the power of medicinal fubftances, which laid the foundation of their pre-eminence in pharmaceutical fkill, and gradually effected thofe changes in the art of medicine which fubfequently occurred. The properties of the productions of nature, efpecially of the vegetable world, were extenfively examined; and the inftruments of the phyfician, by which he could influence the functions of the living body, were greatly multiplied. It is chiefly to the induftry of the ancient empirics that we are indebted for the introduction, or rather for the full knowledge, of fedative and narcotic remedies; on the liberal ufe of which probably depended the fuperior reputation acquired by fome of them over their more cautious antagonifts. Of this fuperiority, a fingular inftance occurs in the many exifting teftimonies to the fame of Heraclides of Tarentum, before mentioned, who is recorded as the moft fuccefsful phyfician in any age or country of the world.

It is eafy to fee, however, that this direction of medical inquiry, given by the empiric phyficians, to the difcovery of the qualities of medicinal fubftances, or drugs, would in all probability lead to many abufes and evils. Experiment of this fort being much eafier, at leaft when carelefsly made, than that unremitting and accurate obfervation of the phenomena of difeafes, which alone can conftitute the fcientific phyfician, the ignorant and idle would content themfelves with pharmaceutic experiments, and neglect the tafk of pathological inveftigation; and felfifh craft and difhonefty would foon learn to impofe on the credulity of the people, in the adminiftration of fecret remedies, when the ufe of a particular drug, and not the general treatment of a difeafe, was fuppofed to be the effence of medicine. Hence it actually happened, even in the early ages of phyfic, that thefe ignorant and illiberal pretenders to *panaceas*, and infallible remedies, who did not know one difeafe from another by its fymptoms, appeared in Egypt, Greece, and Arabia, and were much complained of by their more rational contemporaries. In all fucceeding ages, the race of thefe illiterate pretenders has been multiplied, under the abufed name of *empirics*. In our own time, indeed, while a college of phyficians, conftituted by royal and parliamentary authority, exifts in the metropolis, for the regulation of the practice of medicine, and the prevention of the mifchiefs occafioned by noftrum-mongers, and pretenders of all kinds, *quackery* thrives, unmolefted by the college, and fanctioned, licenfed, and protected by patent, on the part of government, to an extent heretofore unexampled. Le Clerc Hift. de la Med. Schulzii Hift. Med. Celf. in Præf. Galen, Loc. Cit. Walker's Mem. of Medicine.

Empiric, in *Modern Medicine*, is applied to a perfon, who fells or adminifters a particular drug, or compound, as a remedy for a given diforder, without any confideration as to the variations of that diforder, in its different ftages, or degrees of violence, or as it occurs in different conftitutions, climates, or feafons, or in perfons of different age, fex, ftrength, &c. Such a practice implies a total ignorance of the nature of the human conftitution, both in health and difeafe; and therefore is generally found to be the refort of the illiterate and felfifh, not to fay difhoneft, part of mankind. See the preceding article. See alfo Quack.

EMPIS, in *Entomology*, a genus of dipterous infects. The mouth is furnifhed with an inflected fucker and probofcis; fucker with a fingle-valved fheath and three briftles; feelers fhort and filiform; antennæ fetaceous. Thefe are carnivorous, and fubfift on flies and other fmall infects, which they feize with their feet, and pierce with their roftrum, to fuck the blood and juices of their body. Some of the fpecies are found on flowers, in the winged ftate. None of the larvæ are known.

Species.

Borealis. Black; wings fubrotund and ferruginous-brown. Linn.

Inhabits Sweden, Britain, and various other parts of Europe, and is often feen in fwarms in the air, like the gnat, on a ftill evening, about fun-fet.

Pennipes. Black, with the pofterior legs long and feathered. Fabr. *Afilus pennipes*, Scop. Ent. Carn. 994.

Found in Europe, on the geranium fylvaticum and cardamine pratenfis. A fuppofed variety is defcribed by Linnæus, which has the four pofterior thighs feathered, and the wings brown, with a black rib.

Marginata. Black; wings white, with black margin. Fabr.

A fmall fpecies, found in Saxony.

Maura. Black; fhanks of the fore-legs thick and ovate. Fabr.

Inhabits environs of Hamburgh, about ftagnant waters.

Livida. Livid; thorax pale-green, with three black lines; bafe of the wings and legs ferruginous. Fabr.

Frequent on the flowers of the cow-parfnip (heracleum fphondylium) in Europe. The wings are oblong, and veined with fufcous.

Ciliata. Blackifh; wings with fufcous rib; legs black, four pofterior ones feathered. Fabr.

Inhabits Europe, and in fize refembles the laft. The head is black, with a teftaceous probofcis; thorax hairy.

Cinerea. Cinereous; thorax immaculate; legs pale; wings at the tip brownifh. Fabr.

Inhabits Sweden, on umbellate flowers.

Maculata. Cinereous; fnout, fides of the abdomen, and legs teftaceous; wings fpotted. Fabr.

Native of Italy. The thorax is cinereous, with faint lines; legs teftaceous, with black claws; abdomen with a teftaceous line on each fide.

Stercorea. Teftaceous, with a dorfal black line; wings reticulated. Linn. Fn. Suec.

On umbellate flowers, in Europe.

Minuta. Black; legs teftaceous; wings white. Fabr.

Inhabits Denmark, on fungi. Small.

Crassipes. Black; all the fhanks with a long thick joint; wings white, lower half of the outer margin black. Schranck.

Very fmall, and inhabits Auftria.

Rufipes. Black, and fomewhat cinereous, legs ferruginous. Linn.

Native of Europe.

Quadrilineata. Black, and fomewhat greyifh; thorax

thorax with four lines; abdomen cylindrical, with the tip inflected. Linn.

Inhabits Europe.

Trilineata. Cinereous; thorax with three black impressed lines; wings white; legs pale-yellow. Linn.

Abdomen sometimes yellow, sometimes fuscous. This and the three following species inhabit Europe.

Nigricus. Cinereous; thighs black; shanks and wings ferruginous. Linn.

Gibbosa. Fuscous; thorax gibbous; abdomen thin; wings spotted; shanks and ends of the legs white. Linn.

Fuscipes. Brown-cinereous; wings white; legs livid; feet fuscous. Linn.

Leucoptera. Thorax cinereous; abdomen black; wings white; legs livid. Linn.

EMPLASTICS, in *Pharmacy*, are salves, or medicines, which stop up and constipate the pores of the parts they are applied on; otherwise called *emphractics*.

The word is formed from the Greek, εμπλασσειν, *to stop up*.

Such are fats, mucilages, wax, the whites of eggs, &c.

EMPLASTRA Amyntica. See Amyntica.

EMPLASTRUM, popularly called *plaster*, a medicine of a stiff, glutinous consistence, composed of divers simple ingredients, spread on leather, or linen, and applied externally.

The word is formed from the Greek, εμπλαττω or εμπλασσω, *to put in a mass*, or *to smeer over*, because the emplaster is made of divers kinds of simple drugs, worked up into a thick tenacious mass; or because it covers over the piece of leather or linen to be applied on the part affected.

Emplasters are made up in a strong solid body, that by remaining a long time on the part, the medicinal ingredients they are chiefly composed of, may have time enough to produce their effect.

The drugs used to give a body and consistence to emplasters, are usually wax, pitch, gums, fats, litharge, and other preparations of lead.

There are emplasters of divers kinds, and used with divers intentions; stomachic emplasters; cephalic, styptic, hepatic, diaphoretic, resolutive, detersive, emollient, incarnative, astringent, conglutinative, &c. emplasters.

In the prescription of extemporaneous plasters, the greatest regard is to be had to that particular consistence which the part can most conveniently bear, whereupon the application is to be made. Thus, plasters to the breast and stomach, especially in the intention of emollients or discutients, should be yielding and soft, as in the officinal emplastrum stomachicum; but to the loins, or any of the limbs, where warm discutients and strengtheners are to be applied, an higher and more adhesive consistence is to be sought for. The emollient plasters likewise should be laid on thick, and frequently repeated, if the symptoms continue, because their better parts are soon spent. Discutients also applied to hard tumours, require repetition; but the strengtheners, which are purposely contrived of a strong adhesive consistence, are permitted to lie on till they grow dry, and come off spontaneously. In some flatulent tumours, where a plaster alone will not prevail, they are at intervals taken off, and discutient fomentations or lotions made use of; such as are composed of bitters, carminatives, comprehending also lixivial salts or alkaline spirits.

Emplastrum *Adhæsivum*, *Adhesive Plaster*, now called "Emplastrum lithargyri cum resinâ," or "litharge-plaster with resin," is composed of three pounds of litharge or common plaster, with the proportion of half a pound of yellow resin; and is prepared by melting the litharge plaster with a slow fire, and mixing the powered resin. The black sticking-plaster, called the lady's court-plaster, is formed by dissolving twelve ounces of the gum benjamin in twelve ounces of rectified spirit of wine, and straining the solution. In a separate vessel, dissolve a pound of the best isinglass in five pints of pure water; and after straining this solution, mix it with the former, and let them stand in a narrow vessel, that the grosser parts may subside: when the liquor is cold, it will become a jelly, which will melt near the fire when it is to be spread. This quantity will be sufficient for spreading on ten yards of half-yard wide silk; in order to which, the silk must be stretched in a frame, and the mixture may be spread upon it with a spunge or brush, which should be done near a fire. As each spreading dries, it must be repeated to the tenth or twelfth time, and then touched lightly with a brush to give it a gloss. The following more simple preparation may be substituted for the former; dissolve a pound and a quarter of fine isinglass in five pints of water, and before it cools spread it on silk in the manner above directed.

Emplastrum *ex Ammoniaco cum Mercurio*, now called "Emplastrum ammoniaci cum hydrargyro," a form of medicine, ordered to be prepared in the following manner.

Take gum ammoniacum, strained, a pound; purified quicksilver, three ounces by weight; sulphurated oil, one dram by weight, or q. s. Rub the quicksilver with the sulphurated oil till the globules no longer appear; then add by degrees the gum ammoniac melted, and almost cooled again, and make the whole into a plaster.

This plaster is recommended in pains of the limbs, arising from a venereal cause. Indurations of the glands, and other violent tumours, are likewise found sometimes to yield to it.

Emplastrum *Anodynum*, *Anodyne Plaster*, is prepared by melting an ounce of the adhesive plaster; and, whilst it is cooling, mixing with it a dram of powdered opium, and the same quantity of camphor previously rubbed up with a little oil. This plaster gives relief in acute pains, especially of the nervous kind.

Emplastrum *Attrahens*, *the Drawing Plaster*, now "Emplastrum ceræ compositum," a plaster ordered to be now made in this manner: take yellow wax and prepared mutton suet, of each three pounds; and yellow resin, one pound: melt all together, and strain the mixture while it is hot.

Emplastrum *Cephalicum*, or "Emplastrum picis Burgundicæ compositum," is composed of Burgundy pitch, two pounds; ladanum, one pound; yellow resin and yellow wax, of each four ounces by weight; and expressed oil of nutmeg, one once by weight: to the pitch, resin, and wax, melted together, add first the ladanum, and then the oil of nutmeg.

Emplastrum *Commune*, or "Emplastrum lithargyri," litharge plaster, a name given to what has been long called *diachylon-plaster*. It is ordered to be made of a gallon of oil of olives, and five pounds of litharge in very fine powder, boiled together on a slow fire, with about a quart of water, to keep them from burning, till they are perfectly mixed, and have the consistence of a plaster.

This plaster is generally applied to slight wounds and excoriations of the skin; it keeps the part soft and warm, and defends it from the air, which is all that is necessary in such cases.

Emplastrum *Commune cum Mercurio*, or "Emplastrum lithargyri cum hydrargyro," is made in the same manner

manner as the ammoniacum-plaſter with quickſilver, of litharge-plaſter, one pound; purified quickſilver, three ounces by weight; and ſulphurated oil, one dram by weight, or q. ſ.

Emplastrum *è Cymino*, or "Emplaſtrum cumini," is compoſed of cummin, caraway, and bay-berries, of each three ounces by weight; Burgundy pitch, three pounds; and yellow wax, three ounces by weight. Let the pitch be melted with the wax; powder the reſt, and mix all together.

Emplastrum *Gummi*, *Gum Plaſter*, now called "Emplaſtrum lithargyri compoſitum." Take of the common or litharge plaſter, three pounds; ſtrained galbanum, eight ounces by weight; common turpentine, ten drams by weight; and frankincenſe, three ounces by weight. Melt the galbanum with the turpentine, and mix with them, firſt, the powdered frankincenſe, and then the litharge plaſter, previouſly melted with a ſlow fire. This is uſed as a digeſtive, and for diſcuſſing indolent tumours.

Emplastrum *Roborans*, the *Strengthening-Plaſter*, now called "Emplaſtrum thuris compoſitum," or compound frankincenſe plaſter, is ordered to be made thus: take of the common or litharge-plaſter, two pounds; of frankincenſe, half a pound; and dragon's blood, three ounces by weight: melt the plaſter, and then add to it the other ingredients in powder.

Emplastrum *Saponis*, *Soap-Plaſter*, is made by mixing half a pound of ſoap with three pounds of melted litharge-plaſter; and boiling them to the conſiſtence of a plaſter.

Emplastrum *Stomachicum*, *Stomach-Plaſter*, or "Emplaſtrum ladani compoſitum," is compoſed of ladanum, three ounces by weight; frankincenſe, one ounce by weight; cinnamon, powdered, expreſſed oil of nutmeg, of each half an ounce by weight; and oil of ſpearmint, one dram by weight. To the melted frankincenſe add, firſt, the ladanum ſoftened by heat, and then the expreſſed oil of nutmeg. Mix theſe and the cinnamon with the oil of mint, and beat them together in a warm mortar. Let it be kept in a cloſe veſſel. An ounce or two of this plaſter, ſpread on ſoft leather, and applied to the region of the ſtomach, will be of ſervice in flatulencies, ariſing from hyſteric and hypochondriac affections.

Emplastrum, *Veſicatorium*, *Bliſtering-Plaſter*, or "Emplaſtrum cantharidis," is formed by melting two pounds of plaſter of wax, and half a pound of prepared hog's lard; and a little before they coagulate, ſprinkling one pound of cantharides, finely powdered. In order to render bliſtering-plaſters efficacious, care ſhould be taken that the flies be good, freſh powdered, and the powder fine; and that the plaſter ſhould neither be made in too great quantity at once, nor ſpread with a ſpatula too much heated. See Blister.

EMPLEURUM, in *Botany*, from εν, *in* or *upon*, and πλευρα, the *ſide*, alluding to the lateral inſertion of the ſtigma upon the germen. Soland. in Ait. Hort. Kew. v. 3. 513. Schreb. 812. Willd. Sp. Pl. v. 4. 333. Mart. Mill. Dict. v. 2. Juſſ. 298. Claſs and order, *Monoecia Tetrandria*. Nat. Ord. *Rutaceæ*, Juſſ.

Gen. Ch. Male. *Cal.* Perianth of one leaf, bell-ſhaped, four-cleft, permanent. *Cor.* none. *Stam.* Filaments four, thread-ſhaped, equal, ſimple, longer than the calyx, a little ſpreading; anthers erect, oblong, obtuſe, ſomewhat quadrangular, of two cells, each burſting by a lateral fiſſure. Abortive germen ſometimes preſent. Female on the ſame plant. *Cal.* as in the male. *Cor.* none. *Piſt.* Germen ſuperior, oblong, compreſſed, of one cell, terminated by an erect leafy appendage; ſtyle none; ſtigma placed on a lateral tooth at one edge of the germen, erect, cylindrical, ſmooth, deciduous. *Peric.* Capſule oblong, compreſſed, crowned with a leafy oblique appendage, of one cell, burſting at its ſtraighteſt edge. *Seed* ſolitary, oblong, inſerted laterally, encloſed in a bivalve, elaſtic, rigid arillus.—Very rarely two capſules are ſaid to be found in one calyx.

Eſſ. Ch. Male, Calyx four-cleft. Corolla none. Sometimes with the rudiment of a germen. Female, Calyx four-cleft, inferior. Corolla none. Stigma cylindrical, ſtanding on a lateral tooth of the germen. Capſule beaked, of two valves. Seed ſolitary, with an elaſtic arillus.

E. *ſerrulatum*. Soland. in Ait. Hort. Kew. v. 3. 340. Sm. Exot. Bot. v. 2. 7. t. 63. (Dioſma unicapſularis; Linn. fil. in Suppl. 155. D. enſata; Thunb. Prod. 43.) This is the only ſpecies hitherto obſerved. Native of the Cape of Good Hope, where Thunberg, Maſſon, and others have gathered it. Maſſon ſent it to Kew in 1774. It requires the ſhelter of a green-houſe, and the ſame treatment as other Cape plants of the Rutaceous order, *Dioſma*, *Erioſtemon*, &c. but is leſs ornamental than moſt of them, on account of the want of petals. The *ſtem* is ſhrubby, and much branched. *Leaves* ever-green, ſmooth, ſhining, alternate, almoſt ſeſſile, linear-lanceolate, acute, bordered with ſhallow glandular ferratures, deſtitute of ſtipulas. *Flowers* on ſimple, axillary, cluſtered ſtalks, reddiſh, but inconſpicuous. *Capſules* more ſtriking, from their enlarged leafy termination. The whole plant, when bruiſed, ſmells ſtrongly of rue or juniper, like moſt of its natural order. See Diosma and Eriostemon.

EMPNEUMATOSIS, from εμπνεω, *I inflate*, in *Medicine*, a word uſed by ſome writers to ſignify an inflation of the ſtomach; but by others, in a more general ſenſe, for inflations of the womb, or of any other part.

EMPOLI, Jacopo da, in *Biography*, a painter of the Florentine ſchool, who was born at Empoli, as his name deſignates, in 1554; and was firſt inſtructed in his art in the ſchool of Maſo di San Friano. He afterwards applied himſelf to ſtudy the works of Andrea del Sarto, and with very conſiderable ſucceſs, acquiring very much his ſtyle of deſign, and hues and tones of colouring. He copied Del Sarto's works very cloſely, and not only his, but thoſe of other maſters, with ſo much accuracy, as to deceive the judgment of thoſe well verſed in the art. So much talent for this kind of exerciſe in art, is ſeldom accompanied by a power of invention or execution of original works. But Empoli had conſiderable reputation for this alſo, and his compoſitions are ſpoken of as poſſeſſing much ſpirit and ingenuity, and alſo exhibiting conſiderable feeling of beauty and elegance.

Empoli, in *Geography*, a town of Italy, in the duchy of Tuſcany, ſituated on the Arno; 15 miles W. of Florence.

EMPORETICA Charta. See Charta and Paper.

EMPORIA, in *Ancient Geography*, a country of Africa, on the Leſſer Syrtis, in which Leptis ſtood. This territory was under the dominion of the Carthaginians, and was put under contribution by Maſiniſſa. Leptis is ſaid to have paid a talent *per* day to the Carthaginians. No part of the Carthaginian dominions was more fruitful than this. Polybius (l. i.) ſays, that the revenue which aroſe from hence was ſo conſiderable, that all their hopes were almoſt founded on it; and he deduces the origin of its name from its great fertility, and the commerce which diſtinguiſhed it. To this were owing the anxiety and ſtate-jealouſy of the Carthaginians, leſt the Romans ſhould fail beyond the fair promontory, that lay before Carthage, and become acquainted with a country

country which might induce them to attempt the conqueſt of it.

EMPORIÆ, Ampourias, a town of Hither Spain, which lay towards the ſouth, and which was, as its name imports, a commercial port. Strabo ſays, that the Maſſilians were eſtabliſhed here: but Pliny and Silius Italicus ſay, that they were the Phocæans; both which reports may agree, as the inhabitants of Marſeilles profeſs to have derived their origin from the Phocæans. According to Livy, this place conſiſted of two towns ſeparated by a wall; that on the ſea-coaſt, encompaſſed by a wall of 400 paces, was inhabited by Greeks, a colony of Maſſilians, who ſprung from the Phocæans; and the other part, which had no communication with the ſea, was ſurrounded by a wall of 3000 paces. This hiſtorian informs us, that Cæſar, after having defeated Pompey's party, eſtabliſhed a body of Romans in this place. The Greeks, who were eſtabliſhed in this place, had previouſly inhabited a ſmall iſland oppoſite to it, from which they paſſed over to the continent. They worſhipped Diana of Epheſus.

EMPORICUS Sinus, a gulf of Africa, in Mauritania. Ptolemy places it in the Adriatic ſea, at 34° 20′ of latitude.

EMPORIUM, a fortreſs of Italy, in Emilia, 5 miles from the Po.—Alſo, a place of Macedonia.—Another of Sicily.—Another of Italy, in Campania.—Another in Celtica. Steph. Byz.

Emporium, in *Phyſiology*, is often uſed for the common ſenſory in the brain. See Brain.

EMPRIMED, among *Sportſmen*, a term applied to a hart, when he forſakes the herd.

EMPRION, from πρίω, *to ſaw*, in the *Medical Writings of the Ancients*, a word uſed to denote a peculiar pulſe, in which the artery is felt to be diſtended in one part more than another at every ſtroke, and by that means is made to reſemble any ſerrated body, or the light teeth of a fine ſaw.

EMPROSTHOTONOS, in *Medicine*, from ἔμπροσθεν, *forwards*, and τείνω, *I ſtretch*, is the term applied to that form of tetanus, or general ſpaſm, in which the muſcles which bend the body forwards are moſt ſtrongly affected, ſo that the whole body is rigidly fixed in a bent poſition, the neck and back being bowed forwards, the chin fixed upon the breaſt, &c. The term is uſed in oppoſition to Opisthotonos, in which the body is bent backwards. (See Tetanus.) The emproſthotonos, however, is a very rare occurrence; and ſome writers have altogether denied its exiſtence, except as a partial affection confined to the neck.

EMPTOR Familiæ, *buyer of a family*, in the *Roman Law*, one who purchaſed the inheritance of a perſon, or the privilege of being appointed his heir by will.

This was done by the ceremony of ſcales and weights, before five witneſſes, with the uſe of a peculiar formula of words.

Such buyer differed from the heir, *hæres*, as the teſtator in ſome meaſure alienated the right to the former during his own life-time, whereas the latter had only a right by his death. Briſſon. de Formul. lib. vii. p. 585. Pitiſc. Lex. Ant. tom. i. p. 713. voc. *Emptor*.

Emptor *fiduciarius*, *fiduciary buyer*, one who receives a thing in the way of pledge, till the money he has advanced be repaid. Salmaſ. de Mod. Uſur. cap. 14. Pitiſc. Lex. Ant. tom. i. p. 713. voc. *Emptor*.

EMPTYSIS, in *Surgery*, bleeding from the mouth and fauces.

EMPUS, in *Geography*, a town of France, in the department of the Var, and diſtrict of Draguignan; 5 miles N.W. of Draguignan.

EMPUSA, Εμπουσα, among the *Ancients*, a kind of hobgoblin, or bugbear, under the direction of Hecate, who uſed to ſend it to frighten people who laboured under misfortunes. Hofm. Lex. in voc.

EMPYEMA, in *Surgery*, ſignifies a collection of matter in the cavity of the thorax. The term is derived from ἐν, *within*, and πύον, *pus*, or *matter*.

The ancients made uſe of the word "empyema" to expreſs every kind of internal ſuppuration. Ætius firſt employed the term to denote the collections of purulent matter, which ſometimes form in the cavity of the pleura, or membrane lining the cheſt; and all the beſt modern ſurgeons invariably attach this meaning alone to the expreſſion.

The operation for empyema means the making of an opening into the thorax, for the purpoſe of giving vent to the matter collected in the cavity of the pleura. The neceſſity for having recourſe to ſuch an operation, however, does not often preſent itſelf. We would not wiſh to be thought to aſſert, that inflammation of the lungs, pleura, mediaſtinum, diaphragm, and even of the liver, does not ſometimes terminate in ſuppuration. Certainly, the latter event is occaſionally produced; but, when it does happen, the matter does not always make its way into the cavity of the cheſt. Very frequently external abſceſſes form, or the pus is either coughed up, or diſcharged with the ſtools.

When the ſurface of the lungs and pleura coſtalis have become adherent together, in the ſituation of the abſceſs, the pus, always diſpoſed by a law of nature to make its way to the ſurface of the body, occaſions ulceration of the intercoſtal muſcles, and collects on the outſide of them. An abſceſs of this kind comes on with a deep-ſeated pain in the part affected; an œdematous ſwelling, which retains the impreſſion of the finger; and a fluctuation, which is at firſt not very diſtinct, but from day to day becomes more and more palpable, and, at length, leads the ſurgeon to make an opening to let out the matter.

If an opening be not made, when the fluctuation becomes perceptible, there is ſome riſk of the matter inſinuating itſelf into the cheſt, in conſequence of the adheſion being in part deſtroyed by ulceration. M. Sabatier affirms, that the caſe may take this courſe, even when the abſceſs has been punctured, and while a free external opening exiſts. This experienced ſurgeon had occaſion to remark ſuch an occurrence in a ſoldier. The patient had a collection of matter in the thorax, which was only indicated by a pain all over the ſide; a difficulty of lying in any other poſition in bed, than on the back; and an undulating noiſe in the cheſt, whenever he altered his poſture. When M. Sabatier made the patient hold his breath, the diſcharge, which was very copious, was not increaſed; the pus did not contain any bubbles of air; there was no emphyſema round the wound; nor any blaſt of air from it in the motions of reſpiration. On opening the body, M. Sabatier found, that the abſceſs had been originally ſituated between the intercoſtal, and the pectoralis minor, and major, muſcles, and that the matter had made its way, by ſeveral ulcerated openings, into the cheſt. The lung, in ſome places, was adherent to the pleura. The quantity of effuſed matter was very conſiderable. See Médecine Opératoire, tom. 2. p. 249.

In the ſame manner, if inflammation ſhould occur in the anterior mediaſtinum and end in ſuppuration, the abſceſs may poſſibly burſt into neither of the cavities of the cheſt; but make its way outward, after having rendered the ſternum carious. The following caſe, illuſtrative of this fact,

fact, is taken from Van Swieten's Commentaries on Boerhaave's 895th Aphorism.

A young man was attacked with a violent pleurisy, which seemed to terminate in copious expectorations, which began about a fortnight after the commencement of the indisposition, and continued for a long while. The patient became exceedingly reduced, and his fate seemed inevitable. In the tenth month of his illness, however, a small soft swelling, about the size of a filbert, made its appearance upon the middle of the sternum, the substance of which bone appeared to be obviously carious round the margin of the tumour. The swelling burst of itself, and a discharge of matter ensued. Pus continued to be emitted from the opening for eight months. The cavity of the abscess was capable of containing a pint of the fluid, which was used as a detergent injection. The matter had collected between the pleura and the ribs. The patient recovered of this alarming disease, and was seen by Van Swieten in good health, eight months afterwards. There only remained a small fistulous opening, from which an inconsiderable quantity of matter continued to be discharged.

The foregoing case of abscess in the anterior mediastinum originated from an internal cause. It was the consequence of a violent pleurisy, or rather of a similar disorder, which is attended with nearly the same symptoms, but has a different situation, and has been very accurately described by Salius Diversus. The same sort of abscess may arise, in consequence of a wound in the forepart of the chest. An interesting case of this description is related by Galen. A young man, who had been wounded in the region of the sternum, seemed to have got completely well. An abscess then formed in the situation where the injury was received; it was opened, and healed. The part, however, soon inflamed and suppurated again. The place could not now be healed. A consultation was held, at which Galen attended. As the sternum was obviously carious, and the pulsation of the heart was visible, every one was afraid of undertaking the cure of the case, since it was conceived, that it would be necessary to open the thorax itself. Galen, however, engaged to manage the treatment without making any opening of the kind alluded to, and he expressed his opinion, that he should be able to effect a cure. Not finding the bone so extensively diseased, as was apprehended, and the mammary vessels being found, he began to indulge considerable hopes of success. After the removal of a portion of the bone, he saw the heart quite exposed, by reason of the pericardium having been destroyed by the previous disease. The patient, after the operation, experienced a speedy recovery.

M. J. L. Petit met with a case of an abscess in the mediastinum, in consequence of a gun-shot wound, in the situation of the sternum. The injury had been merely dressed with some digestive application; no dilatation, nor any particular examination of the wound had been made. The patient, after being to all appearances quite well, and joining his regiment again, was soon taken ill with irregular shiverings, and often febrile symptoms. M. Petit probed the wound, and found the bone affected. As there was a difficulty of breathing, he suspected an abscess either in the diploe, or behind the sternum, and, consequently, he proposed laying the bone bare, and applying a trepan. This operation gave vent to some sanious matter, and, as soon as the inner part of the sternum was perforated, a glass full of pus was discharged. The patient was relieved, and afterwards recovered.

When, in consequence of inflammation, an abscess forms deeply in the substance of the lungs, the pus more easily makes its way into the air-cells, and tends towards the bronchia, than towards the surface of the lungs, and into the cavity of the thorax. In this case, the patient spits up purulent matter. When the opening, by which the abscess has burst, is large, and the pus escapes from it in a considerable quantity at a time, the patient is in some danger of being suffocated. However, if the opening be not immoderately large, and the pus, which is effused, be not too copious, a recovery may follow. Abscesses in the substance of the diaphragm, and collections of matter in the liver, may also be discharged by the pus being coughed up from the trachea, when the parts affected have become connected with the lungs, by adhesions, and the abscesses of the liver are situated on its concave surface. When the collection of matter in the liver occupies any other situation, the abscess frequently makes its way into the colon, and the pus is discharged with the stools. Several cases of this kind are related by authors; Sabatier has recorded two in his Médecine Opératoire; Le Dran mentions his having seen others; and Pemberton, in his book on the diseases of the abdominal viscera, p. 36, relates the occurrence of additional instances of a similar nature.

We shall now proceed to the consideration of empyema, strictly so called. No surgical writer, with whom we are acquainted, has written with more discrimination, than Mr. Samuel Sharp, on the symptoms produced by collections of matter in the cavity of the chest. He remarks, that it has been almost universally taught, that when a fluid is extravasated in the thorax, the patient can only lie on the diseased side, the weight of the incumbent fluid on the mediastinum becoming troublesome, if he places himself on the sound side. For the same reason, when there is fluid in both cavities of the thorax, the patient finds it most easy to lie on his back, or to lean forwards, in order that the fluid may neither press on the mediastinum, nor the diaphragm. But, Mr. Sharp takes notice, that however true this doctrine may prove in most instances, there are a few (Le Dran's Obs. 217. vol. i. Marchetti, 65.) in which, notwithstanding the extravasation, the patient does not complain of more inconvenience in one posture, than another, nor even of any great difficulty of breathing.

On this account, observes Mr. Sharp, it is sometimes less easy to determine, when the operation is requisite, than if we had so exact a criterion, as we are generally supposed to have. However, he informs us, that though this may be wanting, there are some other circumstances, which will generally guide us with a reasonable certainty. He states, that the most infallible symptom of a large quantity of fluid in one of the cavities of the thorax, is a preternatural expansion of that side of the chest, where it lies; for in proportion as the fluid accumulates, it will necessarily elevate the ribs on that side, and prevent them from contracting so much in expiration as the ribs on the other side. Mr. Sharp refers also to Le Dran's Observ. 211. vol. i. to prove, that the pressure of the fluid on the lungs may sometimes be so great, as to make them collapse, and almost totally obstruct their action. When therefore, says Mr. Sharp, the thorax becomes thus expanded after a previous pulmonary disorder, and the case is attended with the symptoms of a suppuration, it is probably owing to a collection of matter. The patient, he observes, will also labour under a continual low fever, and a particular anxiety from the load of fluid.

Mr. Sharp also observes, that, besides this dilatation of the cavity from an accumulation of the fluid, the patient will be sensible of an undulation; and sometimes the undulation is so evident, that a by-stander can plainly hear it in certain motions of the body. Mr. Sharp adds, that this was the cafe with a patient of his own, on whom he performed the operation; but the fluid, in the example alluded to, he fays, was very thin, being a ferous matter, rather than pus.

According to the fame author, it will alfo frequently happen, that though the fkin and intercoftal mufcles are not inflamed, they will become œdematous in certain parts of the thorax; or if they are not œdematous, they will be a little thickened. Thefe fymptoms, joined with the enlargement of the thorax, and the preceding affection of the pleura or lungs, feem unqueftionably to indicate the propriety of the operation. But, obferves Mr. Sharp, amongft other motives to recommend it upon fuch an emergency, this is one, that if the operator fhould miftake the cafe, an incifion of the intercoftal mufcles would neither be very painful, nor dangerous. See Critical Enquiry into the prefent State of Surgery; fect. on Empyema.

Although we would wifh the reader to underftand, that patients with empyema can fometimes lie in any pofition, without any particular aggravation of the difficulty of breathing, yet, we muft diftinctly ftate, that the generality of patients with this difeafe cannot place themfelves on the fide oppofite to that where the collection of pus is fituated, without having their refpiration very materially obftructed. Another circumftance, alfo, which we wifh to mention, now that we are treating of the fymptoms of empyema, is, that the œdema of the integuments is fometimes not confined to the thorax, but extends to more remote parts, on the fame fide of the body as the collection of matter. Both the foregoing remarks are confirmed by an interefting cafe, which Mr. Hey, of Leeds, has lately publifhed.

Sept. 3, 1788, Mr. Hey was defired to vifit John Wilkinfon, who had been ill ten days of the influenza. The patient was found labouring under a fever, attended with cough, difficulty of breathing, and pain in the left fide of the thorax. He was bled once; had repeated blifters applied to the thorax; took nitre and antimonials, with a fmooth linctus to allay his cough. He was repeatedly relieved by thefe means, efpecially by the application of the blifters; but repeatedly relapfed. At laft, he became fo ill, that he breathed with the utmoft difficulty, and "could not lie on the right fide without danger of immediate fuffocation."

Mr. Hey found the patient in the ftate juft now defcribed on the 17th of September. "His face, and efpecially the eye-lid, were a little fwollen on the left fide." The left fide of the thorax was larger than the right, and its integuments were œdematous. Upon preffing the intercoftal mufcles they felt diftended; they yielded a little to a ftrong preffure, and rebounded again. The abdomen, efpecially at its upper part, appeared to be fuller than in its natural ftate. See Practical Obfervations in Surgery, p. 476.

Another remarkable fymptom, which is occafionally produced by collections of matter in the cheft, is an alteration in the pofition of the heart. Mr. Samuel Cooper has made mention of a patient who was in St. Bartholomew's hofpital, whofe heart was pufhed quite to the right fide of the cheft, by an empyema in the left bag of the pleura, and pulfated on the right of the fternum. Firft Lines of the Practice of Surgery; part 2. chap. 29.

The fymptoms of empyema are frequently very equivocal, and the exiftence of the difeafe is generally fomewhat doubtful. Panarolius opened a man, whofe left lung was deftroyed, at the fame time that the thorax contained a confiderable quantity of pus. Although the patient had been ill for two months, he had fuffered no difficulty of breathing, and had had only a flight cough. Le Dran met with a cafe of nearly the fame kind. A patient who had been for three days affected with a confiderable oppreffion, and an acute pain on the left fide of the cheft, got fomewhat better. He felt no material difficulty of breathing, on whatever fide he lay. The only thing which he complained of, was a fenfe of a fluctuation in his thorax, and a little obftruction to his refpiration, when he was in a fitting pofture. Thefe fymptoms did not feem fufficiently decided to juftify the operation, and it was delayed. The febrile fymptoms continued with cold fweats, and the patient died on the eighth day. Five pints of pus were found collected in the cheft.

With refpect to opening fuch abfceffes as prefent themfelves at fome part of the parietes of the thorax, in confequence of a pleurify, or an inflammation of the diaphragm, or mediaftinum, it is not attended with any peculiarity. It fhould be done as foon as a fluctuation can be felt, and the aperture fhould be made of fufficient fize to give free vent to the matter. As fome of thefe abfceffes communicate with the external furface of the lungs, and others with that of the liver; as fome of them are accompanied with a caries of the ribs, or the cartilages of thefe bones, while others are attended with an alteration of the fubftance of the fternum; the cure muft frequently be interrupted by unpleafant fymptoms, and very often retarded for a long while, efpecially when there are fome pieces of bone to exfoliate.

We fhall next confider the operation for empyema, in the common fignification of this term.

Mr. Samuel Sharp advifes the incifion to be made between the fixth and feventh ribs, half way from the fternum towards the fpine; which, fays he, though not the moft depending part of the thorax, when we are erect, yet is fituated fufficiently low to give iffue to the fluid, when we lie down.

This author was certainly miftaken in his opinion, that the expanfion of the lungs always propelled the pus out of the wound, but the action of fuch mufcles, as diminifh the capacity of the thorax, may undoubtedly produce this effect. The reader, on looking over the article EMPHYSEMA, will be perfectly convinced, that the lungs cannot become diftended with air, and expanded on one fide, while, on this fide of the cheft, there exifts a free communication between the outward air and the cavity of the pleura.

Mr. Sharp quotes the practice of Marchetti, who always made the opening between the fifth and fixth ribs, to confirm the prudence of choofing this fituation for the incifion. See Critical Enquiry, &c.

A great many of the moft eminent writers on the operations of furgery have had hardly any other object in view, in the operation for empyema, than making an opening into the thorax in fuch a fituation, as would be a moft depending one, in the erect pofition of the body. Hence thefe authors even fanction and recommend the unneceffary plan of cutting through the mufcles of the back to make an iffue for the matter in the exact place, which, according to their principle, ought to be chofen. We are forry, that the refpectable names of Bertrandi and Sabatier might be adduced in favour of this mode of proceeding.

The fafeft, and moft convenient fituation, for making an opening into the cheft, is between the fixth and feventh true ribs, on either fide, as circumftances may render neceffary. The furgeon fhould only recollect, that the two cavities of the pleura are completely diftinct from each other, and have no communication whatfoever, fo that, if fluid were contained on the left fide of the thorax, making an opening into the right cavity would not ferve for difcharging the accumulated matter. The practitioner fhould alfo remember,

remember, that, when there is a fluid on both fides of the cheft, paracentefis muft never be done for the relief of the two collections at the fame time; becaufe, there is great reafon to believe, that, as the lungs on one fide ufually collapfe, when there is a free communication between the air and infide of the thorax, they would do fo on both fides, were an opening made at the fame time into each bag of the pleura. It is hardly neceffary to remark, that, in this condition, the patient could not breathe and would die fuffocated. The operation confifts, in making an incifion, about two inches long, through the integuments, which cover the fpace between the fixth and feventh true ribs, juft where the indigitations of the ferratus major anticus mufcle meet thofe of the externus obliquus. Here it is unneceffary to divide any mufcular fibres, except thofe of the intercoftal mufcles, and, by putting the patient in a proper pofture, the opening that is made, will be depending enough for any purpofe whatfoever. The furgeon, avoiding the lower edge of the upper rib, where the intercoftal artery lies, is then cautioufly to divide the intercoftal mufcles, till he brings the pleura into view, when this membrane is to be very carefully divided with a lancet. The inftrument fhould never be introduced in the leaft deeply, left the lungs fhould be injured. The fize of the opening in the pleura fhould never be larger than neceffary. The difcharge of blood and matter will of courfe require a freer aperture, than that of air, or water. If requifite, a cannula may be introduced into the wound, for the purpofe of facilitating the evacuation of the fluid, and it may, even in fome cafes, be proper to let this inftrument remain in the part, in order to let the water, or pus efcape, as often as another accumulation takes place. It is obvious, however, that a cannula, for this object, fhould only be juft long enough to enter the cavity of the pleura, and fhould have a broad rim to keep it from flipping into the cheft. A piece of fticking plafter would eafily fix the cannula, which might be ftopped up with a cork, or any other convenient thing, or left open according as the circumftances of the cafe, and the judgment of the furgeon, may direct.

It is proper to ftate, that fome practitioners make the wound between the fifth and fixth ribs: thus, Mr. Hey, in relating an interefting cafe of empyema, informs us, that the pain which the patient had felt in his fide had been moft acute betwixt the fifth and fixth ribs, and that there he (Mr. H.) made an opening into the cavity of the thorax. His firft incifion was about two inches in length. He cut through the ferratus and intercoftal mufcles clofe to the upper edge of the fixth rib, and made an opening into the cheft capable of admitting the tip of his finger. A large quantity of matter was thus difcharged, and a leaden cannula was introduced into the wound on the fecond day after the operation, and was retained in its place by a flannel bandage. Mr. Hey did not allow the patient to leave off wearing the cannula, until the difcharge from the thorax had ceafed, and he had completely regained his ftrength. He wore it fifteen months.

Mr. Hey thinks it of great confequence to retain a cannula in the wound, until all probability of relapfe is removed. This precaution, he apprehends, will not hinder the patient from recovering his ftrength, even when the ufe of the inftrument is not abfolutely neceffary. See Hey's Practical obfervations in Surgery, p. 477, &c.

EMPYEMATA, fuppurating medicines.

EMPYI, patients with empyema.

EMPYREUM, among *Divines*, denotes the higheft of the heavens, where the bleffed enjoy the beatific vifion; called elfo empyrean heaven, and paradife.

The word is formed of εν and πυρ, *fire*, becaufe of its fplendour.

EMPYREUMA, in *Chemiftry*, is that fmell and tafte of fcorching which takes place in moft animal and vegetable fubftances, when heated to that point at which decompofition by fire begins. It is always attended with a darkening of colour of fubftances naturally clear and limpid. The degree of heat at which this change occurs is various, but it is always above that of boiling water, fo that the ufe of a boiling water-bath for digeftions, or deficcations, is an effectual mode of preventing empyreuma. There is, however, a change that takes place in vegetable decoctions or infufions when evaporated to the confiftence of an extract, however low the heat is kept, fince when thefe extracts are again diluted to their original confiftence, they differ both in fenfible and chemical properties, from the original liquor. The caufes of this change are, probably, in part the action of the external air, but principally, feveral complicated chemical actions that take place between the various component parts of the vegetable fubftance itfelf, when their particles are concentrated by evaporation of the water which held them in folution. This circumftance is often confounded with empyreuma, properly fpeaking, or the changes produced by heat pufhed to the degree at which decompofition occurs, and as fome of the effects appear to be nearly fimilar, it is perhaps impoffible to adhere ftrictly to the real diftinction. The leading circumftance that indicates empyreuma in vegetable and animal matters is the *charring*, or converfion into black carbon, of part of the fubftance thus heated, whence a carbonaceous infoluble powder is produced, which partly fubfides on dilution with water, and partly remains finely fufpended.

The fmell and tafte of empyreuma in vegetable infufions, may be in many cafes got rid of by filtering through recently-burned charcoal powder.

Empyreuma is alfo ufed for the heat remaining upon the declenfion of a fever.

EMPYREUMATIC Acid and Oil, in *Chemiftry*. When moft animal and vegetable fubftances are diftilled *per fe* in a heat gradually urged to rednefs, a dark-coloured ftrong fmelling oil almoft invariably rifes towards the end of the procefs, which is ftrongly empyreumatic.

Many vegetable fubftances yield alfo, at the fame time, a ftrongly acid and empyreumatic liquor, which appears to be chiefly acetous acid generated in the procefs, and holding much carbonaceous matter in folution, from which it may be partly freed by a feparate diftillation in a gentle heat. See Pyroligneous and Pyromucous Acid.

EMRODS, or rather Hæmorrhoids. See Hæmorrhoids.

EMS, in Latin *Amifia*, or *Amafius*, in *Geography*, is a confiderable river of Germany, which has its fource in the county of La Lippe, in Weftphalia, flows through Eaft Friefland, and falls into the North fea, near Emden. It gives its name to one of the new departments of Holland, which is the ancient province of Eaft Friefland, whofe chief place is the town of Leuwarden.

Ems, a town of Germany, in the circle of the Upper Rhine, and principality of Heffe-Darmftadt; feven miles E.S.E. of Coblentz.

EMSBACH, a river of Germany, in the circle of the Lower Rhine, which runs into the Lahne, three miles E. of Limburg, in the electorate of Treves.

EMULATION, is a generous ardour kindled by the brave examples of others, which impels us to imitate, to rival, and, if poffible, to excel them. This paffion involves in it efteem of the perfon whofe attainments or conduct

 we

we emulate, of the qualities and actions in which we emulate him, and a defire of refemblance, together with a joy fpringing from the hope of fuccefs.

The word comes originally from the Greek αμιλλα, *difpute, conteft;* whence the Latin *æmulus*, and thence our emulation.

Dr. Hartley refers emulation to a clafs of the fympathetic affections, by which we grieve for the happinefs of others; and Dr. Reid, in his "Effays," (p. 167,) defines it as a defire of fuperiority to our rivals in any purfuit, accompanied with an uneafinefs at being furpaffed. He claffes it, together with refentment, under the head of the malevolent affections, which, though they are parts of our conftitution, given us by our Maker for good only, and, when properly directed and regulated, of excellent ufe, are neverthelefs fubject to excefs or abufe, and thus become the fource and fpring of all the malevolence that is to be found among men. From the obfervations which he has introduced for the illuftration of this affection, he infers, that emulation, as far as it is a part of our conftitution, is highly ufeful and important in fociety; that in the wife and good, it produces the beft effects without any harm; but in the foolifh and vicious, it is the parent of a great part of the evils of life, and of the moft malignant vices that ftain human nature.

Plato obferves of emulation, that it is the daughter of envy; if fo, there is a great difference between the mother and the offspring; the one is a virtue, and the other a vice. Emulation admires great actions, and ftrives to imitate them; envy refufes them the praifes that are their due; emulation is generous, and only thinks of furpaffing a rival; envy is low, and only feeks to leffen him.

Perhaps, therefore, it would be more juft to fuppofe emulation the daughter of admiration: admiration, however, is a principal ingredient in the compofition of it.

EMULGENT, in *Anatomy*, a term applied to the blood-veffels of the kidnies. See Arteries and Veins.

EMULSION, from *emulgere*, to milk, in *Chemiftry* and *Pharmacy*, is any milky opake liquor formed by the diffufion of any oily or refinous matter in water, through the medium either of alkalies, or of mucilage, or any other vifcid matter foluble in water.

Milk itfelf is a natural emulfion, and when viewed in a powerful microfcope is feen vifibly to confift of oily particles fufpended in a ferous liquor. Many vegetable matters form natural emulfions when merely triturated with water, of which kind are almonds, and moft of the oily nuts, the oil being held fufpended by the mucilage or farina with which thefe fubftances naturally abound.

All the oils are rendered mifcible with water, when rubbed with mucilage of gum arabic, or with the yolk of egg, or with a fmall quantity of any alkaline falt, and all thefe mixtures are common in pharmacy. Thick fyrups alfo promote the diffufion of oily matters in water, but lefs perfectly.

This combination, however, is but temporary, as all the emulfions are decompofed by mere reft for fome hours, and as befides they are very apt to ferment, they are only ufed in extemporaneous prefcription.

The common emulfion, now called "Lac Amygdalæ," is made by beating an ounce and a half by weight of fweet almonds, with half an ounce by weight of double refined fugar, in a marble mortar, and rubbing them well together; adding gradually the quantity of two pints of diftilled water, and ftraining the liquid. If two ounces and a half of the mucilage of gum arabic are added to the almonds whilft they are pounded in the mortar, we fhall have the arabic emulfion. Thefe emulfions may be ufed as ordinary drink, in cafes which require foft cooling liquors. The camphorated emulfion is prepared by grinding half a dram of camphor, and half a dozen fweet almonds together in a ftone mortar, and adding by degrees eight ounces of mint water, ftraining the liquor, and diffolving in it half an ounce of white fugar. A table fpoonful of this emulfion may be taken in fevers, and other diforders which require the ufe of camphor, every two or three hours.

The emulfion of gum ammoniac is made by grinding two drams of the gum with eight ounces of water poured gradually upon it till it is diffolved.

This emulfion is ufed for attenuating vifcid phlegms, and promoting expectorations. In obftinate coughs, two ounces of the fyrup of poppies may be added to it. It may be adminiftered in a dofe of two table fpoonfuls, three or four times a day. The oily emulfion, prepared by mixing fix ounces of foft water with two drams of volatile aromatic fpirit, and an ounce of Florence oil, and half an ounce of fimple fyrup, is ferviceable in recent coughs: in more obftinate coughs, it will be better to fubftitute for the aromatic fpirit the paregoric elixir of the Edinburgh Difpenfatory. A table-fpoonful of it may be taken every two or three hours.

EMUNCTORY, in *Anatomy*, from *emungo*, to clean or wipe the nofe, is any part of the body, which feparates from the blood humours judged to be impure or excrementitious, and therefore hurtful. This procefs is fuppofed to purify the blood. The kidnies and fkin are called the common emunctories, as they afford very copious fecretions. This notion of the feparation of noxious particles is built on the opinions of the older phyfiologifts; and confequently the ufe of the term emunctory has at prefent nearly ceafed.

EMUNGS, in *Geography*, one of the Pelew iflands.

ENABY, a town of Sweden, in the province of Eaft Gothland; 20 miles S. of Linkioping.

ENADA, in *Ancient Geography*, a town of Paleftine, in the tribe of Iffachar, according to the book of Jofhua.

ENÆMON, Εναιμον, from αιμα, *blood*, an external medicine which ftops or ftanches the blood; or which, by binding, cooling, or drying, clofes the paffages of the veffels before open, or diminifhes the fluidity and motion of the blood. See Styptic.

ENÆOREMA, Εναιωρημα, from αιωρω, *to exalt*, expreffes fuch contents of the urine as float about in the middle, refembling a cloud; and thence alfo called nubecula. See Urine.

ENAGARA, in *Ancient Geography*, an ifland of Afia Minor, in the Mediterranean fea, placed by Pliny overagainft Lycia, and near the ifle of Crete.

ENAIM, a town of Judea, in the tribe of Judah, according to the book of Jofhua.

ENALLAGE, in *Rhetoric*, a figure whereby we change and invert the order of the terms in a difcourfe, againft the common rules of language.

The word is derived from the Greek, εναλλαγη, formed of εναλλαττειν, which fignifies *to change*, as well as the fimple verb αλλαττειν.

The grammarians too have a kind of enallage, whereby one part of fpeech, or one accident of a word, is put for another.

Such is the change of a pronoun, as when a poffeffive is put for a relative, *e.gr. fuus* for *ejus;* or of a verb, as when one mood or tenfe is put for another.

ENALURON, in *Heraldry*, is ufed by Guillim to exprefs a bordure charged with birds; as an enaluron of martlets,

martlets, &c. but Mackenzie charges this as a miſtake ariſing from ignorance of the French tongue; enaluron properly ſignifying orle, or in manner of a bordure, and being applicable to a bearing of any thing in that form.

ENAMBUSH, in *Military Affairs*, relates to a device uſed for the purpoſe of ſurpriſing an enemy, either on his route, or when purſuing a ſmall body of troops ſent out for the purpoſe of decoying him into the ſnare. This inſidious practice is often of conſiderable ſervice in the minor branches of warfare, but can rarely be practiſed on a great ſcale; though hiſtory furniſhes us with inſtances of armies having been taken by ſurpriſe, owing to the cunning of their adverſaries, in lying concealed in ſuch places as enabled them to take advantage of an unſuſpecting commander. This, however, is not what in ſtrictneſs is termed an *ambuſh*. That term more properly is confined to that kind of preconcertion, which rather leads an enemy into the danger, by ſome ſuppoſed advantage held out to his acceptance, whether it be for forage, the ſeizing of a depot, the interception of a convoy, or the attack upon ſome weak poſt. Here we ſee an immenſe field open for contrivance and ſpeculation. It is to be underſtood, that when a body of troops is placed in ambuſh, certain intelligence has been obtained of the numbers, route, and object of thoſe who are to be intercepted. If theſe be not previouſly aſcertained, the ambuſcade may prove fatal: ſince, ſhould it turn out that, inſtead of five hundred, five thouſand were to be attacked; that, in lieu of their being foragers laden with booty, they ſhould prove to be a body of light horſe, with riflemen at their backs; or that, inſtead of being a detachment ſent to ſurpriſe ſome ſmall outpoſt, they ſhould be the advanced guard of a ſtrong column:—in either of theſe caſes, a ſad reverſe would take place; for, although at the firſt bruſh, there might be ſome ſurpriſe, and poſſibly ſome confuſion, it would in all probability be but for the moment; after which the aſſailed party would preſs forward with great eagerneſs, and by means of their flanking parties cover the ſpeculators with diſgrace and ruin. The moſt deadly kind of ambuſcade is that wherein fire-arms are rejected, the whole depending upon pikes and cutlaſſes: in ſuch, ſilence is an important object, even in the very moment of falling upon the enemy. This not only prevents the other parts of the line from being able to aſcertain the exact ſituation of the aſſailants, as may always be done by obſerving the flaſhes from muſketry, &c.; but renders it impoſſible to aſcertain their numbers. Add to this, that when men fire, in the dark eſpecially, at a moving object, they are by no means certain of their aim; nor can they ſo ſpeedily recover themſelves, after their pieces may have been diſcharged. Beſides, it is well known that pikes cauſe infinite conſternation, when coming to cloſe quarters; being much longer than the muſket with the bayonet attached, they are infinitely more deſtructive, when properly uſed in this ſpecies of warfare. In many countries, it is next to impoſſible to enambuſh the enemy; while, in others, almoſt every ſpot affords the means of concealment. The great art is, to avoid all common-place modes of laying *perdue*: ſuch are rarely ſucceſsful, owing to that invariable attention paid towards the examination of every ſuch ſuſpicious ſituation. On the other hand, thoſe parts which are leaſt ſuſpected often prove particularly formidable; but where ſuch are reſorted to, the means of retreat, or at leaſt of defence, ought to be fully eſtabliſhed. Thoſe ambuſcades which are the moſt collected, always carry the greateſt probability of ſucceſs: they are leaſt liable to detection, far more pointed in their attack, and moſt calculated for reſiſtance, when prematurely diſcovered. Cavalry is rarely employed in ambuſhes, though a conſiderable body may, if convenient, be poſted in a proper direction, for the purpoſe of ſupporting the infantry concealed in woods, &c. On ſome occaſions, it is even advantageous that ſuch cavalry ſhould be viſible, but in an oppoſite quarter; ſo as to cauſe the force to be attacked to be concentrated, by calling in their ſcouts and videttes; by which thoſe in ambuſh might elſe be diſcovered. This device likewiſe occaſions the baggage to be ſent upon the other flank, out of the way of the cavalry, and leaving that flank towards them free from incumbrance. When this happens, and that the cavalry make a ſhew of charging, the baggage will commonly fall into the hands of thoſe in ambuſcade. Naval ambuſcades are by no means uncommon: it often happening that a well-concerted decoy lures an enemy into ſuch a ſituation as at leaſt places him under conſiderable diſadvantage, or eventually cauſes him to ſurrender. Thus, diſguiſing veſſels by means of new painting; changing their mode of rigging; appearing to avoid rather than to purſue; ſending out a ſlow ſailing veſſel to paſs between a cruiſer and an iſland, behind which a ſuperior force is concealed, &c. &c. are all *ruſes de guerre* in common uſe. One device, which probably would otherwiſe be often practiſed, is contrary to the laws of honour and the rules of war, namely, making ſignals of diſtreſs, with the view to draw an enemy's veſſel to give aſſiſtance, and then to capture her. To aſſume the appearance of being damaged, either by weather or by action, is all fair; becauſe then the enemy bears down as upon a prey, and not as a protector. However, the practice of enambuſhing, whatever advantages it may ſeem to offer, is ſubject to extreme danger: unleſs guided by the moſt certain knowledge of the force to be ſurpriſed, it becomes almoſt invariably a loſing concern, and has the pernicious tendency of creating great diffidence in the conduct of that commander by whoſe inſtructions it is made. Nor can the ſmalleſt ſucceſs be hoped for, unleſs where the peaſantry are friendly diſpoſed, and the country around thoroughly known.

ENAMEL, in *Anatomy*, the hard ſubſtance which covers the crown of the tooth. It is deſcribed in the account of the teeth, contained in the article CRANIUM.

ENAMEL, in the *Arts*. Enamels are vitrifiable ſubſtances, and may be arranged into three claſſes, *viz.* tranſparent, ſemi-tranſparent, and opaque. The two former are chiefly employed in enamelling on gold and ſilver, for watch-caſes, trinkets, and other ſmall articles of jewellery; the latter is principally uſed on copper, for the making of clock and watch-dial plates, and for other plates which, when properly fluxed, are fit for the purpoſe of enamel-painting.

The baſis of all kinds of enamel is a perfectly tranſparent and fuſible glaſs, which is rendered either ſemi-tranſparent or opaque, by the admixture of metallic oxyds. White enamels are compoſed by melting oxyd of tin with the glaſs, and adding a ſmall quantity of mangneſe, to increaſe the brilliancy of the colour. The addition of oxyd of lead, or antimony, produces a yellow enamel; and Kunckel affirms that a beautiful yellow may be obtained from ſilver. Reds are formed by an intermixture of the oxyds of gold and iron; that compoſed by the former being the moſt beautiful and permanent. Greens, violets, and blues, are procured from the oxyds of copper, cobalt, and iron; and theſe, when intermixed in different proportions, afford a great variety of intermediate colours. Sometimes the oxyds are mixed before they are united to the vitreous baſes. Such are the principal ingredients employed in the production of the various enamels; but the proportions in which they are uſed, as well as the degree and continuance of the heat

heat neceſſary to their perfection, conſtitute the ſecrets of the art. Other ſubſtances than thoſe here mentioned are occaſionally uſed in the compoſition of enamels; and it has been ſaid, that the peculiar quality of the beſt kinds of hard or Venetian enamel is owing to the admixture of a particular ſubſtance found on mount Veſuvius, and known to be thrown up by that volcano.

The work of Neri on glaſs, with the notes of Merret and Kunckel, afford many good precepts for making enamels; yet the exact nature and methods of compoſition of the beſt kinds, both of the hard and ſoft enamels, ſtill remain among the arcana of enamelling. The ſoft white enamel is generally called glaſs, and is manufactured at the glaſs-houſe, near the ſite of the Albion mills, on the Surrey ſide of Blackfriars-bridge; the hard enamels are chiefly made at Venice, and, from the operations of the war, are not at preſent to be procured in London. In conſequence of this, the beſt enamel, which formerly, when ſmuggled into the kingdom, has been ſold as low as from 2*s.* to 2*s.* 6*d.* *per lb.*, and even when the duty has been paid at the Cuſtom-houſe, at from 3*s.* to 4*s.*, has progreſſively advanced to a guinea, and from that to 50*s.*; and it cannot now be obtained at any price.

Enamel-*Painting.* See Painting *on Enamel.*

ENAMELLING. The art of enamelling is of great antiquity, but of unknown origin. That it was practiſed by the Egyptians is evident, from the remains that have been obſerved on the ornamental envelopes of mummies. From them it probably paſſed to the Greeks, and afterwards to the Romans, who appear to have introduced the art into this country; as various Roman antiquities have been dug up in different parts of Britain, in which enamels have formed portions of the ornaments. That the Britons received the art from their conquerors may be conjectured from the circumſtance of enamelled trinkets having been found in Britiſh barrows. That the Saxons practiſed it is certain, from the jewel found at Athelney in Somerſetſhire, and now preſerved at Oxford; which jewel, as appears by the inſcription, was made by command of the great Alfred. The gold cup, given by king John to the corporation of Lynn in Norfolk, proves that the art was not loſt under the Normans; for the ſides of that cup are embelliſhed with various figures, whoſe garments are partly compoſed of coloured enamels. The tomb of Edward the Confeſſor in Weſtminſter Abbey, conſtructed in the reign of Henry III., was alſo ornamented with enamels, pieces of which ſtill remain. The beautiful crozier of the celebrated William of Wykeham, of the time of Edward III., may be alſo adduced as exhibiting ſome curious ſpecimens of the application of this art: and other examples might be pointed out, of its progreſſive deſcent to our own age.

It would ſeem from the above brief review, that anciently enamels were principally applied to the purpoſes of ornament; but ſince the invention of clocks and watches, their uſefulneſs has been proportionally increaſed. For clock and watch dials there is probably no ſubſtance that could be ſubſtituted, that can equal enamel in permanence and beauty: in ſeveral reſpects, it poſſeſſes advantages even over the rich metals of ſilver and gold. Within the laſt 30 or 40 years, an *imitative enamel* has been uſed, and, through the ſcarcity of real enamel, is now in much demand for clock plates; but it is by no means comparable with its prototype: for, being chiefly compoſed of flake white, ground up with ſpirits of turpentine, and afterwards mixed with copal varniſh, it will neither aſſume an equal brilliancy in colour, nor continue unchanged in different climates; on the contrary, the action of the air occaſions it to become dingy and yellow. In fact, imitative enamelling is nothing more than a branch of the art of *japanning;* which ſee.

The proceſſes of enamelling have never been accurately deſcribed. The jealouſies that exiſt in all arts in which any thing like a ſcientific knowledge is wanting, operate to ſecluſion. The practitioner conceals his information from motives of profit, and the amateur ſeldom acquires an inſight ſufficiently minute to enable him to unfold the modes of operation. Whatever may be the defects of the preſent attempt, it will be found to contain a better account of the practical branches of the art than has before appeared.

Enamels are commonly laid upon a metal ground, yet they have been ſometimes uſed in ſubſtance, for diſhes, flower-pots, ornamental veſſels, figures, vaſes, &c. In theſe caſes, the enamel is run into moulds immediately from the pots in which it has been melted. The metals employed to enamel on are gold, ſilver, and copper. Of the other metals, ſome are too fuſible to endure the action of the fire, and the remainder, as platina, &c. are, to uſe the language of the art, too *ſtrong*, for the enamel: that is, the adheſion between the two ſubſtances is not powerful enough to keep them together, the enamel cracking as it grows cold, and flying off the metal in flakes. It appears, therefore, that a certain, however ſlight, degree of oxydation is neceſſary to make the enamel and the metal unite with ſufficient firmneſs. Gold is unqueſtionably the beſt ſubſtance to enamel on, its richneſs of colour ſhowing a beautiful tinge through the enamel: yet the metal generally uſed, except for watch-caſes, and valuable articles of jewellery, is copper; and that on account of its ſuperior cheapneſs. Both the gold and the copper ſhould be of the finer kinds, the others being too refractory to agree properly with the enamel.

By the cuſtom of the trade, rather than from any principle of utility, enamelling is now divided into two branches, *viz.* dial-plate enamelling, and tranſparent enamelling. The former includes the manufacture of clock and watch plates, with fluxed plates for enamel painting, the latter comprehends the enamelling of watch caſes, broaches, pins, and other bijoux: of late years the making of theſe leſſer articles has gradually grown into great diſuſe in this country.

Dial-Plate Enamelling, conſiſts of the two diviſions of hard-enamelling, and ſoft, or glaſs enamelling; in the firſt branch, the Venetian enamels only are employed, in the laſt, the Engliſh or glaſs enamels. The practice of hard-enamelling requires more ſkill, time, and labour than the others, and is conſequently eſteemed the moſt. In preparing the metals to be enamelled on, whether of gold, ſilver, or copper, the proceſs is ſimilar; one deſcription will therefore ſuffice for the whole:—and firſt of the making of watch dials.

The copper being evenly flatted in long ſlips (which is done at the flatting mills between ſteel rollers) and to a proper thickneſs, pieces are cut off for uſe according to the ſize wanted. They are then annealed in a clear fire, in order to make them ſufficiently pliable to take the required forms which is given to them by means of dies. The dies are ſmall circular plates of braſs evenly turned, varying in thickneſs, perhaps, from the ſixteenth of an inch to an eighth, or more, according to their diameter. Some of them are flat, others are hollowed out for the purpoſe of giving a ſlight curve to the *copper*, as the metal to be enamelled on is technically termed when prepared for uſe: the edges of the dies are turned off in an oblique direction, and in the centre is a ſmall hole, rather larger than that which is wanted in the dial-plate. A complete ſet of dies varies in ſize from about three-fourths of an inch to two inches and a half, the gradations being very ſmall, perhaps not

not more than the thirty-fecond part of an inch between each.

The copper being cut with a pair of fciffars nearly to the fize required and properly annealed, is next placed on the die beft adapted for the purpofe, and the eye, or centre hole, is made. This is effected by firft forcing up the copper into the hole of the die with a fmall round-headed punch ; by this means a fmall concave bulge is formed, the upper fide of which is then filed through with a fmooth grained file ; it is then again placed on the die, and preffed gradually open till it nearly fills the hole with an oval burnifher ; it is afterwards preffed tighter into the hole with a round broach, the burr being occafionally taken off by the file, and care employed to prevent the eye from cracking. The punch, burnifher, and round pin, are all of fteel ; the two latter taper in regular gradation towards the handles.

When the eye is completed, the edge of the copper is cut round, fo as to leave a fmall part, probably about the thirtieth of an inch, projecting beyond the die. The projecting part is then turned up, or burnifhed, againft the edge of the die, the copper being firft laid fmooth and flat by the burnifher. The turned-up edge of the copper is afterwards filed evenly round, and reduced to the proper height, according to the thicknefs of the brafs-edge, or rim, to which it is to be fixed when in the watch. The infide burr is then fcraped off with a graver, and ftill further cleared away by means of a fcratch-brufh : this latter tool is compofed of fmall brafs or fteel wire tied together in a round bundle, about the fize of the little finger. The purpofe for which the eye of the copper is formed, and the edge turned up, is to retain the enamel in its proper place, fo that the plate may be finifhed both fquare and neat.

According to the kind of watch to which the dial is to be applied, the copper, if for a feconds watch, muft be kept almoft flat ; or if for a watch where a greater fpace is wanting beneath, to give more fcope for the wheels, muft be raifed from the edge to the centre in a regular and exact manner. To effect this a fmall circular block or fetting die is ufed, made of box or other hard wood turned out to the neceffary degree of concavity, and having a hole in the middle to receive the eye of the copper when placed within the hollow of the block. The copper is then gradually fet up to the convexity or height required by rubbing it gently yet firmly with a bent, or fetting fpatula, formed of a thin flip of fteel, about five inches long, properly fixed. It is now ready to have the feet foldered on, by which it is to be pinned down to the brafs edge or frame of the watch ; and the places for the feet being marked on the back of the copper, through the holes drilled for the purpofe in the edge or frame, the feet are prepared for foldering.

The feet are always of wire of the fame kind of metal as that to be enamelled on, and the wire is drawn into different thickneffes, proportioned to the fize of the intended dial-plate ; thus varying perhaps from the tenth to the fixteenth of an inch. In the more common kinds of enamelling, the feet are generally cut off from filvered wire, that is, copper wire plated with filver ; the filver itfelf forming the folder when the feet and copper are expofed to the united action of the lamp and blow-pipe. In the beft kind of work plain copper wire is ufed, and the feet are faftened to the copper by means of fpeltre, or of filver folder. When fufficient care is exercifed, either of thefe modes is equally appropriate, but the feet foldered on with fpeltre take the firmeft hold ; thofe with the filvered wire the flighteft. The feet are evenly filed, either to a flat face, or an angular one, according to the defcription of copper for which they are wanted ; and are cut off the wire into proper lengths by a pair of cutting-pliers or nippers. In order to make the feet remain in their places, and facilitate the foldering, the end of each foot, before putting it on the copper (which is done by means of a pair of corn-tongs or tweezers), is dipped into a flight wafh of borax and water, through which it adheres with fufficient force to admit of its being expofed to the power of the blow-pipe. The lamp in common ufe contains from a pint to a quart of oil, and has a cylindrical fpout projecting about three inches, and being an inch or more in diameter. This fpace is filled with cotton, which being lighted, a good ftrong flame is produced. The copper is carefully placed upon a piece of folid charcoal, long enough to be held in the hand, and the flame being then propelled by the blow-pipe againft the folder, or filvered wire, as the cafe may be, the feet are firmly united to the copper. In this operation, attention muft be given to the exact degree of heat required to fufe the folder, for fhould it be too powerful, the copper itfelf will melt at the fame inftant : care muft be taken alfo that all the feet keep in their due places, otherwife the copper will not fit properly, and the feet muft either be cut off, and new ones foldered on, or much trouble will be found in drawing the holes of the brafs-edges or frames, to get the coppers into their proper centrical fituations.

The copper being thus far advanced is thrown into the pickling-pan, in order to free it from the fcale or oxydable covering acquired from the heat. The *pickle* is either oil of vitriol, fufficiently neutralized for the purpofe by water, or elfe a folution of the beft double aquafortis. When the fcale is enough foftened to admit of its being removed by a foft brufh, ufed with water and a little white fand, the copper is taken out of the pickle, and all the impurities being wafhed away, it is dried by means of heat, or elfe with a foft cloth. In this ftate, the copper will generally require to be again put into a proper fhape, by means of the brafs die, and fetting block, as it is fcarcely poffible but that fome irregularities will be produced through the operations laft defcribed. It is alfo hardened in a flight degree by rubbing the under fide with the fetting fpatula, and the furface with the fcratch-brufh. When this is done, the copper is completed, and fit to be enamelled on. It is to be remarked, that when many coppers are prepared at once, much time is faved by turning off the edges by means of the lathe and arbour, inftead of by filing them even in the manner detailed above.

The above are the methods by which the common coppers are prepared ; it is now requifite to defcribe what are called *French edges*, from their having been firft made in France. Thefe are of two kinds, the folid French edge and the laid-down French edge. To make the former, a piece of copper is taken, either about a fixteenth or a twelfth of an inch thick, according to the diameter of the intended plate, and a hole being drilled in the centre, the copper is placed upon an arbour, and fixed tightly by means of a fmall cone and fcrew-nut fitted to the maundrel. The arbour being then fixed upon a lathe, the edge of the copper is next turned off in an oblique direction, inclining inwards, with a graver, and the copper is then reduced to the proper thicknefs for enamelling from the edge to the centre, by means of a fcorper and other tools ; thus leaving the edge folid, and taking care alfo that a fufficient fubftance is left unreduced round the cone, to form the outer circle of the eye. The laid-down French edge is made by preparing a copper in the common way from a thin flip, the edge being left rather higher than ufual, and then fixing it upon the arbour, when the edge of the copper being firft turned perfectly even with a graver,

graver, is next forcibly bent inwards by a fmall triangular tool, (perhaps formed from the end of a three-fquare file worn fmooth,) and afterwards fquared and finifhed by the graver and fcratch-brufh. It is in general neceffary to reverfe the coppers on the arbour, and turn a fmall portion of the under fide away, both of the folid and laid-down kinds, in order to make the edge of a due fharpnefs. The coppers are laftly fet up, and the feet foldered on, as before defcribed. French edges are moftly ufed for watches of a particular kind, where room is wanting, and the dials are fixed upon the frames without a brafs-edge.

When a dial is made for a feconds' watch, or for one requiring ftill more circles than two, the additional eye, or eyes, is made by marking the centres accurately with a point on the under fide of the copper, and then bulging the copper upwards with a fmall punch from each centre, by ftriking it gently with a fmall hammer into a piece of lead, about three times the thicknefs of a die; the lead forms a fufficient refiftance to prevent the eye from cracking, and is yet foft enough to admit of the copper being bulged up evenly. The fmall eyes are afterwards evened with the file, and opened with a fmall needle or round-pin to the required fizes. Some trivial variations in the mode of making the feconds' holes, &c. occafionally occur.

The coppers being thus prepared, the next procefs is that of *enamelling*, properly fo called. Where the operations of *hard* enamelling, and *glafs* enamelling, are diffimilar, the difference will be defcribed in proceeding, but to a certain extent they are the fame.

The enamel, as it comes from the makers, is generally in fmall cakes from four to five or fix inches in diameter. In preparing it for ufe, a fmall hammer is ufed, having one end flat, and the other of the fhape commonly employed to rivet with. With this the enamel is broken into thin pieces or flakes, by ftriking the edge of the cake fmartly as it refts upon the fore finger of the left-hand. The pieces are then put into an agate mortar, and with a peftle of the fame kind are finely pulverized, the fplinters being prevented from flying about, by keeping the enamel covered with pure water all the time the procefs of *grinding* is going on. The point at which the trituration fhould be difcontinued, can only be afcertained from experience, as the different kinds of enamel, and the different modes of its application, require the *ground* enamel to be either more or lefs fine. In general it may be ftated, that the *backing* fhould be much finer than the *firft coat;* the *fecond coat* of an intermediate finenefs; the hard enamels confiderably finer than the glafs, and the flux ftill finer than thofe, as the fire operates with lefs effect upon the flux than upon either of the former fubftances. In grinding, great care muft be taken to keep the enamel free from dirt, and the light flue which arifes muft be wafhed away three, four, or more times, as may be neceffary in the courfe of the operation, till the water comes off quite clear. A fmall tea-pot is commonly ufed to pour the water from, and when the enamel is ground fufficiently, the produce is emptied into fome other fmall cup for ufe, the furface being kept juft covered with water.

The manner in which the grinding is performed, is by placing the mortar upon the work-board, on a coarfe piece of flannel or linen, twice or thrice doubled, and wetted to prevent its flipping. The handle of the peftle is then grafped firmly about the middle with one hand, and the palm of the other being placed upon the top, the operator inclines the upper part of his body over the mortar, and crufhes the enamel by preffing forcibly with his breaft upon that hand which covers the peftle. This motion is repeated in quick fucceffion, till all the larger pieces are reduced into coarfe and uneven grains; which grains are afterwards ground to the requifite equality and finenefs, by holding the mortar firmly down with one hand, and with the other giving a circular direction to the peftle, ufing at the fame time as much ftrength as can be conveniently exerted.

In enamelling watch dials, many coppers are ufually prepared to go on with at once; that method poffeffing the three-fold advantage of faving time, materials, and labour. When the enamel is ground, therefore, the coppers having been firft cleanfed by the pickle, and carefully brufhed out with water, are fpread, face downwards, over a foft half-worn cloth, or fmooth napkin, and a thin layer of hard enamel, called, in its ground ftate, the *backing*, is fpread over the under fides with the end of a quill, properly cut, or with a fmall bone fpoon. The coppers are then flightly preffed on by another foft cloth or napkin, which, by imbibing fome portion of the water, renders the enamel fufficiently dry to be fmoothly and evenly fpread with the rounded fide of a fteel fpatula. The water is then again dried out by the napkin, and a yet further evennefs produced by going over the enamel as before, with the fpatula, and thefe operations are repeated, till the back becomes completely fmooth, and the enamel is of an equal thicknefs all over. It muft be obferved, that the water fhould not be *entirely* abforbed, as in that cafe the enamel would fall off, in powder, before the fubfequent operations are completed. When the enamel is properly fpread, the loofe particles are carefully cleared away from the edge and eye of the coppers; from the former by the fpatula, from the latter by twifting round it the pointed end of a quill, and the procefs of *laying the bottoms* is thus finifhed. Some flight variations to the above method are in ufe among different artifts, but the difference is fcarcely important enough to require defcription. In fome inftances the enamel is laid on with the fpatula itfelf, and the coppers, inftead of being held between the fingers, are placed upon the round pin, by means of the centre holes, till the backs are duly fpread: in both modes due care muft be taken that the coppers are not bent out of their proper forms.

The next operation is to lay the *firft coats;* that is, to fpread a layer of *glafs* enamel over the upper fides of the coppers. In doing this, the furface is firft brufhed flightly over with a fmall camel-hair brufh, or a hare's foot, to remove any dirt or extraneous particles of enamel, as the mixture of any hard enamel with the glafs would infallibly fpoil the work. The glafs is then fpread upon the coppers in a layer, the thicknefs of which is commonly the fame as the height of the edge and eye. The water is afterwards flightly abforbed with a clean napkin fmoothly folded, and the enamel fpread by a thin, flat fpatula, till all unevennefs is removed, and the furface lies regularly from edge to centre. The edge being then gently tapped twice or thrice at different places with the fpatula, the water rifes towards the top, and is again dried off by the napkin, when the enamel is once more made fmooth by the fpatula, and the water being wholly taken up by the napkin, or as nearly fo as can be effected, without difturbing the enamel, the *firft coats* are placed upon rings for *firing*.

The rings ufed in enamelling are generally made of a mixture of pipe-maker's clay and Stourbridge clay, rolled up into the form of cylinders, and turned in a lathe by means of a cylindrical piece of wood forced through the centre of the mafs when wet. Each ring is about a quarter of an inch in thicknefs, and the fame in depth; the upper fide is prepared for ufe by rendering it flightly concave, which is done by rubbing it carefully upon a half globe of lead fprinkled over with fine filver fand: the under fide is nearly flat. Through the concavity thus given to the rings, the

the edge of the copper or dial-plate only is ſuffered to touch, by which means the enamel on the back remains undiſturbed, and the edges are prevented from ſticking by rubbing over the ſurfaces of the rings with ſoft chalk or whiting.

The firſt coats having been placed carefully upon the rings, are next put into a ſhallow tin veſſel, called a tin cover, which is either made ſquare or round, according to the fancy of the artificer, and is commonly about three quarters of an inch in depth. All the moiſture is then ſlowly evaporated from the enamel, by placing the cover upon a German ſtove, or in ſome other convenient ſituation near a fire, where the evaporation can be properly regulated: for, ſhould the water be dried off too quickly, the work would be in danger of ſpoiling from *blebs* or *bliſters*. Theſe are very ſmall air-bubbles, which, by riſing to the ſurface of the dial-plates, deſtroy their ſmoothneſs and beauty. They appear to be occaſioned, partly by want of due care in laying on the enamel, and partly by the confinement of the air which the water contained, and which, in the proceſs of firing, becomes rarefied; throwing off, by its expanſion, a portion of the ſurrounding enamel, yet not entirely eſcaping without a very vivid heat, and even then reſolving into black or green ſpecks, ſo coloured through the oxydation of the copper.

The *firing* is executed beneath a muffle, placed in a ſmall furnace ignited with coke and charcoal. (See Muffle and Furnace *Enamellers*.) The furnace being drawn up to a ſufficient heat by means of a regiſter, the firſt coats are taken ſeparately from the tin covers, and placed upon thin planches of clay, or iron, chalked over, and gradually introduced beneath the muffle; where, in a very ſhort time, the enamel melts, or technically *runs;* and becoming properly conſolidated, the firſt coat is complete. Great attention is requiſite in this operation, to prevent the enamel from being over-fired; as in that caſe, the glaſs would loſe ſome portion of its opacity, and other defects alſo be produced, to the detriment of the work. The planches are placed towards the further extremity of the muffle, by means of a pair of ſpring tongs; and as ſoon as the fuſion is ſeen to take place, are turned carefully round, in order that every part ſhould be equally fired. The planches are generally made circular, and ſlightly concave, for the convenience of moving the work without danger of ſhaking off the enamel before it becomes fixed by the heat.

As all ſolids, when reduced to a granulated ſtate, occupy a greater ſpace than before, *et vice verſâ*, it will be found, that a very conſiderable depreſſion has been produced in the enamel of the firſt coats by the act of fuſion; and that the edge and eye are now much above the ſurface. This deficiency in ſubſtance it is the office of the *ſecond coats* to ſupply. When the work is cooled, therefore, the ſcale is wholly removed from the edges and eyes by means of a fine-grained Lancaſhire file, or a ſmooth grey-ſtone; and being then waſhed and dried, each plate is put upon a ſmall round wax-block, of ſufficient bulk to be held in the hand, and about four or five inches high. The feet are then either preſſed firmly into the wax which covers one end of the block, or the plate is otherwiſe fixed by means of three ſmall cones of wax placed triangular-wiſe upon the block; care being taken not to ſtrain the enamel by too weighty a preſſure. A ſecond layer of ground enamel is then gently ſpread with a quill, and prepared for firing by the napkin and ſpatula as before; after which the ſecond coats are placed upon the rings, and the moiſture being evaporated in the tin-cover, (one edge of which, both in this and in the preceding operation, ſhould be left a little open to give iſſue to the ſteam,) they are ready for a ſecond fire.

The ſecond firing requires an equally cautious management as the former one. The plates muſt not be over-fired, nor muſt the heat be ſuffered to melt the enamel too rapidly; but a kind of rotatory motion, called *coddling*, muſt be given to the work, by holding the loaded planch lightly with the tongs, and gently drawing the edge of it towards the mouth of the muffle, and then returning it to its former place, till the fuſion be complete; a proper knowledge of which can be gained only from practice. The work is now in a fit ſtate for poliſhing.

Poliſhing, in this art, has a twofold ſignification: it not only means to render bright, according to the common acceptation of the term; but alſo to make even, without any reference to gloſſyneſs. The enamel has a natural brightneſs of ſurface acquired from the fire; and when this is removed, it is only neceſſary again to expoſe it to a due heat, to cauſe it to reaſſume its former character. Yet as this brightneſs exiſts independent of evenneſs, and as evenneſs is eſſential to the perfection of enamelling, it is requiſite, in moſt caſes, to produce that quality by the methods next to be deſcribed.

The materials uſed in poliſhing glaſs plates are grey-ſtones, rag-ſtones, ſometimes called burrs, fine ground ſilver ſand, and water. The grey-ſtones ought to be of a fine grain and even texture, without knots, which would be very detrimental by making deep ſcratches in the enamel, inſtead of wearing it away evenly. The plates are taken ſeparately, and the thin edges are firſt worn off by one of the finer grey-ſtones, till they become ſmooth and equal; after which the eyes are rubbed down, till the centre of each plate is even and ſquare. Either the grey-ſtone or the rag-ſtone is next employed, according to the nature of the work, to wear away all the irregularities that may exiſt on the ſurface of the enamel; the rag-ſtones being only uſed for the more common kinds of dials. This is done in different ways; *viz.* firſt, either by holding the plate upon the fore and middle finger of one hand, and giving it a ſort of circular motion by means of the thumb, whilſt with the other hand the poliſhing-ſtone is rubbed with a forward and backward ſtroke over every part of the ſurface; ſecondly, by holding the poliſhing-ſtone on the work-board with one hand, and with the other rubbing upon it the face of the enamel; or, thirdly, by fixing the plate upon a cork, either by means of the feet, or with a piece of wet flannel, and with the fingers giving it a kind of rotatory motion, whilſt the poliſhing-ſtone is rubbed over it in a ſimilar manner. The ground ſilver ſand is uſed to give ſharpneſs to the poliſhing-ſtones, and wear away the enamel with greater celerity than would be otherwiſe acquired; and the act of poliſhing is continued till all the gloſs is ground off the ſurface. In this operation great care muſt be taken that the preſſure be not too powerful, as the plates will then crack in the fire, and can never, or very rarely, be properly mended.

When the enamel is ſufficiently poliſhed, which is eaſily known by the criterion of all the gloſs being removed, the plates muſt be clean waſhed, and the ſpecks of dirt, &c. picked out with a ſharp graver. They are then well rubbed over with ſome fine ground glaſs, either by means of a cloth, a glaſs mull, or perhaps a ſmall bit of fir-wood cut ſmooth, in order to remove the ſtains that may be left by the poliſhing-ſtones; and the clean water being ſuffered to run over them, they are wiped dry, and again placed upon the rings for firing.

The

The degree of heat neceffary for polifhed plates is determined by the finer or coarfer modes in which they were prepared; as the fufion is much facilitated by the enamel being free from fcratches. When the furface is properly run, that is, when it becomes perfectly fmooth, even, and bright, the plate is completed; and when cold, is fit for painting on. See PAINTING *of Clock and Watch Dial-Plates*.

The above defcription regards more particularly the beft kinds of work; but for the more common work there are two other modes of enamelling practifed, which it will be requifite briefly to explain. The plates made in thefe ways are called *run-down plates*, and *run-down fecond coats*.

Run-down plates are thofe which are made by laying the enamel upon the coppers in fufficient quantity to form plates of the required thicknefs, without putting on a fecond coat. Both labour and fire are thus faved; but that neatnefs, regularity, and fquarenefs, which are acquired by the firft method, are rarely obtainable in this: and indeed flat plates can hardly be managed at all in this mode. Run-down plates require more coddling than any other; and a longer continuance of vivid heat is neceffary to make the glafs flow to a proper evennefs of furface: the plates being wholly completed with one fire, and without polifhing. It is obvious that the moft common work only can be thus manufactured; for that of the next fuperior defcription, the run-down *one coats*, are polifhed off with the rag-ftone, and undergo a fecond firing. The run-down fecond coats are thofe which are reduced to a furface comparatively even by the fecond fire, and are then painted on without being polifhed off.

In enamelling *hard-plates* for watches, the coppers and the firft coats are prepared in the manner above defcribed; excepting perhaps that the layer of glafs is rather thinner than in glafs-work only. The hard enamel, which is generally moft valued as it approaches to a rich cream colour, is broken down, and ground in the fame way as the glafs, if a fmall quantity alone be wanted; but if otherwife, it is firft broken from the cake with the hammer, and then pounded in a fteel mortar, till reduced into coarfe grains. Thefe grains are then expofed to the action of a magnet, in order that all the particles of fteel that have been broken off the mortar in the act of pounding may be taken away, as they would infallibly fpoil the work, by rifing in black fpecks to the furface of the enamel, when in the fire. As an additional precaution, alfo, it is neceffary to put the granulated enamel into a fmall bafon, and pouring upon it a ftrong folution of oil of vitriol, or aquafortis, to fuffer it to ftand for fome hours, that the fteel particles, &c. may be wholly diffolved; after which, the enamel muft be very carefully wafhed, till the water comes off pure and taftelefs: for fhould any of the acid remain, the work would certainly blifter. The enamel is then ground to the neceffary finenefs in an agate mortar, and afterwards fpread over the firft coat with a quill, in fmall quantities, and as evenly as it can be laid, that it may require the ufe of the fpatula as little as poffible. The water is then partly abforbed by a very fine and clean napkin, and the enamel fmoothly fpread and clofely compreffed with the fpatula; after which, more water is abforbed, and the fpreading is continued till the furface lies true and equal. The plate is then put upon a ring, and properly fired; and is afterwards polifhed by placing it upon a cork, (the top edge being firft taken off with a fine grey-ftone,) and wearing away the furface, firft, by a very fine-grained Lancafhire file, or fmooth piece of fteel, and filver fand, ground to an almoft impalpable powder; fecondly, by a fine blue-ftone and fand; and thirdly, by the blue-ftone alone. With the latter a fort of half-polifh fhould be given to the enamel; and the nigher that polifh approaches to complete gloffynefs, the better; as the plate will then be finifhed in the third fire with a lefs degree of heat than would be otherwife wanted. In this procefs, much caution is required to prevent fcratches, which cannot be *run up* by the fire without giving the enamel a greater heat than it will well bear. When the polifhing is completed, the plate is carefully cleaned with ground enamel; and fhould there be any fpecks, they muft be picked out with a fmall and fharp diamond, and the hollows very dextroufly filled up with enamel from a quill-point, that they may neither rife above or fink below the common furface, when the plate is again fired: fhould they actually do fo, they muft be made fmooth with a blue-ftone, and the plate muft undergo a fourth fire, to render the furface of one uniform texture and gloffynefs. Hard-enamel dials are always confiderably dearer than glafs ones, through the greater labour, attention, &c. that are requifite in making them; and the beft watches are almoft always made up with dials of this kind.

In the polifhing off both of glafs and hard plates, much addrefs is neceffary to prevent a feparation between the enamel and the edge of the copper; for if too great a preffure is exercifed, or if the grey-ftones, which are employed to wear down the copper, are of too rough a grit, the adhefion will be deftroyed, and various black indents arife round the edge of the enamel, when the plate is again expofed to the fire. In glafs dials, thefe defects may be fometimes amended; but in hard-enamel dials, fcarcely ever.

The operations of *tranfparent enamelling* are nearly fimilar to what have been already defcribed in the making of watch dials. As the work is generally of a more minute kind, greater delicacy of handling perhaps is required; and as the enamels are of various colours and defcriptions, more cups, veffels, &c. and additional foft cloths or napkins, are wanting to keep them from mixing. Watch cafes are commonly enamelled upon gold, as well as moft fuperior articles of the fancy kind; and the furface of the gold is frequently engraved into different figures and compartments, before the enamel is laid on; by which means the work affumes a beautiful variegated appearance through the vitreous coating.

In enamelling the backs and edges of watch-cafes, &c. quince-water is frequently ufed as the medium by which the enamels are laid on; for this poffeffing a more adhefive and retentive quality than common water, better prevents the enamel from flowing from its proper fituations: for where the convexity is confiderable, the enamel will of courfe have a tendency to float towards the loweft part. When enamels of different colours are intended to be employed on the fame article, which is frequently the cafe in ornamental works, fmall edges or prominent lines are left in the fubftance of the metal, for the purpofe of keeping the enamels feparate; and thefe are polifhed with the enamel, and reduced with it to a fimilar equality of furface. Tranfparent enamels are not unfrequently polifhed to complete gloffynefs, without expofing them to an additional fire: in thefe cafes, the work is finifhed with rotten-ftone.

It is fometimes defirable to take off the enamel from a watch-cafe or trinket, without injuring the metallic part. For this purpofe it has been recommended to lay a mixture of common falt, nitre, and alum in powder, upon the enamel requiring to be removed; and afterwards to put it into the furnace: and when the fufion has commenced, to throw

throw the cafe, &c. fuddenly into water, which caufes the enamel to fly off in flakes.

In ornamental tranfparent work, a very pretty effect is often produced by applying fmall and very thin pieces of gold or filver, cut or ftamped, into different figures, as acorns, oak-leaves, vine-leaves, bunches of grapes, fruits, &c. upon the furface of the firft coating of enamel, where they are fixed by the fire; and are afterwards covered over by the fecond layer, through which they appear with confiderable beauty. When any quantity of fancy-works of fimilar defign is wanting, this mode of enamelling is much cheaper to execute than to have the furface of the metal itfelf engraved into the required forms.

Clock Dial-Plate Enamelling, is far more laborious than the other branches, and requires confiderable experience to be properly executed, though the methods of operation are foon explained. The copper, being procured from the flatting mills in thin flips, and of an adequate diameter and thicknefs, is cut to nearly the required fize with a pair of ftrong fciffars, a circle having been firft ftruck with the compaffes. If in a foft ftate, it is then cleaned by the pickle, and having been brufhed out with fand on a flat board, is wafhed and dried for planifhing; if otherwife it muft be well annealed before it is thrown into the pickle, where it muft lie till all the fcale is enough foftened to be removed by the hand-brufh, fand, and water.

Planifhing is a very important part of clock-plate enamelling, and too much care cannot be exerted in the procefs, as the neceffary regularity of furface almoft wholly depends upon it. In large plates the action of the fire has a very confiderable effect, as it caufes an expanfion in the metal, which, unlefs properly guarded againft, cannot but operate to the imperfection, and perhaps total fpoiling of the work. In flatting alfo, a fort of twift is not unfrequently given to the copper, during its paffage through the rollers, that would affuredly caufe the plate to become uneven and out of fhape, were it not to be removed by planifhing and repeated annealings. Another effect produced by the fire, is occafioning the plate to rife, perhaps irregularly, towards the centre, and this can only be checked by counteracting the action which the heat would otherwife generate in the metal by good planifhing. To keep a large plate entirely flat is impoffible; or at leaft no means have as yet been difcovered through which that aim can be attained. The beft way, therefore, to provide againft the irregularities which the fire might caufe, is to give to the copper, in the courfe of planifhing, a flight and even rife or curve from the edge to the centre; this can either be effected by the ufe of large brafs dies, or by a machine adapted for the purpofe.

The *machine* of which, probably, there is only one in the trade, confifts of two principal parts; the one a folid mafs of iron, with a concave and polifhed face, imbedded immoveably in a ftrong oak block, firmly fixed on a foundation of brick-work, and the top edge hooped with a thick iron ring, to prevent fplitting; the other, an anfwering and weighty mafs of iron with a convex face, fimilarly polifhed, and fixed in an upright frame of timber, but fo contrived as to become *moveable* by means of fliding grooves, a rope, a pulley, and a lever, and fo placed as to fall directly upon the mafs beneath, in a fimilar way to the monkey of a pile-driving engine. The diameter both of the hammer and the anvil, as the upper and under maffes of iron may be called, for the fake of perfpicuity, is about thirteen inches; that fize being nearly as large as clock dials are ever made or wanted. The convexity of the hammer is exactly fitted to the concavity of the anvil, and may be defcribed, perhaps, as forming a portion of a circle fifty feet in diameter; and the centres of both are kept true to each other, and confequently to the regularity of curve, by means of large fcrews and nuts, which adjuft the pofition of the hammer by altering the perpendicularity of the bars of iron that the grooves act upon. The power of this machine faves much labour in planifhing, as well as time; yet as it is infufficient wholly to prepare the coppers, and as the charge of erecting one would be very confiderable, it will never, perhaps, come into general ufe.

In planifhing with this machine, it is neceffary to be provided with various thin circular pieces of lead, evenly flatted, and adapted in fize to the diameters of the coppers to be planifhed. Without thefe the ftroke given by the hammer would have a very imperfect effect; and the impulfe given by the weight of its fall would alfo be continually weakening the foundation and bed of the anvil.

The coppers prepared for planifhing by this machine are taken feparately, (the eyes having been previoufly cut out to a proper fize by means of an iron punch, an hammer, and a lead block,) and each one is laid upon a lead of a correfpondent diameter, and placed upon the anvil in fuch a manner that all the centres agree. The hammer, which has been hitherto retained at fome height by an iron ftay fixed in one of the timbers, and moving on a pivot, is then let fall, three or four times in quick fucceffion, it being each time lifted up to the height of three feet or more, by means of the lever. The hammer is then again faftened by the ftay, whilft the copper is turned over on the lead, after which the operation is repeated, and the copper is then taken off, and another laid down till the whole are gone through. The weight of the hammer, and the impetus acquired by its defcent, remove moft of the unevenneffes in the coppers, yet cannot entirely remedy them: a ftrong and unequal fpring will ftill be felt, and the metal being now rendered hard by the action of the hammer, annealing muft again be reforted to, and the coppers muft be pickled and cleaned as before. The machine is then ufed a fecond time in a fimilar way; and afterwards a third, a fourth, a fifth, and even a fixth and feventh time, according to the diameters of the coppers, or to the refractorinefs of the metals, due care being taken properly to anneal and pickle them between every operation.

The coppers will now be found of a regular fhape, and the fpring in the metal tolerably uniform; it is effential, however, to the perfection of the plate, that the fpring fhould be *entirely* uniform from edge to centre, otherwife the plate would warp and cockle in the fire. A kind of intermediate procefs muft therefore be carried on between the taking the coppers from the machine, and before repeating the annealings. This is performed by means of a circular brafs die, about a quarter of an inch in thicknefs, and from fifteen to eighteen inches in diameter, fcrewed firmly down to a ftrong oaken block, having three ftout legs, placed triangular-wife, and of a fufficient height to ufe conveniently when the artift is in a ftanding pofture. The die fhould have the fame degree of curve as the machine, otherwife the effect produced by each would occafion a fort of reciprocal counteraction. The coppers, having paffed through the machine, are placed in fucceffion upon the die, and a wooden box-hammer (fomewhat refembling that ufed by gold-beaters) with two faces, the one a circle about three inches over, the other cut away on the front edges, fo as to leave only a portion about an inch or an inch and a quarter in breadth remaining in the middle, is then taken, and the copper is both rubbed and ftruck with it till the metal becomes too hard for any further impreffion to be made, and requires annealing. The circular end is ufed to ftrike the

copper

copper with, which is done by short, quick beats of the hammer, the artist working from centre to edge, and communicating the necessary motion and direction to the coppers by means of the fingers of one hand, so extended over the work as to give the requisite command in guiding it: the other end is employed in rubbing the coppers strongly with a backward and forward action, under which they are moved upon the die by the fingers as before. Where the machine is not used, the planishing must then be entirely performed in the way just described, and great care must be taken, that in the rubbing, the coppers be not bent, which would occasion both additional labour, and further annealing. No positive direction can be given as to the number of times that the coppers must be annealed in the course of the planishing; as a general rule, it may be said that the larger the size, the more frequently must the annealings be repeated. For plates of from three to four inches, twice or thrice is commonly enough; from five to eight inches, about four or five times are requisite; for larger sizes, the annealings must be continued till the spring or action in the metal becomes uniform, as already mentioned. This is best determined by the regularity with which the copper will flap or jerk into the curve given by planishing when turned either side uppermost upon the die. When the planishing is completed, the coppers are cut exactly to the sizes required, and having been pickled and cleaned, they are then ready to be enamelled on. After the last annealing, it is best to planish but slightly, that the coppers may be left in a state of comparative softness.

For time-pieces, table clocks, and some others, *round* plates are commonly used, and in these cases it is necessary to have moveable brass dies formed into the curves required. Round plates are those which have a considerable rise in the centre, made by a pretty quick forcing up of the copper into a sort of shoulder about where the circles of the hours come, and afterwards continuing the rise more gradually. The bent spatula and the scratch brush are chiefly employed to set the coppers into these curves, and where the rise is very quick from the edge, the copper is sometimes turned up as in small dials, that the enamel may be the better retained in its place.

The quantity of enamel wanting for clock dials renders the grinding it a very laborious and tedious operation; especially as the hard kind only can be used with complete certainty. It is true that plates of from ten to twelve inches diameter have been made with glass enamel, where particular attention has been given to the *annealing up*, and to the *cooling down*, (phrases that will be presently explained,) and where the backing has been of a quality perfectly agreeing with the nature of the glass. Of the experiments made in this way, however, the success has not always been proportionate to the loss, and the few enamellers who have clock-furnaces cannot always be induced to repeat them.

The enamel for clock dials is broken down in a steel mortar, and afterwards cleansed and ground in an agate mortar, in a similar way to that prepared for watch plates. Sometimes, where the enamel is of a good quality, the *washings* are made use of for backing, and no bad consequence results, but this requires considerable care in the laying on as well as in properly drying, in order to prevent the surface of the back from rising in blisters, either entirely or partially. Washings is the name given to the almost impalpable powder which arises in grinding, and floats in the water, intermixed with the dust and minute hairs which are sure to fall into the mortar, and which renders it necessary that the enamel should be several times washed during the process by pouring off the buoyant matter from time to time, and introducing fresh water, from the tea-pot. Pure spring water ought always to be used, and a large bason provided for the reception of the washings.

In the best and largest kinds of work, the washings ought never to be used, as their great propensity to blister can hardly be counteracted; and when the blistering is considerable, the plates will assuredly *cockle*, or get out of shape. The peculiar fineness of the washings, also, occasions it to be very difficult to lay on as backing in an even manner. Where the enamel in substance only is used, the success of the work is rendered more certain; the additional expence therefore is fully balanced by the greater security.

The general way of putting on the enamel is to lay the copper upon a cloth, twice doubled, and placed upon a die or piece of board, for the conveniency of turning. The backing is then spread carefully over it by means of a small ivory or bone spoon, and when the whole surface is covered, the water is partially dried off by another cloth, and the enamel laid even by a large spatula, (see Spatula,) finely polished. These operations are repeated till the back surface is sufficiently evened and dry; when the copper is turned, and the first coat laid on and evened in a similar manner. The work is then placed upon a planch for firing, and is next put into the annealing places in the upper part of the furnace, (see Furnace *for Clock-Dials*,) where the humidity is gradually evaporated as the fire draws up. The planches are from a quarter of an inch to three quarters in thickness, in proportion to the size, and are either made of fine free-stone, or of a composition of Stourbridge clay, pipe clay, and *old stuff*, as the broken muffles, planches, &c. are called, pounded together in an iron mortar, and passed through a coarse sieve. The face of each planch is either flat or rubbed into a similar curve to that given to the coppers, and before the work is put on to it, a slight covering of whiting, dried, is sifted over it, through a small brass-wired sieve: this is done to prevent the enamel from sticking to the planch when in the act of fusion.

The muffle is *got up* or rendered hot with sea-coal, and when sufficiently vivid, which is known by its near approach to a white heat, the first coats are taken from the annealing holes by means of iron prongs, which are slid beneath the planches by a steady and careful motion, lest the enamel should be shook whilst in powder; to prevent this, also, a farther provision is frequently made by means of *irons*, as they are called in the business, which are placed below the planches, and having a round form, and a convex bottom, are extremely useful in moving the work, by admitting the prongs to be readily passed below them. The irons are adapted to the size of the planches, and are formed out of thin iron plates, and are cut into a circular shape; some portions of the metal, to render the irons less weighty, being wholly removed from between the rim and the centre, which from this circumstance appear to be connected by cross bars.

When the first coats are properly fired, which can only be determined from practice, they are replaced in the annealing holes, and there left for some hours to cool down, all the fire having been first raked out from the furnace. The operation of cooling down must be effected in a very gradual manner, for were it done too quickly, the plates would crack in different places, through the action of the metal upon the enamel. The particular cause of this cracking seems to arise from the surface of the enamel being too suddenly fixed by the cold air, to admit of that gradual adjustment to the contraction of the metal, which the latter, by retaining the heat longer than the enamel, renders necessary. On a similar principle, the annealing up of the second coats must be equally progressive; for should they be too fuddenly put into the fire, the metal, by expanding with the heat before the fufion of the enamel has commenced, would caufe the enamel to fly through its brittlenefs, and the furface would be thereby ftreaked with cracks.

The enamel for fecond coats, as in watch plates, muft be ground finer than for firft coats, yet not fo fine as for backing. It is laid on with a fpoon, and reduced to a fmooth and equal furface by the fpatula, in the fame manner as above defcribed; and the plate being enamelled with the requifite attention, is fired a fecond time, and gradually cooled down as before. The next operation is polifhing.

Clock plates are polifhed by a fomewhat different procefs than watch dials. When perfectly cold they are taken off the planches, and either carefully fixed upon a bed of wet fand, fo that not any hollow or vacancy is left below the plate, or imbedded in a fimilar way with fand upon wet flannel, twice or thrice doubled. When thus prepared, the furface is gradually worn even by means of fine filver fand, paffed through a fieve, that the coarfer particles may be prevented from fcratching the enamel, and polifhing-ftones formed of flint pebbles, ground at one end to a regular furface. The fand is ufed with water, and the operation is performed by giving the polifhing-ftone a quick circular direction in progreffive movements over every part of the plate, till the furface is evenly reduced, which is known by the gloffynefs being wholly worn off: this occupies from half an hour to an hour, or more, according to the fize and previous evennefs of the plate. Sometimes the polifhing is accelerated by ufing pieces of lead or iron, as half-pound weights, for inftance, in the early ftage of the procefs, and afterwards finifhing with the flint; and that not only to give a fmooth furface to the enamel, but likewife to remove the general ftain or blacknefs which proceeds from the ufe of the lead or iron. When the polifhing is completed, the plates are well wafhed and brufhed, and afterwards made perfectly clean by fome fine enamel being ground over the face of each with a fmall mull or polifhing-ftone for about a quarter or half a minute; the operation being repeated twice or thrice, as may be neceffary, and the loofe enamel being carefully wiped off with a fmooth cloth or napkin, after the laft cleanfing, inftead of being wafhed away: this is done in order that the fmall pores which are fometimes laid open by polifhing into the fubftance of the plate, may be filled up by the minute particles of enamel that efcape the action of the cloth, but would be removed by the water. Whatever fpecks or blifters may be in the plate, are then opened with the diamond, and the holes neatly ftopped with finely-ground enamel from a quill-point, as in watch-plates; the *ftoppings up* being fuffered to lie rather higher than the furface, to admit of the reduction in bulk occafioned by the fufion. The plates are now again put into the annealing places upon the planches; and the furnace being properly heated, are fired for the third and laft time, before painting. In this latter firing, great care fhould be taken that the enamel be not over-fired, which would occafion a freckled appearance in the plate, when held againft the light; and if the work is drawn out from the muffle after the fufion has commenced, and again returned to complete it, the air will be found to have given additional richnefs to the gloffynefs of the furface. The precife time required for firing polifhed plates can only be known from practice; thofe on which the fineft polifhing-fand was ufed, and, of courfe, where the fcratches are lefs deep, wanting lefs heat than when the fand has been employed in a rougher ftate. After firing, the finifhed plates are returned to the annealing-holes, and gradually cooled down for painting on. See PAINTING *of Clock and Watch Plates.*

In the making of *fluxed plates* for enamel-paintings, fimilar methods of planifhing are practifed to thofe already detailed; and fimilar or even increafed care muft be taken in deftroying or regulating the fpring of the copper. Fluxed plates are commonly either fquare or oval: in the fquare ones, about an eighth of an inch, or fomewhat more, fhould be cut off each angle of the copper, previous to enamelling, to prevent the danger of breaking them. In preparing them for the flux, every thing is conducted in the fame way as for clock-dials, till they are polifhed off, when, inftead of firing them in their polifhed ftate, the flux is laid on as a third coat. In grinding the flux, very particular attention muft be given to keep it free from dirt; and the grinding muft be continued till the flux becomes extremely fine, as it will not otherwife flow to an even furface, when expofed to the fire, without a more intenfe heat than the fubftance will well bear. The flux indeed requires a peculiar delicacy of treatment, and the firing of the fluxed plates muft be managed with great caution and nicety. The heat which they require in fufion is much ftronger than that for enamels only; but the exact point of time for withdrawing them from the furnace muft be dexteroufly feized, left the flux fhould fall into freckles. It is not cuftomary to polifh off the flux, as by fo doing it would be deprived of fome portion of its brilliant richnefs; yet that perhaps would be in fome meafure compenfated for, by the fuperior evennefs that would be attained. Fluxed plates muft be cooled down with great care, as the brittlenefs of the upper coating renders them more liable to crack when too fuddenly made cool. In fluxing, hard enamel muft always be ufed; as the flux will not agree with glafs enamel, but cracks in circles as it grows cold. See FLUX.

The greater ductility of gold, and its fuperior mellownefs of colour, render it by far the beft metal that could be employed for the bafis of fluxed plates; though, on account of the expence, it is feldom ufed. For naked figures, portraits, or other fubjects, where much flefh is exhibited, gold plates ought to be exclufively employed, as their rich hue would fave confiderable labour in the painting.

Till the prefent age, fluxed plates were feldom made of a larger fize than four or five inches; but fince the art of enamel-painting has been carried to fuch great perfection by Mr. Bone, enamel-painter to the king and the prince of Wales, they have been progreffively increafed in extent for his ufe, and are now made of every fize up to twelve and fourteen inches. The largeft ever completed meafures eighteen inches by fixteen and a half; and Mr. Bone is now employed in painting it from Titian's famous picture of Bacchus and Ariadne, in the collection of lord Kinnaird. See PAINTING *on Enamel.*

In chufing enamels for ufe, great experience is neceffary: indeed the moft expert practitioner may be deceived, unlefs he make the requifite trials by aid of the furnace. Some enamels can only be employed alone; others may be ufed for the upper coats, but require a ftronger kind for the backs; and fome can be ufed only for backing. Should a new fort be proffered for ufe, experiment alone is the criterion by which its qualities can be determined. In a fimilar manner, fome fluxes will only agree with particular enamels; others muft be ufed feparately; and others again muft be mixed in grinding, before they can be employed with certainty.

In every branch of enamelling, it is effential that the copper, or other metal employed to enamel on, fhould be of a proper thicknefs. Should the metal be too thick, the plates will always crack, either in their fecond coats, or in their polifhed ftate; and fhould it be too thin, they would be be extremely likely to warp from the too powerful action of the enamel. The due medium can only be afcertained by practice; for even the different kinds of enamel will require a difference in the thicknefs of the metal.

The proper management of the fire, and the mode by which the muffle is heated, will be explained under the words FURNACE and MUFFLE; it need only be ftated here, that the time neceffary to *get up* a clock furnace varies from about an hour and a half to two and three hours, or more, according to the intenfity of the draught, the method of ftoking, and the quality of the fuel. The work is turned in the muffle by means of fpring tongs, fo that each part may have a regular and due heat; and it is returned into the annealing places with the prongs. Should many plates be fired at one time, the labour will be found to be very fevere, and the heat too powerful; as it carries a flux of blood to the head, and occafions languor and oppreffion throughout the whole frame.

ENAMELLING *Flux.* See FLUX.

ENAMELLING *Furnace.* See FURNACE.

ENAMELLING, *Imitative.* See JAPANNING.

ENAMELLING *Muffle.* See MUFFLE.

ENAMELLING *Spatula.* See SPATULA.

ENARA, in *Geography*, the chief lake of Lapland, in the northern extremity, about 70 Britifh miles in length by 30 at its greateft breadth.

ENAREA, a province of Abyffinia, conquered by the troops of the Negus, at the beginning of the 17th century, fituated at the S.W. extremity of the empire.

ENARGEA, in *Botany*, from εναργης, *confpicuous*, or *diftinguifhed*, alluding doubtlefs to the ftriking and elegant appearance of the plant, fo little to be expected in the dreary country about the Straits of Magellan, of which it is a native. Banks in Gærtn. v. 1. 283. t. 59. f. 3. Schreb. 232. Willd. Sp. Pl. v. 2. 230. Mart. Mill. Dict. v. 2. (Callixine; Juff. 41. Lamarck t. 248. f. 2: alfo, Philefia; Juff. 41. Lamarck t. 248. f. 3. Willd. Sp. Pl. v. 2. 231.) Clafs and order, *Hexandria Monogynia.* Nat. Ord. *Sarmentaceæ*, Linn. *Afparagi*, Juff.

Gen. Ch. *Cal.* none. *Cor.* Petals fix, erect, elliptic-oblong, acute, inferior; three of them exterior; three interior, larger. *Stam.* Filaments fix, fhorter than the corolla, equal, awl-fhaped, dilated at the bafe, flightly attached to the bottom of each petal; anthers oblong, verfatile, incumbent. *Pift.* Germen fuperior, globofe; ftyle the length of the ftamens, erect, fwelling, and triangular upwards; ftigma in three obtufe lobes. *Peric.* Berry globofe, of three cells. *Seeds* angular, three or more in each cell.

Eff. Ch. Calyx none. Petals fix, erect; three of them internal. Stigma three-lobed. Berry fuperior, with three cells and many feeds.

1. E. *marginata.* Gærtn. as above. Willd. Sp. Pl. v. 2. 230. Petals nearly equal. Leaves with many ribs.—Our fpecimens of this pretty little plant were, fome of them, gathered by Commerfon in the ftraits of Magellan, and communicated by the celebrated M. de Juffieu; others by Mr. Archibald Menzies in Staten land near Cape Horn, in Feb. 1787, all of them in bloffom. Lamarck's figure is a tolerable reprefentation of the whole plant, except the ftigma, which he erroneoufly draws fimple and entire. His fruit is copied from Gærtner.—The *roots* are creeping, and throw out clufters of branched fibres. *Stems* a fpan high, erect, branched, angular, deftitute of pubefcence, as is the whole herb; branches zig-zag, leafy, fheathed at their bafe. *Leaves* alternate, nearly feffile, upright, about half an inch or more in length, elliptical, acute, entire, fomewhat revolute, their edges rough with minute fpines; their underfide marked with three or five ftrong prominent ribs; the upper even. *Flowers* terminal, folitary, drooping, on fhort fimple ftalks. *Petals* white, ribbed; the three outermoft elliptical; the reft rather broader and obovate; each of the fix is faid by Gærtner to be marked with two green fpots below the middle. Commerfon defcribes three of them only as having a pair of obfolete glands at their bafe. *Berry* the fize of a pea.

2. E. *buxifolia.* (Philefia buxifolia; Willd. Sp. Pl. v. 2. 231.) Inner petals thrice as large as the outer. Leaves with numerous tranfverfe veins.—Commerfon alone feems to have found this fine fpecies, in the ftraits of Magellan. Lamarck's plate, drawn from one of his dried fpecimens, is a very juft reprefentation. We have received feveral of thefe from Thouin and Juffieu. The *fhrub* is two or three feet high, with the afpect of box, much branched and fmooth. *Leaves* ftalked, an inch long, elliptic-oblong, pointed, revolute; green, fmooth, with a longitudinal furrow above; glaucous, with a central prominent rib, a marginal one at each edge, and numerous tranfverfe veins, beneath: their edges are rough with minute teeth near the point. *Flowers* terminal (not axillary), large and very handfome, apparently reddifh; their three outer petals elliptical, flat, about half an inch long; the three inner obovate, thrice as long; all veiny. We prefume to unite thefe two plants under one genus, the differences defcribed in their ftigmas having no foundation in truth, and there being a fufficient difference between the outer and inner petals of the firft, to fhew that a more ftriking difference of the fame kind in the fecond can only make a fpecific, not a generic, diftinction. S.

ENARGIA, Εναργεια, in *Rhetoric*, a figure, which paffing from the narrative ftyle, points out, and as it were, fets the fubject before the eyes of the audience. Voff. Rhet. lib. iii. p. 361.

ENARTHROSIS, in *Anatomy*, is that kind of joint, in which a rounded head of one bone is received into a cup-like hollow of another. See DIARTHROSIS.

ENBAR, in *Geography*, a town of Afiatic Turkey, in the Arabian Irak, on the Euphrates; 40 miles weft of Bagdad.

ENBORNE, a parifh in the hundred of Kentbury-Eagle, Berkfhire, England, is fituated 59 miles from London, and contains 46 houfes, and 275 inhabitants. A remarkable and well-known cuftom is attached to its manors, that if the widow of a copyholder fhould marry again, or be guilty of incontinency, fhe forfeits her free-bench, or life-intereft in her late hufband's copyhold; which is not recoverable but by her fubmitting to ride into court upon a black ram, repeating fome ludicrous lines, which end with a petition for her hufband's land. The fteward of the manor is then obliged to reinftate her. At every court, the jury ftill prefent this as one of the ancient cuftoms of the place. The penalty has not been literally enforced within the memory of man; but it is faid, that a pecuniary commutation has been received in lieu of it, which may perhaps have been more readily accepted, from the difficulty of procuring a proper animal for the purpofe. Lyfon's Magna Britannia, vol. i.

ENCÆNIA, Εγκαινια, a Greek term, fignifying *reftauration*, or *renovation*, being compounded of the prepofition εν, and καινος, *new.*

ENCÆNIA is more particularly ufed for the name of a feaft celebrated by the Jews on the twenty-fifth of the ninth month, in memory of the dedication, or rather purification of of the temple, by Judas Maccabæus, after its having been polluted and plundered by Antiochus Epiphanes.

The Jews had also two other Encænia, *viz.* the dedication of the temple by Solomon, and that of Zorobabel, after the return from the captivity.

ENCÆNIA is likewise applied in the *Fathers*, and *Church-History*, to the dedication of Christian churches. See DEDICATION.

Our translators of the Bible do not retain the word Encænia, in St. John, x. 22. where mention is made thereof; in lieu of that, they call it "Feast of the Dedication," which is less proper. In effect, it is not the feast of the dedication, but of the purification or re-consecration of the temple profaned, that is there spoken of.

St. Augustine assures us, that in his time the use of the word Encænia was even transferred to profane matters; and that they called it *Encæniare*, when they put on a new suit of clothes.

ENCALYPTA, in *Botany*, from εν, and καλυπτος, *covered* or *veiled*, alluding to the extraordinary size of the calyptra or veil, which is a characteristic mark of the genus. Extinguisher-moss; Schreb. 759. Hedw. Sp. Musc. 60. Sm. Fl. Brit. 1180. Turn. 17. (Leersia; Hedw. Fund. v. 2. 88. Bryum; Linn. Gen. 564. Juss. 11. Hudf. 474. Dill. 338.) Class and order, *Cryptogamia Musci*. Nat. Ord.. *Musci*.

Gen. Ch. Male, *Flowers* axillary, composed of imbricated scales. Female on the same plant. *Fl.* terminal, several abortive. *Caps.* stalked, cylindrical, inclining to ovate, erect, regular. *Fringe* simple, of sixteen linear, upright, thin, palish teeth. *Veil* bell-shaped, inflated, membranous, much wider than the capsule, erect, often toothed or fringed at the edge.

Eff. Ch. Capsule cylindrical. Fringe of sixteen linear upright teeth. Veil bell-shaped, inflated, lax.

This is but a small genus, consisting of five species only in Hedwig's Sp. Musc. and of four in the Flora Britannica, to which indeed a new one, E. *alpina*, is added in Engl. Bot. t. 1419. The most common is E. *vulgaris*. "Veil entire and smooth at its margin. Stem nearly simple. Leaves lanceolate." Figured in Engl. Bot. t. 558. (*Bryum extinctorium*); and by Dillenius in his t. 45. f. 8. It occurs not unfrequently on shady banks, and in the crevices of rocks, and is strikingly distinguished by its large and deep veil. E. *streptocarpa*. "Veil contracted and torn at its margin. Stem branched. Leaves oblong. Capsule spirally furrowed." Is the largest and finest species, long much misunderstood by botanists. See its figure in Hedw. Sp. Musc. t. 10. f. 10—15, and Haller's Hist. t. 45. f. 3. Dillenius exhibits the leaves and stem only, t. 43. f. 71.

Mr. Turner, in his Muscologiæ Hibernicæ Spicilegium, suggests an opinion that this genus is not really distinct from *Grimmia*, and we confess that E. *Daviesii*, Engl. Bot. t. 1281, seems not very justly referred to it. It is certain that the fringes of several *Grimmiæ* have the thin pale aspect supposed essential to *Encalypta*, but their veils are truly those of *Grimmia*.

ENCAMPMENT, in *Military Affairs*, implies the position taken for the night, or for any time, of an army, for the purposes of exercise, or for warfare. It is common in all countries for the regular forces to be called out, at stated periods, especially during favourable seasons, from their barracks or quarters, in order to unite for their acting in concert upon a large scale, and for their being reviewed by some superior officer. These camps are usually pitched on certain large commons, whereon evolutions may be conveniently performed by several regiments or brigades, and whose sites are favourable both in regard to salubrity, and the easy supply of water and provisions. When we speak of encampments in a literal sense, we invariably attach thereto the idea of living under canvas; and such is absolutely the case, when troops are called out for the above purposes. But we are not to conclude that in time of war, when on actual service, such takes place on all occasions: far otherwise, for it is a general maxim always to spare the camp equipage, as far as may be practicable; and to keep every thing packed, which is not immediately in requisition: therefore, we usually see regiments, especially of infantry, stationed in towns, with lines of pickets in advance, and along their intervals, when the distances between such towns may not be great, and the enemy not so near at hand as to render such breaks dangerous. Thus, an army of 40,000 men is frequently seen to occupy full 20 miles, or even more, in this manner; the different regiments occupying the several villages along that line, and closing up into more compact arrangement, whenever danger may be apprehended. This manner of disposal not only saves infinite trouble and delay, respecting the camp equipage; but exposes the army less to inclement weather, or to noxious localities; and besides, facilitates its movements very considerably, by allowing the whole to move in separate columns, from one station to another. In this the columns necessarily act nearly parallel, much the same as in the advance of a battalion by the right or left of companies in open column.

Encampments, by which we mean the mode of laying out the camp into streets and divisions, are, with some trifling variation, formed after the same manner in all countries. The general principles are, 1st, That no more ground should be occupied than may be absolutely necessary for the drawing up the troops in order of battle: hence, all additions whatever should be made rather in the depth than in the breadth of the camp. This is done to avoid such breaks as could not fail to weaken the line, and to admit the incursions of the enemy's horse. It is, however, usual to allow the interval of about an eighth of their respective fronts between battalions of infantry, and of 30 or 40 paces between squadrons of cavalry. 2dly, The leaving of passages, or streets, throughout, so that bodies may move from one part to the other without hindrance, and without being compelled to pass along the front of the bells of arms. 3dly, That due precaution should be taken for the prevention of disease, by a judicious arrangement of the regimental and general hospitals, as well as by securing the due facility for the removal of filth, and for abundant ventilation; both which can only be effected by due care founded on the precaution of not allowing the camp to be too crowded, either by its situation, or the number of persons contained therein. It is usual to allow a front of two feet for every file (whether two or three deep) of infantry, and a front of three feet for every file of cavalry: hence camps, wherein the battalions are formed three deep, must have their streets full one-half deeper than where the corps are drawn up only two deep. When the ground may permit, the streets are usually at right angles with the front; each row of tents containing the men of a company, arranged according to their several stations, or numbers, in their companies respectively. Supposing the whole to be standing at the doors of their respective tents, and to be ordered to fall in, they would, by this arrangement, arrive in regular succession, either from right to left, or from left to right, at their several stations. The horses and the tents of a troop of cavalry are arranged in a similar manner. The grenadiers and light infantry are ordinarily encamped in single rows, on the flank; but the battalion companies, in double rows: each two companies thus forming a ſtreet, of which the tent-doors are face to face. This mode certainly looks well, but does not anſwer for all climates. In low latitudes, and in very cold weather, the tent-doors ſhould be pitched from the wind, without regard to appearances. A ſingle row, or one company, occupies nine feet in front; and a double row, or two companies, twenty-one feet; if formed of the old pattern, rectangular tents, which hold only five men each: but if the new bell-tents are uſed, fifteen feet muſt be allowed in front for a ſingle, and thirty feet for a double, row. In the cavalry, a row (or troop) occupies in front as follows:

	Old Tents.		New Tents.
Tent - - - - -	3 yards.	—	5 yards.
From the front pole of the tent to the picket rope -	3 do.	—	3 do.
For the horſe - - - -	6 do.	—	6 do.
For the dung - - - -	2 do.	—	2 do.
Totals - - -	14 yards.		16 yards.

The breadth of a row in front, whether cavalry or infantry, being multiplied by the number of rows, and the product ſubtracted from the whole extent of the front of a battalion of infantry, or of a ſquadron of cavalry, will leave the ſpace for the ſtreets, which are generally divided thus:

For the infantry,	$59\frac{1}{2}$ feet each.
For the cavalry,	30 feet each between the tents.
————	46 feet each between the horſes.

By the foregoing it will be ſeen that the utmoſt order prevails in laying out the tents of the ſoldiery, where the ground will permit. In places abounding with trees, rocks, puddles, &c. it muſt of courſe follow, that the locality of every tent conforms to theſe interruptions: but the main points muſt, nevertheleſs, be ever adverted and conformed to; otherwiſe all thoſe evil conſequences, attendant upon want of management, will inevitably follow. Negligence will admit filth; filth will create diſeaſe; and diſeaſe will produce weakneſs, diſcontent, and deſpair. The following is the diſtribution of the depth of a camp of infantry, or of cavalry, when the ground permits.

Diſtribution of the Depth of a Camp.	Infantry.	Cavalry.
	Yards.	Yards.
From the quarter guard parade to battalion parade - - - - - - - -	62	
From this firſt line of parade to the front of the { ſerjeant's tents / quarter maſter's tents } - - -	16	
N. B. *Theſe tents open to the front.*		
To the firſt picket of horſes - - - - - - - - - - - - -	—	15
Infantry for every tent in depth.		
——, old pattern - 9 feet.		
——, new pattern - 15 feet.		
Cavalry, for every horſe - 3 feet.		
N. B. *The infantry privates' tents open to the ſtreet.*		
The cavalry ditto to their horſes' heads.		
Suppoſe infantry 12 tents deep / ——— cavalry 60 horſes ditto } old pattern - - - - - - - -	36	60
From the laſt tent of infantry, or laſt horſe of cavalry, to the front of the ſubaltern's tent *(openings to the rear)* - - - - - - - - - - -	15	12
To the front line of captains *(openings to the front)* - - - - - - - -	15	15
To the front of the field officers *(open to the front)* - - - - - - - -	10	15
To the colonels - - - - - - - - - - - - - - -	10	10
To the ſtaff officers - - - - - - - - - - - - - -	10	14
To the firſt row of batmens' tents - - - - - - - - - - -	10	
To the firſt row of pickets for bat-horſes - - - - - - - - -	2	
To the ſecond row of ditto - - - - - - - - - - - - -	10	15
To the ſecond row of batmen - - - - - - - - - - -	2	
To the front of the grand ſutlers' tent - - - - - - - - - -	10	
To the centre of the kitchens - - - - - - - - - -	15	20
To the front of the petty ſutlers - - - - - - - - - - -	15	15
To the rear guard *(opens to the rear)* - - - - - - - - - - -	15	15
Total depth required in yards - - - - - - - - - -	253	226

The captains and ſubalterns are pitched in the rear of their reſpective companies; the field officers oppoſite the outſide ſtreets of the battalion; the colonels oppoſite the central, or main, ſtreets; the ſtaff officers next to the main ſtreets; the grand ſutlers in the rear of the colonels; and the petty ſuttlers in the rear of the kitchens.

If the ground on which the camp is to be formed will not, owing to a ſwamp in the rear, admit of each troop, or company, being formed in one row perpendicular to the front; the diſtribution of the front of a battalion, or ſquadron, muſt be more contracted than the above; and be laid down as follows. Find how many perpendicular rows will be required, by dividing the number of men in the battalion or ſquadron, by the number the ground will admit

admit of in one row; then the number of rows being multiplied, by the breadth of one in front, will give that part of the front to be occupied by the rows; and the difference between it and the whole front allowed for the battalion, or fquadron, will be left for the ftreets; which, if the ftreets are to be equal, muft be divided by their number, to find the breadth of each; or is, otherwife, eafily divided into ftreets of unequal breadths.

When two guns are attached to a battalion, they are pofted on the right in the following order; from the right of the battalion to the centre of the firft gun, four yards; from this to the fecond gun, fix yards. The muzzles of the guns in a line with the ferjeants' tents. The fubalterns of artillery, if any, in a line with the fubalterns of infantry; the rear of the gunners' tents in a line with the rear of the battalion tents.

The park of artillery fhould always be placed, if practicable, within a fhort diftance of water carriage, and have the moft ready communication with every part of the line. Its form muft depend on its fituation. Ten feet are ufually allowed in front for one carriage and its interval, and about fifty yards from the hind wheels of the front row to the fore wheels of the fecond: this interval fhould allow fufficient room for putting the horfes to the carriages, and for a free paffage along the line. In parks not on immediate fervice, it is ufual to arrange the guns with their muzzles to the front, but where the guns are likely to be wanted at a fhort notice, appearances muft give way to promptnefs, and the gun-carriages muft be parked with their fhafts to the front, ready to receive the horfes, or other draught animals.

A quarter-guard is placed in front of the park, and the non-commiffioned officers' and gunners' tents on the flanks, at about twenty paces diftant; forty paces to the rear are the fubaltern officers' tents; at ten more the rear of the captains; and ten more to the front of the commanding officers: the mefs-tent is fifteen paces in rear of the line of officers. At a convenient diftance, in the rear of the whole, are the horfes, picketted in one or more lines, with the drivers on their flanks. The horfes are fometimes picketted in lines perpendicular to the front of the park, and on the flanks of the carriages, between the men and the carriages.

An army is fometimes encamped in two, or even in three, or more lines; according to its numbers, and the nature of the ground. The diftance between two lines muft depend entirely on local circumftances, or on the object in view: fometimes they are not more than two hundred yards afunder, and fometimes full five or fix hundred; occafionally they are pitched in reverfe, efpecially when covering a convoy that has taken poft between two hills, or rivers, or woods; in fuch inftances they are "in reverfe," and, in lieu of rear guards, have a central force to act as a referve.

With refpect to the choice of ground for an encampment, it muft be recollected that no pofition is tenable, in a military point of view, which does not ftand exempt from the enfiladeof an enemy. In fact, all commanding grounds ought to be beyond the reach of cannon, fo that the camp fhould not be fubject to moleftation from fuch fituations. Four principal objects demand attention in the choice of a pofition for encampment. 1ft. The advantages of the ground, as arifing naturally, in point of defence. 2d. The accefs to, or the poffeffion of, fupplies for the army. 3d. The particular object to be attained; whether mere fecurity, the covering of any depot, the cutting off of an enemy's refources, the communication with other parts, and efpecially with fhipping. 4th. The means of retreat if too clofely preffed by a fuperior force.

The front of an encampment, or, as already explained, of a pofition, fhould be interfected by rivers, ravines, or broken grounds, or any other obftacles which may prevent the enemy from advancing in order of battle, and oblige him to pafs through defiles: but the front fhould neverthelefs be exempt from fuch obftacles as might debar the army from moving out of its camp, or advancing when neceffary. All obftacles ought to be within reach of the artillery, or the enemy will pafs them unmolefted. In a flat country, where the ground does not afford commanding fituations, a pofition is more or lefs eligible according as it may be covered by obftacles; fuch as very thick woods, in which there are few roads; large rivulets that cannot be croffed but by means of bridges; deep and broken ravines; ground much interfected by ditches and hedges; the poffeffion of mills, churches, convents, and other buildings that are capable of obftinate defence, and are within the encampment. A fituation where the rear is covered by fwamps has certain advantages, but is attended with this danger, that, in cafe of defeat, retreat muft be difficult, if at all practicable. The principal obftacles, if a choice can be made, ought to be thrown upon the flanks, and force the enemy to narrow his front when attacking the encampment; but, if fuch obftacles fhould be of a nature to be eafily poffeffed by him, they will prove peculiarly exceptionable, and ought not to be depended upon, any more than the fupply of water from ponds, wells, or ftreams that lie expofed to his interference. Laftly, the want of wood, or of water, even though provifions fhould be abundant, totally difqualify a pofition; unlefs, indeed, for a very fhort occupancy, and rather as a refting place than an *appui*, or defenfive aid. Thefe deficiencies muft invariably operate, on large armies efpecially, fo as to render fuch fituations untenable, whatever advantages they might offer in regard to natural ftrength, or diftrefs occafioned by their occupancy, to the enemy.

ENCANTHIS, a term in *Surgery*, derived from the Greek ἐν, fignifying *in*, and κανθος, which implies the *angle of the eye*. By a kind of abufe of words, which is too common in every language, the Greek writers have applied the name of "encanthis" to a fmall, roundifh, unequal, more or lefs confiderable, fometimes red, at other times light-coloured tumour, fituated in the caruncula lachrymalis, which every furgeon knows is naturally placed near the angle of the eye.

Profeffor Scarpa, of Pavia, has furpaffed every author, with whom we are acquainted, in the excellent and interefting account which he has given of the difeafe under confideration. To him we feel highly indebted for a great deal of the matter, which we are about to infert. He obferves, that the incipient encanthis is a fmall, foft, reddifh, or fometimes flightly livid, excrefcence, which grows from the caruncula lachrymalis, and alfo from the adjacent femilunar fold of the tunica conjunctiva. In general, the inveterate encanthis is of very confiderable fize, its roots reaching beyond the caruncula lachrymalis and femi-lunar fold of the conjunctiva, and extending along the membranous lining of one, or both eye-lids. In confequence of its being fituated between the internal commiffure of the eye-lids, which it hinders from becoming clofed on the fide next the nofe, it fubjects the patient to a great deal of inconvenience, by keeping up a chronic ophthalmy, obftructing the action of the eye-lids, and, in particular, by rendering the patient incapable of fhutting his eye. Alfo, partly by compreffing the orifices of the puncta lachrymalia, and partly by altering their natural direction, the encanthis becomes an impediment

ment to the free paffage of the tears from the eye into the nofe.

The encanthis, in its early ftate, has ufually a granulated appearance, like a mulberry; or elfe it is compofed of little portions refembling fringe. When the excrefcence has attained a confiderable fize, a certain part of it has a granulated appearance, while the remainder looks like a fmooth, whitifh, or afh-coloured fubftance, ftreaked with varicofe veffels, and fometimes extends fo far over the conjunctiva, covering the fide of the eye-ball next the nofe, that it reaches to the place where the cornea and fclerotica meet. When the encanthis has increafed to this confiderable pitch, it conftantly affects, together with the caruncula lachrymalis and femi-lunar fold of the conjunctiva, the membranous lining of one, or both eye-lids. In this ftate, it may be obferved, that the excrefcence, befides the roots, which it derives from the caruncula lachrymalis, and conjunctiva, has a firm prominent appendage, or elongation, which extends along the inner furface of the upper, or lower eye-lid, in the direction of its edge. In other terms, we may ftate, that the middle portion, or body (as it were) of the encanthis, near the cornea, divides, in the form of a fwallow's tail, into two appendages, or elongations, one of which extends along the infide of the upper eye-lid, covered by the edge of this part, while the other is continued along the inner furface of the lower eye-lid, concealed under its margin, and proceeding in the direction from the internal towards the external canthus of the eye.

Scarpa remarks, that the body of the encanthis, or that middle portion of the excrefcence, which reaches from the caruncula lachrymalis and femi-lunar fold inclufively, over the conjunctiva of the eye-ball, even to the very edge of the cornea, is fometimes as prominent as a common nut or a chefnut. In other inftances, it is of the fame fize, but depreffed and flattened, as it were, in the middle. However, the body of the excrefcence does not now retain the fame granulated appearance which it prefented at an earlier period, while one, or both the appendages, extending along the inner furface of one, or both eye-lids, feem more like a flefhy, than a granulated fubftance.

When the eye-lids are turned out, thefe appendages of the encanthis form a projection forward, and when this is obfervable on both palpebræ, on their being turned out in this manner, the two flefhy appendages make together a kind of ring, which comes into clofe contact with the globe of the eye behind. Scarpa informs us, that Fabricius Hildanus was acquainted with this difeafe, which he fucceeded in curing, and which he named *ficus. fcirrhofus ad majorem oculi canthum*. See Centur. 1. Obf. 2.

However, Scarpa takes notice, with refpect to the cafe recorded by Hildanus, that the encanthis had only one appendage, which was fituated on the inner furface, and below the margin, of the upper eye-lid.

Scarpa, in conformity with moft furgical writers, has very accurately explained, that the encanthis, as well as the pterygium, occafionally puts on a cancerous malignity, which is denoted by the dark-red, or leaden colour of the tumour; by its unufual degree of hardnefs; by its darting pains, which extend to the forehead, and all over the eye and temples, particularly whenever the excrefcence has been even gently touched; by its tendency to bleed; and, laftly, by the ulcerations, which occur in feveral places, emit a fungous growth, and difcharge a thin irritating fanies. Scarpa is of opinion, that this worft form of the encanthis can only receive palliative treatment, unlefs an attempt at extirpation be made, by removing, together with the difeafe, all the parts contained in the orbit, the fuccefs of which operation he alfo reprefents as exceedingly doubtful.

At the fame time, that we profefs the higheft refpect for the fentiments of Scarpa in general, on the fubject of difeafes of the eyes, we cannot filently fubfcribe to his advice, that no endeavour fhould be made to effect a radical cure of any malignant encanthis, without extirpating all the contents of the orbit. If the difeafe were not fo very extenfive, as to prevent the furgeon from making a fair removal of every part of it, without taking away the eye itfelf, what practitioner can doubt, that the latter formidable operation ought to be difpenfed with. It would be full time enough to have recourfe to this fevere ftep, when it had been decidedly evinced, that cutting away the difeafed parts alone was infufficient, and that malignant morbid mifchief ftill prevailed.

Scarpa informs us, that the benign encanthis, whether of fmall, or confiderable fize, may be cured by excifion. The fmall beginning encanthis, whether of a granulated or fringed appearance, and originating from the caruncula lachrymalis and femi-lunar fold, or, alfo, from a fmall portion of the margins of the eye-lids, where they form the internal commiffure, may be raifed with a pair of forceps, and be completely cut away clofely to its bafe with the curved fciffars. In order to accomplifh this operation, it is needlefs to follow the plan, which fome adopt, of introducing a needle and thread through the little excrefcence, with a view of raifing and detaching it more accurately from the parts, to which it is adherent. This object can be fulfilled with the forceps, without annoying the patient by the punctures, and by drawing a thread through the tumour, for the purpofe of making a noofe. However, in taking away fuch portion of the incipient encanthis, as arifes from the caruncula lachrymalis, Scarpa very prudently cautions us againft removing more of the fubftance of that body, than the complete eradication of the difeafe requires, left the lofs of too much fhould occafion an irremediable flux of tears from the eye.

When the little excrefcence has been extirpated, the eye ought to be repeatedly wafhed with cold water to get away the blood, and fhould then be covered with a piece of fine linen and a retentive bandage. About the fifth, fixth, or feventh day, as foon as the inflammation, produced by the operation, has quite fubfided, and fuppuration from the wound has commenced, Scarpa advifes us to touch the cut furface with a fmall button of alum, fcraped into the fhape of a crayon-pencil, and he alfo recommends a collyrium, containing the zincum vitriolatum and mucilage of quince-feeds, to be frequently applied to the eye in the courfe of the day. If this plan of treatment fhould not have the defired effect of making the wound heal; but, on the contrary, if the cut furface of the caruncula lachrymalis and internal angle of the eye fhould, inftead of continuing to heal up, put on a fungous appearance, it fhould be repeatedly touched with the argentum nitratum, care being taken not to apply this cauftic to the conjunctiva, more particularly, if any part of this membrane fhould have been wounded. After the deftruction of the fungous granulations, a collyrium, containing the zincum vitriolatum, will accomplifh the cure, or the practitioner may introduce between the eye-ball and internal commiffure of the eye-lids, three times a day, an ointment compofed of frefh butter, powdered tutty, and armenian bole. Scarpa alfo acquaints us, that Bidloo fpeaks much in favour of ufing for the latter purpofe powdered chalk, either alone, or mixed with calcined alum. See Exercit. Anat. Chir. Decad. 2.

Scarpa informs us, that we may alfo cut away the large inveterate

inveterate encanthis, either with a flat body, or with one, which projects in the ſhape of a common nut, or cheſnut, and having one, or two fleſhy appendages extending along the lining of one or both the eye-lids. In this inſtance, a ligature cannot be properly made uſe of, becauſe the neck of the tumour is never ſmall enough to allow of being advantageouſly tied. On the contrary, the encanthis, when it is very large, is always extenſively connected with the caruncula lachrymalis, and with the conjunctiva, almoſt as far as where the cornea begins, and it has, moreover, one or two fleſhy appendages, which run along the under ſurface of one or both the eye-lids. For this reaſon, even ſhould the middle part of the encanthis be extirpated with a ligature, ſtill one or both the appendages would ſtand in need of removal, which object could only be accompliſhed by exciſion.

The apprehenſion of the bleeding from the latter operation is quite unfounded, as there are numerous caſes on record, where the operator has cut away a large inveterate encanthis, without any ills ariſing from hemorrhage. Scarpa mentions, that he could relate himſelf ſome caſes which he has met with, in confirmation of the truth of the foregoing ſtatement. This candid writer, however, does not diſſemble, that Pellier records an example, in which a troubleſome degree of bleeding followed the exciſion of an encanthis; but, it is juſtly obſerved, that the particulars of the diſeaſe are undeſcribed, as well as the exact way in which the operation was performed. Had theſe circumſtances been detailed, perhaps they would have explained the reaſon of the unuſual occurrence. Indeed, Pellier himſelf has remarked, "j'ai ſouvent fait cette operation a des excroiſſances de cette nature, et jamais je n' ai èprouvé un pareil accident."

In the caſe of the large inveterate encanthis, referred to above, and in which there was only one appendage continued along the inſide of the upper eye-lid, Hildanus, after taking hold of the body of the encanthis with a tentaculum, drawing the tumour towards him, and turning out the upper eye-lid, in order to make the whole of the appendage project forward, detached all this laſt portion from the inſide of the eyelid with a ſmall knife, and afterwards cut away the body of the encanthis from the conjunctiva and caruncula lachrymalis. Scarpa remarks, that as this plan was attended with complete ſucceſs, it ought to be imitated by all practitioners.

However, when the inveterate encanthis, of large ſize, has two appendages, one reaching along the inner ſurface of the upper eye-lid, the other along that of the lower one, Scarpa adviſes the following plan to be adopted. The patient is to be ſeated in a chair, and the upper eye-lid turned out by an aſſiſtant, ſo as to make one of the appendages of the encanthis project forward. This production of the diſeaſe is to be deeply cut into with a ſmall knife, in the direction of the edge of the eye-lid, taken hold of with a pair of forceps, and be completely detached from the inſide of the part, in the longitudinal direction, the diſſection being continued from the external towards the internal angle of the eye, as far as the body of the encanthis. The appendage on the inner ſurface of the lower eye-lid ſhould be ſeparated in the ſame way. Then the middle portion of the encanthis ſhould be lifted up with a pair of forceps, or, (if this cannot be done) with a double hook, and be entirely cut away from the conjunctiva underneath, which covers the eye ball, and from the ſemi-lunar fold, and caruncula lachrymalis. This may be accompliſhed partly by means of a ſmall knife, and partly with the aid of curved ſciſſars. The operator is alſo to cut more or leſs deeply into the caruncula lachrymalis, according as the ſtrength and depth of the roots of the diſeaſe may require; for, it muſt be confeſſed, that, when the encanthis is very large, and of long ſtanding, the ſurgeon cannot always avoid wounding the caruncula lachrymalis ſufficiently to prevent ſome degree of weeping from the eye, after the operation.

The eye ſhould be repeatedly bathed with cold water, and the reſt of the treatment is nearly like that recommended after removing a ſmall incipient encanthis. Scarpa recommends the uſe of collyria of aqua malvæ, and of anodyne and detergent ones, until ſuppuration has fully taken place from the ſurface of the wound. Then mild aſtringents, and the above-mentioned ointment may be uſefully had recourſe to. Scarpa particularly adviſes giving a preference to mild applications, both before and after ſuppuration has taken place, eſpecially when a conſiderable piece of the conjunctiva, covering the white of the eye, has been cut away with the encanthis. See Scarpa Sulle Principali Malattie degli Occhi.

ENCARDION, from καρδια, *heart*, in *Botany*, a name given by the Greeks to what the Latins properly call the mediata in trees, the heart of the wood, or central hard part of it.

ENCATHISMA, from εγκαθημαι, *I ſit in*, in the *Medical Writings of the Ancients*, a term uſed to expreſs a ſort of bath, in which the patient was only to be plunged up to the belly.

ENCAUMA, from εν, and καιω, *to burn*, in *Surgery*, the mark left by a burn; alſo a ſmall abſceſs ariſing from the ſame cauſe. The term is ſometimes applied to a ſuperficial ulceration on the eye.

ENCAUSIS, from εν, and καιω, *to burn*, a burn, or the inflammation produced by this ſort of injury; alſo the operation of external heat on the body, as of the ſun, or fire. In Dr. Cullen's Noſology, the word is ſynonymous with erythema and ambuſtio.

ENCAUSSE, in *Geography*, a ſmall town of France, in the department of the upper Garonne; 12 miles E. of St. Bertrand, remarkable for its ſprings of mineral water.

ENCAUSTIC PAINTING, Εγκαυστικη, from εγκαιω, *inuro*, *I burn in*, is a ſpecies of painting with burnt wax, practiſed by the ancients, and lately revived. Pliny has given the following brief account of the invention and nature of this art: "Ceris pingere ac picturam inurere, quis primus excogitaverit non conſtat; quidam Ariſtidis inventum putant, poſtea conſummatum à Praxitele; ſed aliquanto vetuſtiores encauſticæ picturæ extitere, ut Polygnoti, & Nicanoris, & Arceſilai, Pariorum. Lyſippus quoque, Eginæ picturæ ſuæ inſcripſit ἐνέκαυσεν; quod profecto non feciſſet, niſi encauſtica inventa. Pamphilus quoque Appellis præceptor non pinxiſſe tantùm encauſtica, ſed etiam docuiſſe traditur Pauſiam Sycionium, primum in hoc genere nobilem." Lib. xxxv. cap. 11. From this paragraph we learn, that the method of painting in wax, and burning in the picture, was very ancient; nor is it improbable that in former times, when they were unacquainted with dry oils, and tranſparent varniſhes, they ſhould make uſe of this method for preſerving their colours from damps and heats; though ſome imagine, that by *ceris* is meant a compoſition, different from wax, and capable of bearing the fire; and that burning the picture denotes merely enamelling. Pliny in the ſame chapter informs us, that there were anciently two methods of encauſtic painting in uſe: "Encauſto pingendi duo fuiſſe antiquitùs genera conſtat, cerâ & in ebore, ceſtro, *i. e.* viriculo; donec claſſes pingi cœperè. Hoc tertium acceſſit, reſolutis igni ceris, penicillo utendi; quæ pictura in navibus nec ſole, nec ſale, ventiſque corrumpitur." Dr. Parſons maintains, that the *ceſtrum* was a pointed tool uſed in modelling

delling or carving upon ivory or wax; and he fuppofes that there is a contraft between the ufe of the *ceftrum*, and painting fhips with a brufh, and therefore that the term *pingendi* cannot be underftood to mean the laying on of paint. However, there is a paffage in Vitruvius, lib. vii. cap. 9. which ferves to afcertain the nature of the ancient encauftic painting. "At fi quis fubtilior fuerit, & voluerit expolitionem miniaceam fuum colorem retinere, &c." *i. e.* if any one is more wary, and would have the polifhing, or painting, with vermilion hold its colour, when the wall is painted and dry, let him take Carthaginian wax, melted with a little oil, and rub it on the wall with a hair-pencil; and afterwards let him put live coals into a chafing-difh, and hold it clofe to the wax; when the wall, by being heated, begins to fweat, let it be made fmooth; afterwards let him rub it with wax tapers, and clean linen rags, in the fame manner as they do the naked marble ftatues. This the Greeks call καυσις. The coat of Carthaginian wax is fo ftrong, that it neither fuffers the moon by night, nor the fun-beams by day, to deftroy the colour. From this paffage we learn the ancient method of painting in wax by inuftion, more obfcurely expreffed by Pliny; though Pliny, in another paffage, exprefsly informs us, that they ufed coloured wax: "Ceræ (he fays) tinguntur iifdem his coloribus, quæ inuruntur;" that they employed a pencil to lay on the melted wax; "refolutis igni ceris, penicillo utendi:" that the picture was fixed by inuftion, "picturam inurere." And we learn from Vitruvius, that the whole was cleaned and polifhed with linen rags.

The Punic or Carthaginian wax, the ufe of which is afcribed to the ancient painters by Varro, Vitruvius, and Pliny, was faid to be the beft, as it exceeded in whitenefs the Sardinian and Corfican, probably becaufe it was better purified; for the Africans, as we learn from Pliny, were accuftomed to ufe alkali in order to render this fubftance whiter, and alfo to free it, as fome have fuppofed, from all greafy matter. Wax, however, feems to have formed the only ground of wax-painting. The abbé Requeno, who contributed to prefent to the notice of modern painters wax painting, adds maftic; but Lorgna converts his wax i to foap, as Bachelier does with the alkali of Soda. Aftori adds gum and honey, affirming that thus the wax would be rendered much more yielding and fofter for the brufh. Requeno feems to affign the exclufive poffeffion of this art to the Greeks and Romans; but we have reafon for believing that the knowledge and ufe of encauftic painting were older than their time, becaufe the Egyptians, who with the Etrufcans were the parents of the greater part of the inventions known among mankind, and from whom the Greeks derived much of their knowledge, were acquainted with and employed encauftic painting in the ancient ages of their greatnefs and fplendour. This fact has been deduced from valuable fragments of the bandages and coverings of mummies painted in this manner. A mummy of this kind is mentioned in a treatife entitled "Antichita, &c." referred to at the clofe of this article. No oil-painting, it is faid, perhaps only two or three hundred years old, exhibits a white paint that has kept fo well as that feen on the fragment to which we have alluded; and this circumftance fufficiently proves the valuable advantage which that method poffeffes when compared with the common oil-painting. The wax, inftead of becoming black by the contact of the atmofphere, as drying oil does, acquires increafing whitenefs, and according to its natural quality, is not decompofed in the air, and does not ftrongly attract the oxygen of the calces or metallic afhes, which are commonly ufed in painting. That beautiful white, which may be obferved in the Egyptian encauftic above-mentioned, is, as the author of the treatife juft cited apprehends, nothing elfe but a fimple earth, and according to his chemical experiments a chalk *(creta,)* which is alfo unalterable. If we confider this encauftic fragment, fays our author, as belonging to the epoch of the firft violent change, which the religious fyftem of the Egyptians experienced, it will be a fpecimen of painting about 2500 years old; for fuch is the number of the years that have elapfed fince Cambyfes overturned the ceremonies and religious worfhip of the Egyptians, not only by the fword, but by the ftill more powerful weapons of ridicule. Dead bodies were embalmed there in the time of Herodotus, (fee EMBALMING); but the cloth in which they were wrapped, or the bandages bound round them, were no longer painted with facred characters. The bodies were only inclofed in wooden cafes, which were more or lefs ornamented. If Bochart and Menage be not miftaken, the name "mummia" is derived from "muim," which fignifies wax; and one might therefore believe, that the drefs of embalmed bodies was thus named becaufe wax was employed for painting it; and thence it would follow, that the fragment in queftion may be claffed among the oldeft. Petronius praifes the frefh appearance which the valuable works of Zeuxis and Apelles had, even in his time; but Cicero, on the other hand, fpeaks of the paintings of the ancients having fuffered from blacknefs. The former is fuppofed to have fpoken of wax-painting, and the latter is prefumed to have alluded to paintings in oil. The author, whofe fentiments we are now expreffing, detached 24 grains of the encauftic painting from the above-mentioned Egyptian fragment; and in his mode of examining it, the mixture of 100th part of a foreign fubftance would have been difcovered with the greateft certainty: he muft, he fays, have perceived the refin of Requeno, nor could the alkali of Bachelier and Lorgna have efcaped his notice. But in this Egyptian encauftic he found nothing except very pure wax, though he varied his analyfis in every known method.

From the words of Vitruvius above cited it appears, that the Romans, who copied the Grecian procefs, which was borrowed from the Egyptians, mixed the wax with an oil to make it pliable under the brufh, but no maftic, alkali, or honey, as fome have imagined, was employed; what this oil was it is not eafy to afcertain. It does not appear that they ufed thofe fat oils, which are commonly called drying oils, becaufe they could have employed thofe as we do, without the addition of wax, which would have been altogether fuperfluous. Fat oils, which do not dry, would not have been proper for that purpofe, as they would have kept the wax continually in a foft ftate. Our author fuppofes, that the Egyptians, in order to ufe wax in their encauftic painting, muft have combined it with an ethereal volatile oil, of which no traces fhould afterwards remain, and that though they might be unacquainted with the art of feparating ethereal oils from the many fubftances which they contain, they certainly were acquainted with a very volatile thin oil produced by nature, and which in various places iffues from the earth. This oil was either that called naphtha, which is an exceedingly volatile oil, that entirely flies off and evaporates, without leaving a fingle trace behind; or the common fpirit of turpentine, which would very well anfwer the purpofe. The encauftum, thus formed, was ufed in the time of the Romans to cover parts, which had been already painted either with water-colours or in frefco; and it was alfo, as we have reafon to believe, the fubftance with which Apelles daubed over his paintings, and which, according to Pliny, made them appear as if covered by a thin plate of talc or tranfparent felenite, and gave the colours a wonderful foftnefs.

nefs. It might ftill be employed for preferving paintings in water-colours, or on plafter, and fculptured pieces of marble.

The ancient art of encauftic painting, after having been long loft, was reftored by count Caylus, a member of the Academy of Infcriptions in France; and the method of painting in wax was announced to the Academy of Painting and Belles Lettres, in the year 1753; though M. Bachelier, the author of a treatife "De l'Hiftoire & du Secret de la Peinture en Cire," had actually painted a picture in wax in 1749; and he was the firft who communicated to the public the method of performing the operation of inuftion, which is the principal characteriftic of the encauftic painting. The count kept his method a fecret for fome time, contenting himfelf with exhibiting a picture at the Louvre in 1754, reprefenting the head of Minerva, painted in the manner of the ancients, which excited the curiofity of the public, and was very much admired. In the interval of fufpence, feveral attempts were made to recover the ancient method of painting. The firft fcheme adopted was that of melting wax and oil of turpentine together, and ufing this compofition as a vehicle for mixing and laying on the colours. But this method did not explain Pliny's meaning, as the wax is not burnt in this way of managing it. In another attempt, which was much more agreeable to the hiftorian's defcription of encauftic painting, the wax was melted with ftrong lixivium of falt of tartar, and with this the colours were ground. When the picture was finifhed, it was gradually prefented to the fire, fo as to melt the wax; which was thus diffufed through all the particles of the colours, fo that they were fixed to the ground, and fecured from the accefs of air or moifture. But the method of count Caylus is much more fimple: the cloth, or wood which he defigned for the bafis of his picture, is waxed over, by only rubbing it fimply with a piece of bees' wax; the wood, or cloth, ftretched on a frame, being held horizontally over, or perpendicularly before a fire, at fuch a diftance, that the wax might gradually melt, whilft it is rubbed on, diffufe itfelf, penetrate the body, and fill the interftices of the texture of the cloth, which, when cool, is fit to paint upon; but as water-colours, or thofe that are mixed up with common water, will not adhere to the wax, the whole picture is to be firft rubbed over with Spanifh chalk or white, and then the colours are applied to it; when the picture is dry, it is put near the fire, whereby the wax melts, and abforbs all the colours.

Mr. J. H. Muntz, in a treatife on this fubject, has propofed feveral improvements in the art of encauftic painting. When the painting is on cloth, he directs it to be prepared by ftretching it on a frame, and rubbing one fide feveral times over with a piece of bees'-wax, or virgin's-wax, till it is covered with a coat of wax of confiderable thicknefs. In fine linen, this is the only operation neceffary previous to painting; but coarfe cloth muft be rubbed gently on the unwaxed fide with a pumice ftone, to take off all thofe knots, which would prevent the free and accurate working of the pencil. Then the fubject is to be painted on the unwaxed fide with colours prepared, and tempered with water; and when the picture is finifhed, it muft be brought near the fire, that the wax may melt and fix the colours. This method, however, can only be applied to cloth or paper, through the fubftance of which the wax may pafs; but in wood, ftone, metals, or plafter, the former method of count Caylus muft be obferved.

Mr. Muntz has alfo difcovered a method of forming grounds for painting with crayons, and fixing thefe, as well as water colours, employed with the pencil. On the unwaxed fide of a linen cloth, ftretched and waxed as before, lay an even and thick coat of the colour proper for the ground: having prepared this colour, by mixing fome proper pigment with an equal quantity of chalk, and tempering them with water. When the colour is dry, bring the picture to the fire that the wax may melt, pafs through the cloth, and fix the ground. An additional quantity of wax may be applied to the back of the picture, if that which was firft rubbed on fhould not be fufficient for the body of colour; but as this muft be laid on without heat, the wax fhould be diffolved in oil of turpentine, and applied with a brufh, and the canvas be again expofed to the fire, that the frefh fupply of wax may pafs through the cloth, and be abforbed by the colour; and thus a firm and good body will be formed for working on with the crayons. If cloth and paper are joined together, the cloth muft be firft fixed to the ftraining frame; and then the paper muft be pafted to it with a compofition of pafte made with wheaten flour, or ftarch and water, and about a twelfth part of its weight of common turpentine. The turpentine muft be added to the pafte when it is almoft fufficiently boiled, and the compofition well ftirred, and left to fimmer over the fire for five or fix minutes; let wax be diffolved in oil of turpentine to the confiftence of a thin pafte; and when the cloth and paper are dry, let them be held near a fire; and with a brufh lay a coat of the wax and turpentine on both fides the joined cloth and paper, in fuch a degree of thicknefs, that both furfaces may fhine throughout without any appearance of dull fpots. Then expofe the cloth to the fire or to the fun; by which means the oil will evaporate, and the wax become folid, and be fit to receive any compofition of colour for a ground, which is to be laid on as above directed in the cafe of cloth without paper.

Almoft all the colours that are ufed in oil-painting may be alfo applied in the encauftic method. Mr. Muntz objects, indeed, to brown, light pink, and unburnt *terra di Sienna*; becaufe thefe, on account of their gummy or ftony texture, will not admit fuch a cohefion with the wax as will properly fix them; but other colours, which cannot be admitted in oil-painting, as red-lead, red orpiment, cryftals of verdegris, and red precipitate of mercury, may be ufed here. The crayons ufed in encauftic painting are the fame with thofe ufed in the common way of crayon painting, excepting thofe that in their compofitions are too tenacious; and the method of ufing them is the fame in both cafes.

The encauftic painting has many peculiar advantages; though the colours have not the natural varnifh or fhining which they acquire with oil, they have all the ftrength of paintings in oil, and all the airinefs of water-colours, without partaking of the apparent character or defects of either; they may be looked at in any light and in any fituation without any falfe glare; the colours are firm, and will bear wafhing; and a picture, after having been fmoaked, and then expofed to the dew, becomes as clean as if it had been but juft painted. It may alfo be re-touched at pleafure, without any detriment to the colours; for the new colours will unite with the old ones, without fpots, as is the cafe in common fize painting; nor is it neceffary to rub the places to be retouched with oil, as in oil pictures; it is not liable to crack, and eafily repaired, if it fhould chance to fuffer any injury. The duration of this painting is alfo a very material advantage; the colours are not liable to fade and change; no damp can affect them, nor any corrofive fubftance injure them; nor can the colour fall off in fhivers from the canvas. However, notwithftanding all thefe and other advantages enumerated by the abbé Mazeas, and Mr. Muntz, this art has not yet been much practifed. Many of thefe properties belong to a much higher ſpecies of encauſtic painting lately diſcovered in England, the colours of which are fixed by a very intenſe heat; nor are the colours, or grounds, on which they are laid, liable to be diſſolved or corroded by any chemical menſtruum, nor, like the glaſſy colours of enamel, to run out of the drawing on the fire. See on this ſubject, Phil. Tranſ. vol. xlix. art. 100. p. 652. art. 101. p. 655. Id. vol. li. art. 8. p. 40. art. 9. p. 53. Muntz's Encauſtic Eloge of Count Caylus, in the Hiſt. de l'Acad. Roy. des Inſcript. & Belles Lettres, vol. xxxiv. Antichita, Vantaggi e Metodo della Pittura Encauſta; Memoria del Ch. Sig. Giov. Fabbroni, &c. Roma, 1797, 4to. Handmaid to the Arts, &c. vol. i. ch. ix. p. 245. 26'.

ENCAUSTICE has been ſometimes uſed to denote the art of *enamelling*, which ſee.

ENCAUSTUM CÆRULEUM, is a name given to powder blue.

ENCAUSTUM *ſacrum*, a name given, by many authors, to that fine red colour uſed for illuminating the capital letters in ſome old manuſcripts. Procopius calls it *baphe*, ſome have called it coccus, and ſome cinnabar. It is ſaid that it was made of the purple colour, extracted from the murex, or purple fiſh, with ſome other additions. It is to be obſerved, that however well this colour, when laid on the parchment, or paper, might reſemble the colours of enamel, yet it was as improper to call it encauſtum, which ſignifies a "colour burnt in," as in enamelling it would have been to have called it atramentum, or ink.

ENCEADA DA BELA, in *Geography*, a town of Africa, in the kingdom of Adel, on the coaſt of the Indian ſea; 30 miles S. of cape Guardafu.

ENCEINTE, Fr. from *enceindre, to ſurround*, in *Fortification*, the wall or rampart which ſurrounds a place, ſometimes compoſed of baſtions and curtains either faced or lined with brick or ſtone, or only made of earth.

The enceinte is ſometimes only flanked by round or ſquare towers, which is called a Roman wall.

ENCELIA, in *Botany*, Juſſ. 186. Cavanilles Ic. v. 1. 44, t. 61, and v. 3. 6. t. 210, ſee PALLASIA.

ENCEPHALI, in *Medicine*, a term employed by ſome writers to ſignify certain worms, ſaid to be generated in the head.

ENCEPHALITES LAPIS, in *Natural Hiſtory*, the name given, by authors, to a ſort of coarſe ſtone, ſuppoſed, in ſome degree, to reſemble the human brain. We have, in the foſſile world, many ſtones, named from the parts of animals, which they have, in reality, been formed from, or owed their original to; and theſe are properly enough called by names denoting the things whoſe forms they wear; but it is a very wrong practice, from ſome ſlight external reſemblances, to give ſuch names to things that never can have been ſuppoſed to be ſo entitled to them. No one can be ſo abſurd as to imagine a human brain can be petrified, though a ſtone may accidentally ſomewhat reſemble its form. The perſon poſſeſſed of ſuch an accidental ſpecimen, ſhould have ranked it among the ſtones to which it properly belonged as a ſtone, whether a flint, a pebble, or a nodule, and have named, as an accident only, this form of it; and not have given it a peculiar denomination, as if it were a new ſpecies.

ENCEPHALOCELE, from εγκεφαλος, *the brain*, and κηλη, *a tumour*, in *Surgery*, a hernia of the brain. See FUNGUS.

ENCEPHALON, from εν, *in*, and κεφαλη, *the head*, in *Anatomy*, ſhould ſignify, according to its etymology, all the parts contained in the head; but it is commonly applied to the brain, as conſiſting of cerebrum, cerebellum, and medulla oblongata, excluſive of the ſurrounding and containing membranes. Hence, Soemmerring's tabula baſeos encephali is a repreſentation of the baſis of the brain. See BRAIN.

ENCEPPE, in *Heraldry*, denotes chained, or girt round the middle; as is uſual with monkeys, &c.

ENCERIS, in *Pharmacy*, a word uſed by Galen to ſignify ſmall concretions of wax, which formed themſelves in melted plaſters, of which wax was one of the ingredients. As they cooled, the wax cooling firſt, and collecting itſelf into little grumes, ſpoiled the conſiſtence and form of the whole compoſition.

ENCHANTMENT, of *in*, and *canto*, I ſing, denotes certain words and ceremonies uſed by magicians in the practice of their pretended and deluding art; thus called, becauſe the formulæ of their enchantment were generally compoſed in verſe, and deſigned to be ſung. See CHARM, FASCINATION, MAGIC, SORCERY, and WITCHCRAFT.

ENCHARAXIS, from εν, and χαρασσω, *to ſcarify*, in *Surgery*, a ſcarification.

ENCHASING, INCHASING, or CHASING, the art of enriching and beautifying gold, ſilver, and other metalworks, by ſome deſign or figures repreſented thereon, in low relievo. See SCULPTURE, RELIEVO, &c.

Chaſing is only practiſed on hollow, thin works; as watch caſes, cane-heads, tweezer-caſes, or the like. It is performed by punching or driving out the metal to form the figures from within ſide, ſo as to ſtand out prominent from the plane or ſurface of the metal.

In order to this, they have a great number of fine ſteel blocks, or puncheons, of divers ſizes; and the deſign being drawn on the ſurface of the metal, they apply the inſide upon the heads or tips of theſe blocks, directly under the lines or parts of the figures. Then, with a fine hammer, ſtriking on the metal ſuſtained by the block, the metal yields, and the block makes an indenture or cavity on the inſide; correſpondent to which, there is a prominence on the outſide, which is to ſtand for part of the figure.

Thus the workman proceeds to chaſe and finiſh all the parts, by ſucceſſive applications of the block and hammer to the ſeveral parts of the deſign.

And it is ſurpriſing, with what beauty and juſtneſs, by this ſimple piece of mechaniſm, the artiſts in this kind will repreſent foliages, groteſques, animals, hiſtories, &c.

ENCHEIRESIS, Εγχειρησις, from εν, *in*, and χειρ, *a hand*, in *Anatomy*, denotes manual operation; as diſſection.

ENCHELIS, in *Zoology*, a genus of *Vermes Infuſoria*, deſcribed eſſentially as being inviſible to the naked eye, very ſimple, and cylindrical. Nearly all the ſpecies are found in ſtagnant water.

Species.

PYRUM. Inverſely conic, behind tranſparent. Müll.

Common in ſtagnant waters, where the duck-weed grows. Body obtuſe, and filled with molecules; and when at reſt, appears to have a ſmall tubercle in the middle of the body. This kind is remarkable for the rapidity of its motion.

SPATHULA. Cylindrical, ſtriated, with a tranſparent ſpatulate tip. Müll.

Leſs frequent than the laſt, and found in waters in which the duck-weed is infuſed. The body is cryſtalline, and the creature moves in an undulate manner.

PAPULA. Cylindrical, with the tip papillary. Müll.

Found in the water of dunghills. The body is round, protuberant, opake before, and furniſhed with a papillary finger-ſhaped head; pellucid behind, and both ends obtuſe. Its motion is rotatory and oblique.

Fritillus. Cylindrical, truncated anteriorly. Müll. Hermann.

Met with in water in which grafs or hay is infufed. The body is pellucid, convex, and obtufe behind; moves backwards and forwards with a wavering agitation in a line.

Ovulum. Cylindrical-ovate, and hyaline. Müll.

Found in the water of dunghills. Very minute and pellucid.

Fusus. Cylindrical, narrow, and truncated at both ends. Müll.

Obferved only in pure water.

Epistomium. Elongated, cylindrical, with a flender fub-globular tip. Müll.

Inhabits putrid water. The body is round, obtufe behind, and its fize minute.

Seminulum. Cylindrical and equal. Müll.

In water kept fome days. The body twice the length of its breadth, pellucid before, and opake behind. Moves by alternately afcending and defcending.

Nebulosa. Oval-cylindrical, with vifible moveable inteftines. Müll.

Found in waters with cyclidium glaucoma.

Farcimen. Cylindrical, curved, and truncated at both ends. Joblot.

In water kept a few days. Body opake, and in its motion often appears in the fhape of the letter S.

Viridis. Green, fub-cylindrical, and obliquely truncated before.

Abundant in water kept fome weeks. Tail obtufe, inteftines obfcure.

ENCHELUS, Εγχελυς, in *Ichthyology*, the name given by Ariftotle, Appian, and all the Greek writers, to the eel.

ENCHESON, a French word ufed in our *Law-Books* and *Statutes*, fignifying the occafion, caufe, or reafon, wherefore any thing is done. Stat. 5 Edw. III. cap. 3.

ENCHRI'STA, from εγχριω, *to anoint*, in *Surgery*, liniments with which parts are anointed.

ENCHYMA, of εγχυω, *I pour in*, in the *Medical Writings of the Ancients*, a word ufed in feveral fenfes. Some have made it exprefs only an *infufion;* others have ufed it for what the modern phyficians call *plethora ad vafa*, that is, a fulnefs of the veffels, fimply confidered, as a relative to themfelves; and others have made it the name of certain forms of liquid medicines, to be injected into the ears, into the thorax, or any other part.

ENCHYMOMA, of εγχυμος, from εγχυω, in the *Writings of the Ancient Phyficians*, a word ufed to exprefs that fudden effufion of blood into the cutaneous veffels, which arifes from joy, anger, fhame, or any other violent emotion of the mind, and is what we ufually call blufhing; which, according to Dr. Hunter, is a nervous affection.

Enchymoma is alfo an afflux of the blood, whereby the external parts are rendered black and blue, as in the fcurvy, blood-fhot eyes, &c.

ENCHYMONITES, in *Natural Hiftory*, the name of a kind of ftone found in Macedonia, and fome other places, which was alfo called *pæonites* and *pæanites:* it was fuppofed to be of great virtue to affift women in labour. See Ceanides.

ENCHYMO'SIS, from εγχυω, *to pour into*, in *Surgery*, an extravafation of blood from the veffels, attended with black, blue, or livid appearance of the part. See Ecchymosis.

ENCHYSMA, the fame with clyfter or enema.

ENCHYTA, in the *Medical Writings of the Ancients*, a name given to fuch medicines as were injected into the eyes, or into any part.

Some alfo have ufed the fame word to exprefs a fort of funnel, contrived to convey the fumes of medicines to any part of the body.

ENCKENDORP, in *Geography*, a town of Germany, in the duchy of Holftein; 6 miles S.E. of Rendfburg.

ENCKHUYSEN, or Enkhuizen, a confiderable town of Holland, on the Zuyder Zee, in North Holland; 9 miles N.E. of Horn, and 30 miles N.E. of Amfterdam. N. lat. 52° 40′. Its commerce, and particularly its herring-fifhery, was of great importance in former times; but its harbour is now almoft entirely choaked up with fand.

ENCLAVE', in *Heraldry*, is where one thing is let into another, particularly where the jointure is fquare.

ENCLITICA, of εγκλινω, *I incline*, in the *Greek and Latin Grammar*, certain particles, united fo clofely to the preceding word, that they only feem to form one word therewith; and the word which fuftains them does generally likewife bear the accent that governs them, efpecially when the enclitic is a monofyllable; as in *dominufque*, κυριος τε.

There are three enclitic particles in the Latin, *viz. que*, *ne*, and *ve;* but in the Greek many, as του, μου, μοι, με, σου, σοι, σε, πως, πη, τε, γε, φημι, ειμι, ποτε, and others.

ENCLOS, L', in *Biography*, a mufician in Louis XIII.th's band, an eminent performer on the lute and theorbo, or fingle and double lute.

He was father of the celebrated Ninon, who played on thefe inftruments as well as himfelf.

He dying in 1630, left her an orphan at 15 years old, beautiful, full of wit and talents, and formed to infpire the moft violent paffion. Nor did fhe wrap her talents in a napkin, but availed herfelf of all their influence; and even at more than fourfcore, fhe is faid to have awakened love in the learned abbé Gédoin.

It is pretended that cardinal Richelieu had her firft favours, and that he was the only one to whom fhe furrendered, without confulting her inclinations.

She was then 17, and it is certain that, ever after that time, fhe received a penfion of 2000 livres annually, which was long regularly paid.

Ninon gave concerts at her houfe, where perfons of the firft rank and talents came to admire her performance on the lute and harpfichord. The philofopher, Huyghens, the famous aftronomer, likewife obferved Ninon with great attention and accuracy, and even wrote verfes on her, which Voltaire calls *Geometric.*

> "She has inftruments five, which my brain much difturb,
> The two firft are her hands, the next are her eyes;
> But my tongue for the fifth and the beft I muft curb,
> Nor its beauties attempt to difclofe, if I'm wife."

She was feldom left by her lovers, but fhe left them very foon; yet fhe always retained a friendfhip for her old admirers.

She was fo celebrated, that Chriftina queen of Sweden made her a vifit in 1654, in a fmall villa which fhe had in the neighbourhood of Paris.

Madame de Maintenon was her beft friend; and Voltaire afferts that M. de Villarecau was a lover in common with both, without its occafioning a quarrel.

He had two children by Ninon. The hiftory of the eldeft is known, who at 19 years old became paffionately enamoured of her; but on making the difcovery, he blew his brains out. Her fecond fon, called Boiffiere, died at

Rochelle in 1723, commiffary of marine. She loved ferioufly for fome time the marquis de Sévigné, brother of madame de Grignan; but who never wrote the letters to her, which M. d'Amoure has printed under her name about 40 years ago.

Madame de Maintenon, becoming all powerful, remembered her, and fent her word that fhe would take care of her fortune, if fhe would change her way of living, and think ferioufly of religion: Ninon replied, that fhe neither wanted fortune nor a mafk. Ninon died at Paris, 1705, at the great age of 90.

ENCŒLIA, of ἐν, *in*, and κοιλια, *belly*, a word ufed by many of the ancient medical writers, to exprefs the vifcera contained in the abdomen, or lower belly.

ENCOLPIUM, or ENCOLPION, the pectoral crofs of bifhops, abbots, abbeffes, &c.; being one of the ordinary marks of the dignity of fuch perfons both in the Latin and the Greek church.

ENCONDRUS, of ἐν, *in*, and χονδρος, *grain*, in the *Old Greek Writers*, a word ufed to exprefs any thing made up of a great number of fmall pieces, or flakes, or fmall grains of any thing. The manna of the ancients was not in large flakes, as we have it at prefent, but it was formed of a vaft number of fmall granules, and was therefore called by Diofcorides, and fome others of the Greeks, by this name. The word manna alfo fignified with them the fame thing; and they not only expreffed the fubftance by it which we at prefent call fo, but any other thing that was in fmall flakes, or pieces, was called manna. Thus the manna thuris, fo much talked of among the old Greeks, was only a collection of thofe pieces which flew off from frankincenfe in the breaking. See MANNA *Libanotis*.

ENCOPE, of ἐν, and κοπτω, *I cut*, in *Surgery*, an incifion of any part; as in a gangrene, &c.

ENCOUNTER, in a *Military Senfe*, relates to that kind of deliberate attack, which is totally abftracted from accidental hoftility, and may therefore be confidered in contradiftinction to the rencontre, which ordinarily implies a fortuitous meeting. Thus we find, "to lead troops to the encounter," is a very common expreffion; though we occafionally hear the term mifapplied by perfons who defcribe the loffes, &c. fuftained in accidental warfare, as having taken place, not in the rencontre, but in the encounter. We fhould alfo underftand, that, in the ftrict fenfe, (which relates entirely to the arranging of troops oppofite, that is, *en-contre*, to the enemy,) we ought not to confider circuitous attacks, and thofe feints made merely for the purpofe of diftracting the enemy's attention, as coming under this definition; and, on the other hand, we confider not only thofe who come into actual engagement, perhaps to the point of the bayonet, as is often the cafe in the attacks made by columns of infantry, but the fupporting divifions alfo, to be engaged in the actual encounter. Thus we frequently perceive, that the leading regiment of a column is engaged, while the rear regiments bear no fhare in the conteft; but if their fituations be fuch as to expofe them to the enemy's fire, they muft be as much confidered in the encounter as a veffel coming to the aid of another, fo as to caufe the enemy's fhip to furrender, or to retreat. Hence it has ever been held a rule, that all veffels in fight, when a capture is made, become entitled to fhares in the prize; becaufe, on many occafions, the approach of reinforcements adds to the vigour of one party, while it depreffes the fpirits of the other, and influences it to decline further conteft.

ENCRANIUM, in *Anatomy*, the fame with cerebellum.

ENCRASICOLUS, in *Ichthyology*, a fpecies of clupea. See CLUPEA and ANCHOVY.

ENCRATITÆ, formed from ἐγκρατης, *continent*, in *Ecclefiaftical Hiftory*, a fect of ancient heretics, thus called from their making profeffion of continence, and abfolutely rejecting all ufe of marriage.

The founder of this fect was Tatian, a difciple of Juftin, and one of the moft learned perfons of all antiquity. After the death of that martyr, he made a feparation from the church, and foon had his followers; who, befide the dogma juft mentioned, borrowed a great many things from Saturninius and Marcion; befide feveral errors, which they adhered to in common with the Gnoftics and Valentinians.

They abftained from eating any thing that had life, and denied that Adam was faved. They looked on fuch as drank wine to be great finners; and for this reafon only made ufe of water in celebrating the Eucharift, as holding, that wine came from the devil. To countenance this tenet, they produced paffages out of fcripture, where mention is made of what befel Noah and Lot, when they were drunk.

They only admitted fuch of the books of the Old Teftament as they thought good; but in lieu thereof, they owned feveral fpurious and apocryphal writings for canonical and divine. Such were the Acts of St. Andrew, John, and Thomas.

ENCRAULOS, in *Ichthyology*, the name given by Ariftotle, and many other of the ancient Greeks, to the fifh which we call the anchovy. See CLUPEA and ANCHOVY.

ENCRINITES, in *Natural Hiftory*, a kind of columnar extraneous or organized foffil, found in the earth. See ENCRINUS, PENTACRINI, and ENTROCHI.

ENCRINUS FOSSIL, is the remains of an animal, fo called by fome; by others, this clafs of zoophytic remains is called *encrinites* (Parkinfon's Organic Remains, vol. ii. p. 153.); and by others, denominated *entrochi*, or *pentacrini*. See thofe articles. See alfo Harenberg's Encrinus S. Lilium Lap. 4to.

ENCRINUS, a fpecies of *Pennatula*, in the clafs of zoophyte worms, comprehending the clufter-polypi of Ellis, and inhabiting the Greenland fea.—Alfo, the name given by Ellis to the Afteria, a fpecies of Ifis, inhabiting the ocean that wafhes the coaft of Barbadoes.

ENCRIS, in the *Medical Writings of the Ancients*, fignifies a fort of cake made of fine flour, mixed with oil, and fweetened with honey.

ENCROACHMENT *of the Sea*, in *Geography*, fignifies the fudden or gradual converfion of dry land into the verge of the ocean. Hiftory records numerous inftances of great and devaftating effects of this kind: fome occafioned by the waves of the fea undermining the cliffs on its fhore, and carrying away the matter thereof as faft as they fall, by which the boundaries of the fea have been confiderably enlarged in fome places; and its ravages ftill continue with increafing effect in fome places, as on the chalky fhores of Kent and Suffex. Another kind of marine encroachment, highly interefting to the geologift, is evidently taking place, by flow degrees, on a confiderable portion of the flat fhores of England; and can only be explained by an exceeding flow and gradual fubfidence of the ifland itfelf, or a correfponding rife of the ocean which bounds it. This is particularly vifible in the fens and marfhes of our coaft, which

which are now defended by banks of that magnitude and height, which fcarcely any effort of the prefent day could at once effect; but which, as in the marfhes embanked from the Thames below London, muft have been begun centuries ago, when the tide flowed not fo high by many feet as it does at prefent, and have been gradually raifed, as the height of the water increafed. The finding of immenfe fallen woods of trees, of the recent fpecies, with the marks of human labour on them, and even the very tools by which they were felled, under great thicknefs of peat, the whole of which is now much below the level to which the tide rifes twice each day, are alfo proofs of this general encroachment of the fea; fince neither peat nor trees of any kind will grow where the falt-water of the ocean even faturates, much lefs continually overflows the ground. The mention of various inftances of ancient and high embankments of marfhes and fens againft the tide, will be found under our article Canal, in the divifions *Thames*, *Oufe*, *Welland*, &c. See alfo Embankment.

Encroachment. See Incroachment, and Accroching.

ENCURECK, in *Natural Hiftory*, a venomous infect, found in Perfia, and fuppofed by fome to be a kind of tarantula. It neither ftings nor bites, but lets fall its venom like a drop of water, which caufes infufferable pain in the part for a time; and afterwards fo profound a fleep, that we are told nothing can raife the patient from it but crufhing one of thofe creatures on the part affected. It is neverthelefs faid, that the fheep eat thefe infects without damage. Olearius, ap. Boyle, Works abr. vol. i. p. 37. Ibid. p. 38.

ENCYCLOPÆDIA, the circle or chain of arts and fciences.

The word is compounded of the prepofition εν, *in*, κυκλος, *circle*, and παιδεια, *fcience*, *doctrine*, *difcipline*, *learning*; the root being παις, *child*, *infant*.

The Greeks ufed the term for the knowledge of the feven liberal arts, and the poffeffion of all the fciences. *Orbis ille doctrinæ, quem Græci εγκυκλοπαιδειαν vocant*, fays Quintilian. It is fometimes alfo written κυκλοπαιδεια, *cyclopædia*. Vitruvius, in the preface to his fixth book, calls it *encyclios difciplina*. See Cyclopædia.

ENCYSTED Tumours, in *Surgery*, fwellings, which are formed of a bag, or cyft, which is filled with matter very various in its confiftence and appearance. When the contents of the cyft refemble pap, the tumour is named *atheroma*; when they are of the confiftence of honey and wax, it is called *meliceris*; when they are fatty, it is termed *fteatoma*. See thefe words, and efpecially Tumours.

END *for* End, in the *Sea-Language*. When a rope runs all out of the block, fo that it is unreeved, they fay it is run out end for end.

The fame phrafe is applied to a cable that has wholly run out of the fhip. In general, it denotes the reverfal of the pofition of any object.

End-*on* is applied to a fhip, which advances to a fhore, rock, &c. without any apparent poffibility of preventing her.

ENDE, in *Geography*, one of the fmaller Molucca iflands, S. lat. 8° 30′. E. long. 120°.

ENDEAVOUR River, a river on the N. E. coaft of New Holland, which at its mouth has a fmall bar harbour, or creek, that runs in a winding channel three or four leagues inland, and having at its head a fmall brook of frefh water. There is not depth of water for fhipping above a mile within the bar. This part of the coaft is fo barricaded with fhoals, as to make the harbour difficult of accefs, the fafeft approach to it being from the fouthward. S. lat 15° 26′. E. long. 215°.

Endeavour *Straits*, a channel or paffage, fo called by Cook, between New Guinea and New Holland, the N.E. entrance of which lies in S. lat. 10° 39′. W. long. 218° 36′. It is formed by the main, or the northern extremity of New Holland, on the S.E., and by a congeries of iflands, which Cook called "the Prince of Wales's iflands" to the N.W., which iflands probably extend quite to New Guinea. The length of this channel from N.E. to S.W. is ten leagues, and it is about five leagues broad, except at the N.E. entrance, where it is fomewhat lefs than two miles, being contracted by the iflands which lie there. The depth of water in the ftrait is from four to nine fathom, with every where good anchorage, except upon the bank, which lies two leagues to the northward of Wallis's iflands, where, at low water, the depth is only three fathom.

ENDECAGON, or Hendecagon, in *Geometry*. See Hendecagon.

ENDECASYLLABUS, or Hendecasyllabus. See Hendecasyllabus.

ENDECANDRIA, in *Botany*, from ενδεκα, *eleven*, and ανηρ, *a man*, an order of the Linnæan clafs *Monadelphia*, characterized by having eleven ftamens, whofe filaments are, as the character of the clafs itfelf requires, united into a tube. It contains only the genus *Brownea*, the number of whofe ftamens is different in different fpecies, and this precife number of eleven is fo unufual, and apparently unnatural, in flowers where five and ten fo much predominate, that perhaps the order in queftion might be, without mifchief, abolifhed.

ENDECERES, of ενδεκα, *eleven*, in the *Naval Architecture of the Ancients*, a word ufed to exprefs a galley which had eleven feries or tires of rowers. Thofe with two or three tires were very much in ufe among the ancients, and from thofe to fuch as had five or fix tires. Thofe of nine tires were fometimes ufed, but it was very feldom; and thofe of eleven, fifteen, and fo on, were rather for ftate, than fervice. We read of them carried fo high as to contain twenty, thirty, and forty rows of oars. One of this largeft fort was built for Philopater, which required four thoufand men.

ENDEIXIS, Ενδειξις, in *Antiquity*, an action brought againft fuch as affected any place or thing, of which they were incapable by law. Pott. Archæol. Græc. lib. i. cap. 23. tom. i. p. 125.

ENDELAVE, in *Geography*, a fmall ifland of Denmark; eight miles N. of Funen.

ENDEMIC, or Endemial, *Difeafes*, from εν, *in*, and δημος, *a nation*, or *people*, are thofe difeafes which occur among the inhabitants of a particular region or place, in confequence of certain circumftances belonging to it, and not arifing from contagion, or any other general caufe.

Thus agues, or intermittent and remittent fevers, which are occafioned by the miafms of marfhy ground, are *endemic* in low countries: the *goitre*, or bronchocele, connected with that peculiar intellectual imbecility, which characterizes the Cretin, is *endemic* among the Alps, where its origin has been erroneoufly afcribed to the ufe of fnow-water: the colic, Colica *Pictonum*, is *endemic* in the cyder-counties, efpecially in Devonfhire: the bilious remittent fever, or yellow fever, is *endemic* in the Weft India iflands; and fo forth. In all thefe inftances, fome *local* caufe obvioufly exifts, which produces the difeafe in the refpective diftricts; the difeafe belongs to the diftricts, therefore, and affects thofe who refide there, but extends no farther. Whereas an *epidemic* difeafe is produced, or at leaft propagated among the people, in confequence of fome general caufe; as contagion, famine, or, perhaps, fome change in the condition of the atmofphere at large.

Hence the diftinction between endemic and epidemic difeafes is obvioufly of great importance, for, in both cafes, much more beneficial purpofes may be accomplifhed in the way of prevention, than in that of cure. But the prevention of difeafes depends altogether upon a knowledge of their caufes, which fhould therefore be accurately inveftigated, whenever they prevail extenfively. If a difeafe is endemic, *i.e.* originates in fome local caufe, (from marfh effluvia, for inftance;) it may attack the fame perfon again and again, while he remains in the fame fituation; but he infallibly efcapes it by removing his refidence; or the inhabitants of the diftrict may be all defended from its attacks by draining the marfhy ground, whence the miafmata iffue. Thus we are told by writers on the difeafes of armies, that the diforders which arife from the foul ground of camps, are readily made to difappear by removing but a few hundred yards from the fituation which they previoufly occupied. And of the beneficial effects of attention to the local caufes of endemic difeafes, we have a ftriking example in the changes, which have occurred in London, in refpect to the difeafes of its inhabitants. In the time of Sydenham and Morton, *viz.* in the latter half of the feventeenth century, remittent and intermittent fevers were generally prevalent to a great extent, in the autumnal feafon, and were often extremely fatal to the inhabitants of the metropolis; and the bills of mortality fhew, that formerly the dyfentery, which almoft conftantly appears in the fame places and feafons as the remittent fever, was annually fatal to great numbers. But of late years thefe difeafes have almoft entirely difappeared; intermittents occurring only occafionally after wet feafons, in thofe people who have vifited the fenny counties during the harveft; and dyfentery fometimes prevailing, in a mild way, in thofe feafons only when the heat has been unufually great. This exemption, which London now enjoys from thofe endemic difeafes, is chiefly to be afcribed to the improvements that have been made in the pavement, drains, and fewers, and the attention that is paid to cleaning and fupplying with water the feveral parts of the town. In fome towns where thefe precautions are neglected, the remittent fever is ftill found at times to commit great ravages. It is probable that the fever, which proved fo fatal in Philadelphia, in the year 1793, was of this kind, and produced from the caufes juft mentioned. (See Rufh's Obfervations on the Fever of Philad. 1799. Dr. Miller's Report, New York, 1806.)

Some writers confine the term *endemic* to thofe difeafes which are conftantly prefent in certain diftricts, at all times and feafons, fuch as the *goitre* of the Alps; and call thofe *epidemic*, which are the product of certain feafons, although originating in a local caufe, as the autumnal intermittent and remittent fevers of fenny and hot countries. See EPIDEMIC.

ENDENA, in *Geography*, a town of Italy, in the Bergamafco; feven miles N. of Bergamo.

ENDENTED, DENTED, or *Indented*, in *Heraldry.* See INDENTED.

ENDENTED is alfo applied to a fefs or pale, and other triangular pieces, when divided alternately between two different colours. Coupé, or endented with or and azure.

ENDER, in *Geography*, a town of Italy, in the Bergamafco; 12 miles N.E. of Bergamo.—Alfo, a river of Scotland, which runs into the Garry, feven miles W. of Blair-Athol, in Perthfhire.

ENDERSTORF, a town of Silefia, in the principality of Neyfze; $3\frac{1}{2}$ miles, S. of Ziegenhals.—Alfo, a town in the fame country and principality; $3\frac{1}{2}$ miles S.W. of Grotkau.

ENDESIS, from ἐν and δέω, *I bind*, a word ufed by Hippocrates to exprefs that part of the foot where the bones of the tibia end, and which is connected by ligaments to the ankle.

ENDEW, in *Falconry*, is faid of a hawk that digefts her meat fo well, that fhe not only difcharges her gorge of it, but even cleanfes her pannel.

ENDIAN, in *Geography*, a town of Perfia in the province of Chufiftan; 150 miles S.S.E. of Sufa.

ENDICA, a word ufed by the alchemifts for the fæces which fubfide to the bottom of the veffels in infufions; to fome of which they attribute great virtues.

END-JOINTS, in *Mining*, otherwife called *cutters*, in coal-mining, are the fhorter of the natural joints or upright partings of any meafure or ftratum; the longer of thefe joints being called *Backs*, *Slines*, face or lengthway-joints, or partings: for it feldom happens in any quarry or work, that the face-joints are not much longer than the end or crofs-joints.

ENDINGEN, in *Geography*, a town of Germany, in Auftrian Swabia; feven miles N.W. of Fribourg.

ENDINGS OF STRATA, in *Geology*, fignify the edges of the ftrata, in their greateft advance towards the north weft, or in the direction of their general *rife*, according to the obfervations of Mr. William Smith and his followers; by whom it has been obferved, in all the eaftern parts of England, that the ftrata *end* fucceffively towards the N.W. generally with a fingered or digitated outline, in fome, in places running out for miles in ridges, beyond the general range of the edge or limit of the ftratum: the more recent obfervations in Derbyfhire, at Chelmefton-low, for inftance, and other projecting points of ftrata in that *denudated* diftrict, fhew, however, the neceffity of a careful attention to the fingered or projecting points of ftrata, and to other concurrent circumftances, before fuch fingerings alone are admitted as proofs of the ending of a ftratum, rather than as part of the edge of a denudated tract, on the oppofite fide of which the fame ftratum is to be found again, either on the furface, or abruptly funk beneath it by a fault, and upper meafures occupy that furface. See DENUDATION, and CONCENTRICITY *of Strata.*

ENDITEMENT, or INDICTMENT, in *Common Law* See INDICTMENT.

ENDIVE, in *Gardening*, the common name of an efculent plant which is well known in garden culture. There are different varieties of it, but that which is perfectly curled, is the moft ufeful for culinary purpofes. See CICHORIUM.

ENDIVIA, in *Botany*, *Cichorium Endivia* of Linnæus, the garden endive. Ambrofini derives the word from *edendo*, eating, becaufe the plant is fo grateful to the palate. It appears to us rather a corruption of one of its old names, Entyba, or Intuba.

ENDIVIA MARINA, the *fea-endive*, in *Natural Hiftory*, the name of a fpecies of fea plant, or marine fubftance, defcribed by count Marfigli. There are two fpecies of it, the one having broad and jagged leaves, refembling thofe of the vine, the other much narrower. This laft kind grows on ftones, fhells, pieces of wood, or any other fubftances, accidentally found at the bottom of the fea. It feldom grows in very deep water, and thrives beft in places where the fea is calm and quiet. It is of a dufky greenifh colour, variegated in fome places with yellow. It exactly refembles the fhape of the endive common in our gardens, and its leaves are cut and fringed in the fame manner; but

but they are of fo tender a fubftance, that a flight touch deftroys them; they are indeed tenderer and more delicate than thofe of any other known plant, either of the fea or land. When this fubftance is examined by the microfcope, its furface is found to be compofed of a great number of eminences and cavities, or little holes, between and among them; and when the leaves are cut tranfverfely, there are feen a great number of glandules in them. Marfigli, Hift. de la Mer, p. 72. See Corallines.

ENDLESS Rolls, and *Screw*. See the Subftantives.

ENDOCARPON, in *Botany*, from ενδον, *within*, and καρπος, *fruit*, alluding to the receptacle of the feeds being deeply imbedded in the fubftance of the leaf, or rather frond. Hedw. Crypt. v. 2. 56. t. 20. f. A. Ach. Prod. 140. Meth. 125. (Lichen; Zoega Ifland. 15. Dicks. Crypt. fafc. 2. 22. With. v. 4. 52. Sm. Engl. Bot. v. 9. 595, &c.) Clafs and order, *Cryptogamia Algæ*. Nat. Ord. *Lichenes*.

Gen. Ch. *Frond* cartilaginous, rigid, rounded, peltate, depreffed; naked beneath. *Receptacles* immerfed in the fubftance of the frond, globofe; their edges a little protuberant; their concave difk lodging the *feeds* in vertical cells, and at length expanded and difplayed.

Eff. Ch. Receptacles immerfed, globofe, concave, in which the feeds are imbedded.

This genus is, perhaps, more judicioufly than moft feparated from the great genus or family of *Lichen*, by Hedwig, followed by the accurate Dr. Acharius. The only queftion is whether *Verrucaria* ought not to be joined with it, as differing not at all in the parts of fructification, though its frond is a cruft inftead of a leaf, juft as his various *Parmeliæ* differ, even more widely, among themfelves. Several fpecies of *Endocarpon* are figured in Engl. Bot. t. 593—595. 1512. 1698. 1866. 2012, and 2013. They are fmall roundifh or angular plants, commonly growing clofely preffed to the earth or ftone, of a grey or olive hue, their fructification appearing like little black dots over the furface.

ENDOR, in *Ancient Geography*, a town of Judea, in the half-tribe of Manaffeh, on this fide Jordan, according to the book of Jofhua. Eufebius places it four miles S. from mount Tabor, near Naïm, in the way to Scythopolis.

Endor, *Witch of*. See Witch *of Endor*.

ENDORSE, in *Heraldry*, an ordinary, containing the eighth part of a pale.

This, Leigh fays, is never ufed but when a pale is between two fuch: though others hold, that an endorfe may be borne between birds, fifhes, beafts, &c. Sir J. Ferne adds, that it fhews the fame coat has been fometimes two coats, and afterwards conjoined within one efcutcheon, for fome myftery of arms. He bears azure an endorfe argent.

ENDORSED, Endossé, is where things are borne back to back.

ENDORSEMENT, of *in* and *dorfum*, *back*, is particularly ufed, in *Commerce*, for a writing on the back of a bill of exchange by the proprietor or bearer, either thereby to transfer it to fome other, or to render it payable to the order of fome other, or elfe to ferve for an acquittance or receipt. See Exchange.

The endorfement is only the name of the proprietor, or endorfer. Note, when the endorfement of a bill of exchange is to render it payable to another, it is called an *order*.

To an order it is neceffary the endorfement be dated, and contain the name of him who paid the value thereof; in which cafe, the bill belongs to the perfon with whofe name the order is filed, without any other tradition: without thefe conditions, the bill is judged to belong to the perfon who endorfed it. The bearer of a bill of exchange protefted has a remedy againft the endorfers for the payment of the re-change of the places where the bill was negociated by their order. In cafe a bill or note is refufed to be paid, &c. the bearer has a remedy againft any one of the endorfers, where there are feveral. See Bill.

ENDORSING, or Indorsing, in *Law*, implies the writing on the back fide of a deed, inftrument, &c. fomething relating to the matters contained therein.

ENDOSIS, Ενδοσις, of εν and διδωμι, *I give*, in the *Medical Writings of the Ancients*, a word ufed to exprefs a remiffion of any kind, as when a tumour, inflammation, or hardnefs of any part, becomes lefs violent; and when the patient becomes eafier, after the exacerbations in fevers of the continual kind, and after fits of the intermittent.

ENDOWMENT, or Indowment, the giving or affigning of a dower to a woman. See Dower.

The word is alfo ufed figuratively, for the fetting forth or ferving a fufficient portion for a vicar, towards his perpetual maintenance, when the benefice is appropriated; whence fuch a vicarage is called a vicarage endowed.

ENDRACHIUM, in *Botany*, Juff. 133, fee Thouinia. The name is barbarous, corrupted from the Madagafcar word Endrach, under which it occurs in Lamarck's Encycl. v. 2. 356, who neverthelefs calls the genus *Humbertia*, following Commerfon. See Lamarck's plates, t. 103. Dr. Smith named it *Thouinia*, and is followed by Schreber, Willdenow, and Martyn.

ENDRAPA, in *Ancient Geography*, a town of Afia, in Mefopotamia, fituated on the left bank of the Euphrates.

ENDSCHUTZ, in *Geography*, a town of Germany, in the circle of Upper Saxony, and circle of Neuftadt; 4 miles E.N.E of Weyda.

ENDYMATIA, in *Antiquity*, a kind of dance ufed among the Greeks, performed in Arcadia, to the found of certain airs compofed for the flute.

ENEDA, in *Geography*, a town of Switzerland, in the canton of Glaris; 2 miles E. of Glaris.

ENELIAXIS, Ενηλιαξις, or rather *Enyaliaxis*, Ενυαλιαξις, in *Antiquity*, a feftival in honour of Enyalius, whom fome will have to be the fame with Mars, others only one of his minifters. Pott. Archæol. Græc. lib. ii. cap. 20. tom. i. p. 394.

ENEMA, of ενιημι, *I put in*, in *Medicine*, denotes a clyfter. See Clyster.

ENEMY. See Alien.

ENEOREMA, of εναιρεω, *I lift up*, is ufed by ancient medical writers for thofe parts of the urine which float about in the middle refembling a cloud, formed, according to Boerhaave, principally of muriatic falt. Comm. Inftit. § 382.

ENEOS, of εν and αυω, *I cry*, a word ufed by the ancient writers in *Medicine*, for a perfon born deaf, or unable to perform the common offices of life, for want of any of the principal organs.

ENERGETICAL Bodies or *Particles*, are fuch as are eminently active, and which produce manifeft operations of various natures, according to the various circumftances and motions of fuch bodies or particles.

ENERGICI, in *Ecclefiaftical Hiftory*, an appellation given to certain difciples of Calvin and Melancthon, of the fixteenth century, becaufe they held the Eucharift was the energy and virtue of Jefus Chrift; not his real body, nor a reprefentation thereof.

ENERGUMENUS, Ενεργουμενος, a term fometimes ufed by by divines and fchoolmen, to fignify a perfon poffeffed with a devil, or an evil fpirit.

The word is formed from the Greek, ενεργεισθαι, *to be agitated*, *worked*, of εν, and εργον, *opus*.

Though Papias fays, the Energumeni were fuch as counterfeited the actions of the devil, performing things which feemed fupernatural. The council of Orange debars, or deprives the Energumeni of the functions of the priefthood. See DÆMONIAC.

ENERGY, in *Elocution*, a mode of delivery applicable to particular paffages of a difcourfe that are meant to be rendered particularly impreffive and operative upon the feelings and convictions; like emotion, if not too frequently appealed to, or too extravagantly exerted, it has a great tendency to demonftrate the fincerity and real earneftnefs of the fpeaker; which is always one of the indifpenfible requifites for the conviction of the hearer. In declamation it fhould be manifefted alike in the enunciation, the tones of the voice (which fhould be firm and fervid), and in the gefticulation. It is this quality in the fpeaker that feems to have been defignated by Demofthenes as the firft, fecond, and third requifite of an orator. Action (Ενεργεια, the Latin *actio*,) not being confined in fignification to the mere motion of the limbs, but to the entire and reciprocal exertion of the mental and organic faculties of the fpeaker, the co-operative energy of thought, language, enunciation, tone, look, gefture, and deportment. "Et actio oratoris pronunciatio ac geftus, & ipfa adeo adminiftratio cauffæ." Cic. in Orat. c. 17. "Oratorical action is pronunciation and gefture; hence the very delivery of the fubject." "Eft actio quafi corporis quædam eloquentia, cum conftet e voce et motu." Quintil. Q. 3. "Action is, as it were, a certain eloquence of the body, confifting in voice and motion." See alfo Gefner's Thefaurus in voc. actio.

ENERGY, in *Painting* or *Sculpture*, may be divided into two parts, *viz.* energy of thought, and energy of execution.

The former confifts in deeply inveftigating the nature and intereft of a fubject, and felecting that moft impreffive and decifive moment for reprefentation (and alfo the mode of doing it) which fhall convey to the imagination of the beholder with the greateft intereft, either its hiftory or its moral.

The latter confifts in that fame active, animated fpirit, being accompanied by the power of difplaying the reprefentation of that felection, either on marble or on canvas, with force, with freedom, and precifion; without labouring, at leaft without leaving the appearance of labour, in endeavouring to obtain its expreffion.

The comparifon of two artifts who in their works have each refpectively exhibited the poffeffion of thefe two qualities in the higheft degree, will beft illuftrate our meaning.

Raphael's works are full of energy of thought. Thofe of Tritoretto of energy of execution.

The former always fixes upon that precife moment of time in a ftory which is moft favourable for relating it with fuccefs; and is fure to intereft by the force and truth with which he unfolds the circumftances of it. He fometimes even, and that with the greateft propriety, goes farther than the mere relation of the particular fubject; he accompanies and illuftrates it by allufions to antecedent and fubfequent events connected with it; as in the cartoon of the death of Ananias.

In that picture, fome of the difciples on the right of St. Peter are ftill engaged in diftributing alms, not yet having obferved the inftantaneous punifhment inflicted by Almighty vengeance on the guilty finner; we are thus unaffectedly informed of the object for which the apoftles are affembled, and how they were engaged previoufly to the time of the immediate fubject of the work, and we are led as fimply to underftand fomewhat of that which followed, by the introduction of the figure of Sapphira; who advances on the oppofite fide, intent upon counting the money fhe may be fuppofed propofing either to give to the fund devoted to charity, or to withhold, that fhe might gratify her own, and her now dying hufband's avarice; whofe fate, of which fhe appears to be altogether unapprized, fo nearly awaited herfelf, for her defign of committing the crime for which he was fo awfully punifhed.

Thus we fee, that no part of the intereft of the fubject efcaped the active energy of the mind of Raphael, and many others of his works would as well illuftrate his great ability in this point of the art; *e.g.* the cartoon of St. Paul preaching at Athens, but in neither of thefe noble works is there much energy of execution: that was the *forte* of Tintoretto.

He feldom ftopped to think correctly and refinedly upon his fubject. He rarely pourtrays the paffions with truth in the countenances of his figures, or gives his ftory intereft on the mind; except by the aftonifhing freedom, force, and fire of his pencil in the execution, where it appears to have moved with the utmoft rapidity; the canvas trembles under it. His vigour in colour equals the fkill of his workmanfhip; and thefe united, the obferver forgets the want of more valuable beauties. The fkill of the mafter ftrikes more than the work itfelf. His execution well deferves the appellation beftowed upon it by the Carracci, "Il terribile maniera del Tintoretto." It ftill remains a defideratum in art to fee it united with elegance of defign; with feeling, and truth in thought, and expreffion.

In fculpture the author of the Laocoon has effected their union. We may, therefore, hope its fifter art may fometime arrive at an equal degree of perfection. But there are fo many more points of difficulty to overcome in painting than in fculpture, that he muft be almoft fuper-human who effects it.

Many will rather wifh that Michael Angelo had been inftanced as poffeffing energy of thought in preference to Raphael; and juftly he might have been hailed as a wonderful model of it, as he alfo was to a confiderable degree in the other acceptation of the word, *viz.* in execution. But his energy is lefs underftood than that of Raphael; and is of a lefs valuable kind; as it not unfrequently renders his figures enigmatic, and nature is loft in art. Raphael comes equally with him, home to his fubject; and can fcarcely ever be mifunderftood. Hence, therefore, we think ourfelves juftified in prefenting the latter to the attention of our readers rather than the former; not as willing to depreciate Michael Angelo; but becaufe we conceive, that while the confideration of his energetic powers may invigorate the ftudent, it may divert his mind from truth, and lead him to bombaft and affectation; which the contemplation of the works of Raphael never can do, unlefs he be of a moft perverfe ftamp of nature indeed. If energy of thought may be faid to be characterized by thofe ftrong workings of the imagination alone, which produce the reprefentation of the moft extraordinary and powerful actions of the human body, with bold fore-fhortenings and ftrong expreffions; then M. Angelo claims by far the higheft place, but we do not conceive that to be the beft criterion for judgment on this point. He who fees cleareft, and while he gives it powerfully, moft juftly and beautifully illuftrates his fubject, muft furely have as fully and warmly conceived the nature of it; as he, who, mixing the extravagance of enthufiafm with his energies, permits his mind to run wild upon it; and throws upon his canvas-figures which rather confufe than exemplify, and draw the attention of the obferver from the fubject to the painter. This enthufiafm, we think, does characterize in a great meafure the wonderful works of M. Angelo; whilft Raphael's mind, though full of energy, is pure, and going to the extreme of indulgence in his fubject, ftill keeps within its bounds.

ENERVATING, the act of deftroying the force, ufe, or office of the nerves, either by cutting them, by weakening them with debauchery, or by fome other violence.

Excefs of wine, and other ftrong, hot, fpirituous liquors, enervate or weaken the nerves. When they would render a horfe ufelefs, they enervate him, or cut his nerves.

Enervating, is particularly ufed in the *Manege*, for the cutting two tendons on the fide of a horfe's head, under the eyes, which meet on the tip of the nofe; they thus enervate horfes, to make their heads fmall and lean.

The word is alfo ufed figuratively. It is no fmall artifice in difputing, to be able to enervate and extenuate the allegations of one's antagonift. This author has a weak enervate ftyle. See Nerve.

ENERVATION, a term in the *Ancient Anatomy*, applied to the tendons of the recti, or ftraight mufcles of the abdomen.

The fibres of the recti of the abdomen do not go from one extreme of the mufcles to the other, but are interfected by feveral nervous places, called by the ancients enervations, though they be real tendons.

Their number is not alike in all; fome having three, others four, &c.

ENERVE, Folium, in *Botany*, a leaf deftitute of ribs and nerves. See Leaf, and Costatum Folium.

ENFANS Perdus, a French phrafe, ufed in war to fignify the foldiers who march at the head of a body of forces appointed to fuftain them, in order to begin an attack, make an affault, or force a poft.

The word literally imports *loft children*, on account of the imminent danger they are expofed to.

In Englifh, they are called the *forlorn*, or *forlorn hope*.

At prefent, the grenadiers ufually begin fuch attacks.

ENFIELD, William, in *Biography*, was born at Sudbury in the year 1741, and educated for the miniftry among the Proteftant diffenters at the academy at Daventry, where he diftinguifhed himfelf by the polifh of his early compofitions. He was firft fettled as minifter with the congregation at Benn's garden, Liverpool; this was in the year 1763; and, in 1770, he became refident tutor and lecturer in the belles-lettres in the academy at Warrington. He fhortly after qualified himfelf as mathematical tutor, and in that character publifhed "The Inftitutes of Natural Philofophy," in quarto. A new edition of this work was publifhed after the doctor's death, with confiderable additions, and an introduction to the modern doctrines and difcoveries in chemiftry. It may be reckoned one of the beft popular introductions to Natural and Experimental philofophy. During his labours at Warrington, which were highly prized, the univerfity of Edinburgh conferred upon him the title of doctor of laws. In the year 1785, he removed to Norwich, and became paftor of the congregation of diffenters in that place. With the duties of this office, he fuccefsfully employed himfelf in various literary undertakings, among which was the laborious tafk of tranflating and abridging "Brucker's Hiftory of Philofophy," a work to which we have frequent occafion to refer in the courfe of our own inveftigations of the learning of ancient times. This abridgment was publifhed in two vols. 4to. in 1791, and "probably," fays his friend and biographer, Dr. Aikin, "the tenets of the different fects of philofophers were never before difplayed with fo much elegance and perfpicuity. It was, indeed, his peculiar talent to exprefs the ideas of other men to the greateft advantage. His language, chafte, clear, correct, and free from all affectation, is one of the beft fpecimens of that middle ftyle which is fitted for all topics, and he communicates to his reader all that clearnefs of idea which reigned in his own mind. Thefe qualities, together with the candour and moderation which made part of his very conftitution, efpecially fitted him for the office of literary criticifm, and he was long an affociate in one of the moft refpectable of the periodical journals." He died November 3d, 1797, in the 57th year of his age, generally beloved and lamented. In every relation of life, the benevolence of a kind heart difplayed itfelf in the moft engaging features. He publifhed "Sermons," "Family Prayers," and "The Preacher's Directory." His compilations, entitled "The Speaker," and "Exercifes in Elocution," are perhaps the moft popular works in our language, and they unqueftionably merit the patronage which they have had, and continue to have. After his death three volumes of his fermons were publifhed by fubfcription, and the numerous friends who patronized this work, will prove the attachment which he had infpired. Gen. Biog.

Enfield, in *Geography*, a town and parifh in the hundred of Edmonton, and county of Middlefex, England, is fituated nine miles from London, and contained, according to the late return to parliament, 926 houfes, inhabited by 5881 perfons.

It is ftyled in ancient records Enfen, or Infen, from its fenny foil, which is now, however, converted into good land, by draining, &c. The parifh is very extenfive, the town itfelf being but a fmall part of what bears the name of Enfield. The parifh church is an ancient ftructure, and has been recently repaired. Here are a good free fchool, and two meeting-houfes for diffenters. Part of an ancient royal palace ftill remains, where Edward VI. is faid to have refided, and where queen Elizabeth kept her court in the early part of her reign. One of the rooms appears in its original ftate, with oak pannels, and a richly ornamented ceiling: the chimney-piece is of admirable workmanfhip, and decorated with the arms of England and France quartered. The palace was alienated from the crown by Charles I. and has ever fince been private property. In 1670 it was taken by Mr. Uvedale, mafter of the grammar-fchool, who, being attached to botanical ftudies, planted in the garden a cedar of Libanus, which, in 1793, meafured twelve feet in girth, three from the ground. The town had formerly a good market, which is fallen into difufe. In the fuburbs are a number of boarding-fchools, and feveral elegant villas. Enfield was heretofore much celebrated for its *Chafe*, which comprized a large tract of woodland, well ftocked with deer; but during the civil war it was ftripped both of game and timber, and let out into fmall farms: after the reftoration it was again laid open, woods planted, and filled with deer. In 177, it was difafforefted by act of parliament; parcels were allotted to different parifhes, and the remainder fold. A part was bought by Dr. Jebb, who having fuccefsfully attended the duke of Gloucefter at Trent, the king, on conferring the dignity of baronet on him, gave the name of Trent-place to the villa which he had erected here. South Lodge, alfo on the chafe, was the favourite retirement of the late earl of Chatham. Eaft Lodge was the hunting feat of Charles I.

In this parifh, at a place called "Four-tree hill," or Forty-hill, the late Richard Gough, efq. had a feat, where

where he died, in February 1809. Some account of this eminent topographer and antiquary will be given in a subsequent part of this work. Lyson's Environs of London, vol. ii.

Enfield, a townſhip of America, in Hartford county, Connecticut, on the eaſt bank of Connecticut river, oppoſite to Suffield, and bounded on the north by the Maſſachuſett's line; ſettled in 1681. In 1769 it contained 214 Engliſh families. In the town are two congregational churches, and a meeting-houſe for the ſect called Shakers. The town is pleaſant, and contains 1761 inhabitants; 18 miles N. of Hartford.—Alſo, a townſhip in Grafton county, New Hampſhire, about 11 miles S.E. of Dartmouth college; incorporated in 1761, and containing 1121 inhabitants.

ENFILADE, a French term, ſometimes uſed in Engliſh, ſignifying a ſeries or continuation of ſeveral things, diſpoſed, as it were, in the ſame thread or line; as an enfilade of rooms, of doors, of buildings, &c.

The word is formed of the French verb, *enfiler*, to ſtring a thing, which is compounded of *en*, *in*, and *fil*, of *filum*, thread; *q. d.* a thread or ſtring of any thing.

Enfilade, in *Military Matters*, relates to a certain mode of acting upon the defenders of lines, redoubts, batteries, &c. thereby counteracting the impediments thrown in the way of a direct fire. To explain this, it is neceſſary to obſerve, that defences may be attacked in three modes; *viz. direct*, that is, by a reſponſive fire in front, or, at leaſt, ſo little obliqued as to come under the general acceptation of what the French engineers term *fiſhant*, or, plunging; this fire is commonly at right angles with the line of defence to be battered: when the fire is much obliqued, it is ſaid to be *razant*, or grazing. The ſecond mode of attack is by *reverſe;* that is, where the batteries of the beſiegers can be ſo directed as to command the interior of the rampart, and thus render it impoſſible for the defenders to remain at their guns. This mode generally relates to an angle of at leaſt fifteen degrees from the line of the defence in queſtion, but may extend to any angle up to 90°; remarking, however, that the more direct the fire may be in reverſe, the leſs execution will be done, becauſe the ſhot can only ſtrike one particular object. The third mode is by *enfilade*, and is always the moſt deſtructive, eſpecially if the guns of the enfilading battery can be brought to bear at a right angle with the direction of the battery to be enfiladed. When this cannot be effected, it is neceſſary to make a ſmall angle in reverſe, the leſs the better, thereby to throw the ſhots along the interior of the parapets, and to take the whole in flank. Some fortreſſes are unavoidably ſo ſituated as to have one, or perhaps two batteries expoſed to a very diſtant enfilade. Such a defect is of the utmoſt importance, and cannot be radically overcome; for we ſometimes ſee ſome hill, or what is worſe, ſome ſhifting ſand, which cannot poſſibly be either removed or occupied, but which affords both a command, and a lodgment in ſecurity from the fire of the place. Although this is aſſuredly an immenſe drawback on the ſtrength of the works, it is nevertheleſs in ſome ſituations of little moment; for inſtance, where it is neceſſay to retain a ſmall force for the purpoſe only of preventing an enemy from landing at the only acceſſible ſpot upon a long range of coaſt, preſenting in every other part ſuch natural obſtacles as annihilate all apprehenſions of invaſion. In ſuch place the ſurrounding eminences are of no moment; or if they were, muſt rather be conſidered as offering advantages, and the means of rendering the place untenable to the enemy, ſhould they ſucceed in carrying the works.

Speaking generally, however, a fortreſs that can be enfiladed with tolerable ſafety to the beſiegers muſt be untenable; becauſe it is impoſſible to deviſe effectual means for remedying the evil. It is true, we may raiſe large epaulements, or buttreſſes of ſoil, maſonry, &c. for the purpoſe of preventing the enemy's ſhot from ranging along the rampart; but, in moſt inſtances, where enfilades can be made, theſe epaulements would require to be carried to ſuch an immenſe height, as muſt, in a meaſure, deteriorate the other defences; in ſome inſtances rendering them nugatory, or even advantageous to the aſſailants, whenever they may be able to make a lodgment. Beſides, ſuch epaulements are very liable to be deſtroyed by mortar and howitzer batteries, or by mines. This mode of parrying the enfilade has, with much propriety, been of late years deſignated by the French engineers a *defilade*, a term peculiarly expreſſive of the intention of whatever devices may be uſed for the purpoſe of preventing defences from being enfiladed. It muſt not be forgot, that the approaches of beſiegers ſhould be carefully conſtructed; elſe they may be ſubjected to enfilade from ſome of the defences. That evil is, however, eaſily avoided; and if, through ignorance or inadvertence, found to take place, may be inſtantly corrected, as the beſiegers have, on almoſt all occaſions, ample range for alteration, and can adopt a variety of meaſures totally unattainable to thoſe within the fortreſs.

Where a work is carried over a riſing ground, it is generally very difficult to render the interior of the batteries ſafe from either reverſe or enfilade. The beſt mode is to carry them up the aſcent *en eſcalier*, that is, by ſhort levels, each perhaps capable of mounting four or five guns, and every ſuch level being cut off from its neighbour below, by a heavy epaulement, carried up high enough to prevent the beſiegers from trundling their ſhots along within the parapet. The moſt effectual method of cutting off enfilades is to give the rampart ſuch an augmentation of thickneſs as may allow a free paſſage for cannon, &c. along the rear of thoſe in the embraſures, and to fill up the ſpaces between the latter with *traverſes*, carried to at leaſt ten feet in height. Theſe traverſes are nothing more than regular maſſes of ſoil, properly turfed, or perhaps reveted with maſonry, placed at right angles with the parapet, and uniting therewith: their thickneſs ought not to be leſs than ten feet.

We muſt here obſerve, that with few exceptions, the enfilade commonly takes place from the exterior flank of the battery; therefore that quarter ſhould be chiefly attended to. With this view it is found moſt proper to conſtruct each traverſe partly of maſonry, and partly of ſoil well gazoned, (*i. e.* turfed) or, if on emergency, firmly retained by faſcines. Sometimes ſand bags will be found to anſwer for this part, when the reſidue of the thickneſs is completed with good maſonry, at leaſt four feet in ſubſtance. Where cotton, or wool, or raw hides, are procurable, they will be found to make admirable traverſes, if ſuſtained by a firm wall: theſe being placed neareſt to the enfilading quarter, will, by their elaſticity, completely deaden the force of the ſhot, however great their calibres, and cauſe them, if they ſhould reach ſo far, to be weak and inſignificant in their impreſſion upon the interior buttreſs of maſonry. It ſhould ſeem, to perſons unacquainted with the practice of defending places, that, in conſequence of the great reſiſtance offered by ſolid maſonry to cannon-ſhot, which will often bury themſelves full fifteen feet, or more, in ordinary ſoil, the traverſes ſhould be conſtructed of maſonry only: this would, no doubt, preſent great firmneſs in a contracted ſpace; but the inconceivable deſtruction and diſmay occaſioned by the ſplinters knocked off by ſhots that ſtrike upon bricks or ſtones, oppoſes an inſuperable bar to what would otherwiſe prove a moſt

moſt valuable mode of conſtruction; ſuch, indeed, as would render many places abſolutely impregnable. This compels us to reſort to ſuch materials as are, in a great meaſure, devoid of ſuch miſchiefs, of which turf is the beſt.

It is generally conſidered, that the enfilade is cut off by placing traverſes at from fifteen to twenty toiſes aſunder; but the latter diſtance, (equal to forty yards,) is certainly too great: it would even be adviſeable to bed the guns between traverſes, as we have above ſhewn, were it not that by ſo doing the battery muſt be weakened, owing to the ſpaces occupied by ſo many buttreſſes. However, neceſſity and, generally ſpeaking, locality, muſt give laws for the conſtruction of ſuch impediments to the enfilades. It muſt be underſtood, that the obnoxious battery may be very powerful; that is, it may not only mount heavy cannon, but may be far more numerous than might at firſt be ſuppoſed. To explain this, it muſt be ſtated that the moſt deſtructive enfilade is that which ranges along the interior of a battery, at about from two to ſix feet within the parapet; ſince in that direction it is ſure to deſtroy not only the defenders, but even the cannon, diſmounting them, and cruſhing the gunners, as well as cauſing a variety of ſplinters to ſcatter among them, from the ſeveral parts of the wood and iron work. Sometimes, indeed, when the ſhots touch upon the cannons themſelves, the former, being of caſt iron, and conſequently liable to ſhiver when forcibly ſtruck, break into numerous pieces, or even fracture the latter, ſo as to render them perfectly unſerviceable.

If ſhots were to be fired at ſuch an elevation as barely to graze the creſt, or ſummit, of the parapet, they would certainly prove moſt deſtructive to the defence flanked by ſuch a forcible fire; but this cannot be effected at ſhort diſtances, ſince, it is evident, the ſhots would, at the moment of touching the creſt of the parapet, be *aſcending*, and that too with ſuch force as could not fail to impel them far over every part of the fortreſs, and thus to prove completely unavailing. This mode of enfilade, therefore, commonly takes place where the cannon is not at leaſt on a level with the creſt of the parapet, ſo as to ſend its ſhot through it with ſufficient force to cut clean through, without being thrown upwards into a new direction, and thus to plunge into the more remote part of the defence. When the enfilade is more diſtantly ſituated, the ſhots may certainly be thrown over the parapet as they are *deſcending* upon their long range; but this is very uncertain, and rarely does much execution; to be ſure, when the ſhots can be correctly thrown, the havoc they create is dreadful.

The uſual mode of enfilading is by ricoçhet, that is, by giving the piece, whether mortar, howitzer, or cannon, ſuch an elevation, and ſuch a charge, as may cauſe the ſhot to bound firſt on the glacis, and then over the rampart into the battery. This, our readers will perceive, is exactly on the principle of "a three-quarter ball" at cricket; which, if it paſſes over the wicket, makes ſeveral low bounds, or, as they are technically termed, "lobs," in proceeding along their courſe, until they come to a ſtate of reſt. So does a cannon-ſhot, after bounding over a rampart, keep lobbing, rather more forcibly indeed than a cricket-ball, along the terre-pleine of the rampart. It will not be neceſſary to expatiate on the effects of this dreadful contrivance, they being ſo obvious, and ſo completely ſimilar to what is called "raking fore and aft," in naval warfare.

The moſt powerful ricoçhet takes place at an angle under ten degrees of elevation; fifteen degrees are the utmoſt that are allowed, both becauſe the effect produced is leſs when the elevation is encreaſed, and the gun-carriage is proportionably injured by the direction of the recoil deviating from the horizontal, ſo as to depreſs and ſtrain the hinder parts of the frame work; while, at the ſame time, the wheels are lifted in the fore part, and return to the ground with undue force. When mortars are uſed in ricoçhet firing, they are commonly charged with a number of ſhots, or of ſhells, forming in the whole, what we may term, a round of grape proportioned to the calibre of the piece. In batteries intended ſolely for ricoçhet firing, the embraſures ſhould have their ſuperior ſlope outwards, as ſeen at K in the plate; whereby the enemy could not fire into it ſo eaſily as if the embraſures were made in the uſual way: in fact, they could not diſtinguiſh them, as the whole would be nearly ſolid, much the ſame as a mortar-battery. Where infantry or cavalry are to be fired at in ricoçhet, the pieces muſt not be elevated more than three degrees, otherwiſe their greateſt effect would not be produced. Ships may likewiſe be acted upon by ricoçhet, if the ſhots are cauſed to ſtrike the water at a *depreſſed* (inſtead of an *elevated*) angle of about four degrees, ſo as to touch the ſurface at from two hundred to two hundred and fifty yards from the battery. But this applies only to particular caſes; for if the veſſel be remote, or that any object is to be fired over, the ſame angle of elevation may be uſed, taking care ſo to proportion the charge, that the ſhot may light upon the water at about two hundred yards from the veſſel, if ſhe be large; but if ſmall, the ſhot muſt light nearer to her, in proportion to her want of bulk.

It was neceſſary to ſay thus much of ricoçhet firing, in order to give a complete inſight into the manner of enfilading, by means of ſmall charges of powder. The reader will likewiſe perceive that ſeveral guns may enfilade the ſame battery, in exactly the ſame line, merely by cauſing them to be removed farther from the object of attack, the one behind the other, only taking care that the parapet before each be ſufficiently ſubſtantial to prevent accident to the other batteries in its front, and cauſing the more remote to charge higher, in order that their ſhot may be thrown ſufficiently far to make the firſt bound in a proper manner, over the epaulement of the defence to be enfiladed. We ſhould obſerve that the mode of enfilading before-mentioned, namely, by grazing directly over the creſt of the parapet, may be extended to remote works; but unleſs they are manned for action little damage will be done, as the beſieged will rarely fail to *houſe* their cannon, by pointing them towards the enfilading-battery; ſo that they may be far leſs expoſed than when ſtanding in their proper directions.

We ſhall annex to this article, which we have dwelt upon in deference to its importance in military affairs, a few general principles. 1ſt. That the deſcending enfilade is the moſt deſtructive in long ranges. 2dly. That the ricoçhet-enfilade is peculiarly adapted to ſhort diſtances. 3dly. That the angle ſhould, if practicable, be kept under ten degrees of elevation; the greater effect being generally in proportion to the leſs deviation from the horizontal direction. 4thly. That the more direct the fire may be along the line, or defence, to be enfiladed, the greater will be the damage done thereto, provided it be within ſuch a parallel with the parapet as may ſubject both the cannon and the gunners to its range. 5thly. That if any angle is to be made with the line to be enfiladed, a few degrees in reverſe are better than even half their number in advance; becauſe, though the former may not ſtrike any object in its original courſe, the ſhots may, after having grazed againſt the interior of the parapet, *genouillere*, &c. ſtill do conſiderable damage; and, even though they ſhould not either diſmount a cannon, or kill any of the men on the battery, they muſt tear the garon-revetement far more than one of maſonry, which is oftener put exteriorly, though not within: the latter would turn the ſhots off,

off, in all probability, and caufe them to have only the effect of a weak fire *razant*. 6thly. It will be neceffary to afcertain the thicknefs of the parapet behind which the enfilading fhots are to trundle: in common fortifications it may fuffice to compute, as nearly as may be practicable, upon about four toifes, (or eight yards,) from the extremity of the fuperior flope of the angle; but in places where the parapets are made of mafonry, lefs will commonly be neceffary, for the purpofe of ftriking fomewhere upon the line of platforms, and of thereby difmounting the cannon. 7thly. Where howitzers are ufed for the enfilade, the traverfes muft be very numerous, to prevent the pieces of burften fhells from fpreading to any extent. But, in fuch cafe, the traverfes will not require fo much folidity, as if oppofed to heavy fhots. 8thly. Where a remote battery is to be enfiladed, efpecially if the enfilade be direct, that is, in a line with the prolongation of fuch battery, great care muft be taken to be exact in afcertaining its diftance from that part of the defences which may be neareft to the enfilading party. This may, in general, be done, with precifion, by means of two long ladders placed face to face, and elevated during the night, fo as to give a command of the works then in a ftate of actual oppofition; when the flafhes from their cannon will prove a fufficient guide. This may, however, be done with more precifion during the day time, though certainly with more danger; but the operation being certain and fpeedy, compenfates for the rifk. The enfilade on fuch occafion muft not be by ricoçhet, but by defcent. Thofe who are in front of the enfiladed battery, or nearly fo, will fee the effects of the fhots, and can, by means of pre-concerted fignals, give information accordingly to the enfiladers.

The following references to the figures in *Plate* III. *Fortification, fig.* 1, will explain more fully what has been faid.

Let A B be the face of a baftion, whofe faliant or flanked angle, B, is battered in breach from C C. In fuch cafe, the befieged muft make a very ftrong epaulement from B to P, on the adjoining face, to prevent the fhots from the enfilading battery at D trundling upon the terre-pleine of the face A B; in aid of this refiftance, the traverfes, S, S, S, muft likewife be thrown up. The battery at D being a direct enfilade, that is, in the line of the face A B, is highly deftructive; while that at E, which is only 15° in reverfe, is far lefs fo. It is indeed evident, that one cannon at D would be more effectual than two at E; unlefs the fhots from the latter fhould be thrown in fo as to fall upon the neareft part of the interior of the parapet, as has been already implied: they would then be capable of tearing away the interior of the merlons, and of caufing great numbers of fplinters, &c. The battery at F is a direct-enfilade of the face of the remote baftion H; but its fire muft not be in ricoçhet, (as that could never reach its object,) but by defcent. At I, an enfilading battery is fhewn in profile, the cannon being funk, and the embrafure, K, having an inverted flope, covering the cannon from the fire of the battery at L. This flope being only 10°, admits the fhots from the cannon to afcend, by means of a fmall charge, in a curve meeting the ground at N; thence reafcending over the face L, (correfponding with B P in the upper figure,) fo as to light again at O, upon the terre-pleine of the face M, (here feen in reverfe, and correfponding with the interior of A B in the upper figure;) whence it will again rife, and, if unimpeded, bound on in fucceffively diminifhing curves, until its force be expended. The dotted line, from the cannon I to O, on the baftion M, fhews the direct or plunging enfilade by defcent, which is beft adapted to cannon of a fmaller calibre; the force of the fhot being, in this inftance, unabated by any bound; as muft be the cafe in ricoçhet, wherein, by ftriking at N, the impetus is confiderably diminifhed. This diminution will be greater, in proportion as the elevation of the cannon is increafed. As already ftated, the enfilade of H from F will be of little moment, unlefs the battery at H be in action; but, as the obliquity of the embrafures may enable the enfiladers at F to act either in ricoçhet, or by defcent into the reverfe of A C, or even of A B, there might be confiderable advantage gained by fuch a pofition. It is proper to ftate, that this does not appear to be generally practicable; as the diftance from C C, (the main breaching batteries,) to F muft render the latter rather infecure, and expofe it both to the batteries of the place, and to the fallies of the garrifon: it is therefore given merely as an illuftration of the terms ufed in the explanation of all that relates to enfilade. When fhipping, or craft of any defcription, lie behind a mole, fo as to be fecure from the direct fire of any battery, the ricoçhet-enfilade may be adopted, either by elevation, as fhewn above; or by depreffion, as from the cannon at P directed downwards to Q; whence the fhots will bound over the mole R, and fall among the veffels behind it. This is occafionally done to deftroy veffels in a harbour, or to enfilade fuch as may be actively employed in any attack; and thus to force them to a change of pofition, rather than fuffer themfelves to be raked fore and aft with hot balls.

ENFILED, in *Heraldry*, is applied to a fword, on which is placed the head of a man or beaft, or any other charge.

ENFRANCHISEMENT, the incorporating any man into a fociety or body politic. See FREEDOM and FRANCHISE.

Thus, he that by charter is made denizen of England, is faid to be enfranchifed. The like is underftood of a perfon made a citizen of London, or other city or corporate town; becaufe he is thereby made partaker of the liberties appertaining to the corporation whereof he is enfranchifed.

EN FRAPPANT, *Fr.*, in *Mufic*, a term applied, in beating time, to the firft note of a bar.

ENGADINE, in *Geography*, one of the higheft vallies of Switzerland, in the canton of the Grifons. It is divided into the Upper and Lower Engadine. St. Martin's bridge on the river Inn feparates the Lower Engadine from the Tyrol. The towns of this valley are lefs agreeable than thofe of the upper one; but the foil is uncommonly productive. In fome places the roads are narrow and rocky, and nature difplays its wildeft fcenes. The river Inn is often compreffed in a narrow deep channel: there are, however, a few fine plains, where fruits come fooner to maturity than in the Upper Engadine, from which it is divided by the Pont Alta. The fituation of the upper valley is much higher; it has very long winters, and the air is generally cold. In the midft of fummer, night frofts nip the corn and fruits. The towns are agreeably fituated, and moftly handfome, built of free-ftone, and painted white; even the barns are fine buildings. The river Inn flows flowly in a larger bed; there are feveral beautiful bridges of a fingle arch thrown over it. Near the pretty town of Schoulz are fourteen fprings of mineral water of different qualities. There are feveral manufactures, chiefly iron works and founderies, in the Engadine, which give employment to a great number of its inhabitants, and an appearance of chearfulnefs and comfort to their habitations.

ENGAGE, *To*, when applied to *Military* or *Naval Affairs*, means to attack. Perhaps no circumftance incident to warfare requires more precaution, or indeed more judgment,

judgment, than that relating to the giving battle to an enemy. The general, or commander of any defcription, who neglects to provide againft thofe checks which arife, often when leaft expected, or for following up any advantage he may gain, efpecially if it be within the limits of his anticipations, muft be totally unqualified for fo refponfible and fo important a fituation. We fpeak principally of proceedings in the field, where many alterations and much diverfity may be perpetually offering; for we confider the manner in which battles on the ocean generally proceed, and in which they almoft invariably terminate, to be fo pre-eminent as to leave us only the opportunity of defcribing them, (as we fhall do under the head of ENGAGEMENT,) and to debar us, unlefs indeed we wifhed to incur the charge of prefumption, from ftating when or how fingle fhips or fleets fhould engage the enemy.

In the firft inftance, it will be abfolutely neceffary for the commander of an army to know, with precifion, the ftates of health, of difcipline, of fatigue, of fupply, and of competency in general, of every corps compofing his army. He muft be thoroughly informed as to the condition and numbers of his cattle, of the amount of his provifions, and of the manner in which the feveral corps, the cattle, and the fupplies, are diftributed along his line. He muft have a thorough knowledge of the numbers, the difpofition, the fupplies, and the probable refources, of the forces oppofed to him; as well as of the nature of their warfare, their general habits, the ftrong pofts in their rear, the opportunities they may have of forming ambufcades, or of retreating to advantage; and efpecially whether, in cafe of fuccefs, he may be able to avail himfelf of thofe invaluable opportunities which the valour and difcipline of his troops may offer to his acceptance.

However confident a general may be of fuccefs, he muft never lofe fight of the poffibility of a reverfe: in truth, it is moft generally found, that where the beft preparations are made againft difafter, the moft decided victories are obtained. This is natural, both becaufe the whole of a line feel infpirited by the reflection, that due provifion is made for the worft; and becaufe, where fuch arrangements are carefully preconcerted, the appropriate remedy is prompt for application, and the enemy are rendered unable to continue in that line of fucceffes, which, but for fuch apt oppofition to their momentary or local advantages, muft inevitably be at their command.

Whenever we obferve that a commander courts the opinions of thofe whofe rank and experience may qualify them to offer advice, we may confider it a moft fortunate omen. The immortal Nelfon always difclofed his plans, and opened his mind fully, to the admirals and captains under his command: he folicited the correction of whatever errors might have crept into his projects, and was eagerly anxious that all fhould have a competent underftanding of his intentions. This ought ever to be the ftudy of a commander; elfe, fhould he fall, or fhould unforefeen accidents occur in any part of his line, his fucceffor, as well as his fubordinates, muft be totally at a lofs either to continue victorious, or to arreft the progrefs of the enemy.

But perhaps the moft effential point may be for a commander to afcertain how far his troops are well difpofed to the caufe; whether they proceed to engage with alacrity and zeal; and whether they have an entire confidence in the courage and abilities of their leaders. This part of the fubject is fometimes overlooked, until it is too late to be remedied; and the moment of engaging is the moment of treafon, or of cowardice. It is true, the Britifh army may claim an exemption from thefe ungovernable mifchiefs; but no commander fhould be indifferent to matters which are within the fcope of poffibility, and which may often be avoided by a little courtefy, or by fome well directed policy. We fhould confider, that in our time the moft unforefeen events are daily brought forth; that the opinions of perfons inimical to the welfare of the ftate are every day promulgated; and that, within thefe very few years, even a field officer of our army endeavoured to miflead thofe guards, who are exclufively appointed to protect his majefty's facred and moft valuable life. Fortunately for Britain,

> "Such divinity doth hedge our king,
> That Treafon dared but peep at what it would!"

Therefore we may ever hope that the difpofition of our foldiery will remain unfhaken; and that we may find them, as they ever have been, bold, active, and obedient in the field, and ready on all occafions to engage in fupport of our king, and our conftitution.

It may be proper to add, that too much ardour to engage may exift in an army: this is affuredly dangerous. There is a certain eftablifhed coolnefs in veteran regiments, refulting from the prefence of perhaps only a fmall portion of veterans among them, which is highly conducive to the character and to the prowefs of the corps at large. Such regiments are admirably calculated for refiftance; while new levies are generally more fuited to the charge, and to thofe tremendous conflicts which fpeedily terminate the ftruggle in their quarter. In truth, we are well affured from the moft refpectable authorities, as well as from the numerous facts which proudly and pre-eminently offer themfelves to our notice, that nothing can refift the attack of our new regiments; while, on the other hand, nothing can fubdue the firmnefs and patience of our old ones.

ENGAGEMENT, in the *Military Profeffion*, relates to fuch conflicts as take place between bodies of armed men, generally regular troops, and efpecially to that kind of warfare which is carried on between armies of fome magnitude, in contradiftinction to thofe lefs extenfive contefts, which ordinarily are confidered as fkirmifhes. Engagements may be either partial or general; in the latter cafe, they are commonly attended with marked and decided confequences; whereas, in the former inftance, little or no difference may be made in the pofitions of the contending powers. We generally find, that, according to the modern mode of warfare, great ingenuity and cunning are exerted, for the purpofe of deceiving the adverfary into an opinion of a general attack. This is done with the intention of preventing reinforcements being fent from any part, the whole being kept in action, while the main attack is made on fome point, either naturally weak, or by gaining which the fortune of the day may be determined in favour of the affailants. This, although it bears the appearance of a general engagement, is in fact but a partial affault; the greater portion of the conteft falling upon a few regiments, which, unlefs properly fupported, are commonly fwept away: to fay the leaft, they muft fuffer very confiderably.

Previous to engaging the enemy, every attention muft be paid to fecuring a retreat, in cafe of a check. This precaution is indifpenfable in all ordinary inftances; though, in fome fituations, it may be found the beft policy to deftroy the means of evafion, under the intention of convincing the army that it has only the alternatives of victory or death. Thus, when Cæfar landed in Britain, he deftroyed the fleet which had brought him to our fhores; a meafure which, in thofe times, compelled the invaders to fight to the laft. They knew they had to contend with an enemy, from whom

whom no quarter was to be expected; therefore, like rebels, they ftruggled for life; they fought virtually with halters around their necks; and, thus rendered defperate, contended with fuch favage, fuch unrelenting fury, as neceffarily caufed the engagement to be fanguinary to an extreme.

Engagements are of two kinds; namely, either in the field, where the oppofing parties are both divefted of the protection of fortifications of any defcription, fuch as we ordinarily find to take place in open countries; the other confifting of that mixed kind of warfare, which comprifes the attack and defence of *abbaties*, the croffing of rivers in the face of an enemy, and, on many occafions, the attacks made upon open towns, &c. With refpect to thofe engagements which are connected with the ftorming of lines, or of fortifications of any defcription, we confider fuch to appertain to that protracted fyftem included under the head of *fiege*, which fee; and the attacks upon fuch to be, not engagements, but affaults.

It is fcarcely to be credited upon what very flight incidents the fate of an engagement may depend! Circumftances, which, if confidered in the cabinet, fhould appear to be akin to impoffibility, arife unexpectedly, and change the face of affairs inftantaneoufly. Hence, during the moment of conteft, a commander fhould be intent on obviating thofe mifchiefs which muft refult from the falling back, or the failure, of any part of his army. He muft carry in mind, and perhaps might advantageoufly delineate on a card, the great outline of the engagement; ftudying to choofe fuch a pofition as may give him a general view of the field, but moft efpecially of fuch portions as may either appear to him either weak, *ab origine*, or to be hard preffed by the enemy.

To defcribe an engagement is next to impoffible; for though we might perhaps afford fome general idea of the incidents ufually occurring during a battle, fuch is the diverfity to be found in the localities, as well as in the fyftems of warfare adopted even by perfons in the fame fervice, that to enter upon the inveftigation of the fubject in all its bearings, and throughout its amplifications, would be to comprife a volume of no fmall magnitude. We muft, therefore, content ourfelves with obferving, that the ordinary difpofition for an engagement, where no particular *point d'appui* is in queftion, confifts of two or more lines, compofed chiefly of infantry, properly fupported by artillery of various natures, that is to fay, of brafs 18 pounders, alfo of 12, 9, 6, and 3 pounders, with a portion of howitzers, commonly of $4\frac{1}{2}$, or $5\frac{3}{4}$ inches diameter in the bore, or eventually up to 8 inches. Thefe are placed in the intervals between the feveral regiments, while one or more parks of artillery are arranged in fuch parts of the feveral lines, as may appear to require that powerful aid; or on fuch commanding fpots as may enable the artillerifts to act with greater effect againft the enemy. See TACTICS, *Military*.

Where the ground may admit, the cavalry often commences the action, by endeavouring to prevent the enemy from forming upon, or taking poffeffion of, ftrong pofitions. The horfe artillery, together with the pieces of lighter conftruction which can be fpeedily withdrawn, advance to cannonade; while the infantry may be deploying from column into line, or forming according to the inftructions of the generals commanding in the feveral quarters of the army; to whom the commander in chief previoufly communicates his intentions. During this time, the greateft order, coolnefs, and promptnefs, are indifpenfably neceffary: it is now that fuperior difcipline will manifeft itfelf, and that the real powers of an army will be afcertained. Let it not, however, be fuppofed, that that kind of fymmetrical order which is the boaft of our parade martinets, is to be found in the field of battle! Far otherwife; in lieu of regular firings by divifions, each individual loads and difcharges his piece when, and how he can; in place of a regulated pace conforming to any particular cadence, the advances and retreats are generally too much divefted of that order, and of that fyftematic uniformity, which fo highly delight the fair fex when they vifit our fummer camps, to witnefs the fplendid array attendant upon parade evolutions. In fhort, the celebrated fong in the "Recruiting Serjeant" is the beft, and moft pithy defcription of an engagement we have ever heard, efpecially that part which relates to the moft arduous portions of the conteft.

"But the merrieft joke of all,
Is when to clofe attack we fall.
Killing, wounding, maiming, butting,
Dafhing, flafhing, flaying, cutting:
Horfe and foot,
Both go to't;
Blood and thunder!
Then to plunder,
Oh! what a charming thing's a battle!"

A very charming thing, indeed; efpecially when we confider that many of the wounded are often murdered by perfons, chiefly women, who follow the feveral armies, for the purpofe of plundering fuch unfortunate brave men as may be incapable of making refiftance. It is, indeed, a well-known fact, that this iniquitous and difgraceful practice, is more than ever prevalent in many countries, whofe inhabitants, being at leaft on a par with thofe of the moft enlightened parts of the world, fhould rather endeavour to foften the rigours of war, than to perpetrate the moft favage cruelties on thofe whofe misfortune it may be to be difabled in the courfe of an engagement.

Thefe fluctuations between victory and defeat, which fometimes alternate for hours together between contending armies, muft afford the moft lively intereft to a fpectator, and cannot fail to produce the moft exquifite fenfations of joy, or of mifery, in the breafts of the refpective commanders. What can afford a greater gratification than the complete fuccefs of an army? or what can occafion more pointed chagrin than the evidence of its defeat? Perhaps, of all the men who ever experienced fuch reverfes, the old king of Pruffia may be confidered as the moft illuftrious inftance of fortitude under difafter, and of moderation when fuccefsful. Thefe good qualities, though they may have been coeval with his birth, muft neceffarily have been confiderably enhanced, by that intenfe application the monarch paid to the difcipline of his army. Hence, we are informed, that no reverfe appeared to him irremediable, and that no victory was confidered by him to be permanent. Such a man muft have viewed an engagement under very peculiar impreffions: he muft have been moft ardently intent upon the confideration of what evolutions would be moft fuited to the events paffing under his notice; while at the fame moment, his mind muft have been actively employed in the confideration of refources, wherewith he might, according to the modern cant term, "carry on the war." We muft, however, remark, that the great Frederick rarely had a large army; but that which he had, though comparatively fmall, was of immenfe ftrength: every part was fyftematically organized under the moft fevere code of difcipline, and under the moft penetrating obfervation. We have heard old officers ftate, that the Pruffian army, under their immortal royal general, performed its evolutions, and preferved

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the fame order, and went through their firings, as regularly while in action as when on their feveral parades. We fear this fingular inftance of military confiftency, is not likely to be again difplayed by the Pruffian army at this date; nor, indeed, have we any authority, if paft events are to guide us, for expecting to fee, or hear, that they fhould throughout an engagement difplay thofe qualities which, however much we may commiferate the fufferings of thofe individuals whereof it was compofed, characterized the military eftablifhment of that now ill-fated country! We leave to our readers to contemplate what muft be the feelings of the brave marfhal Mollendorff, who, we believe, is the only furviving general now of the many that held commands under that military prince, whofe exiftence in thefe times would, no doubt, have given a very different afpect to the affairs of Europe.

Engagement, in a *Naval Senfe*, denotes a particular or general battle at fea, or an action of hoftility between fingle fhips, or detachments, or fquadrons of men of war: the whole economy of which may be arranged under the heads of preparation, action, and repair. The preparation is begun by iffuing the order to clear the fhip for action, which is repeated by the boatfwain and his mates at all the hatchways. The hammocks are firft removed; every failor ftowing his own bedding properly and firmly cording it with a lafhing, or line provided for that purpofe: as each fide of the quarter deck and poop is furnifhed with a double network, fupported by iron cranes fixed immediately above the gunnel or top of the fhip's fide; the hammocks, thus corded, are firmly ftowed by the quarter-mafter between the two parts of the netting, fo as to form an excellent barrier or fort of parapet, to prevent the execution of fmall fhot on the quarter-deck: the tops, waifte, and fore-caftle, are fenced in the fame manner.

At this time all heavy luggage, fuch as chefts, &c. are handed down into the hold, and the furgeon, with his mates and affiftants, together with whatever women may be on board, defcend into a part called the cock-pit; which, being below the level of the water, is confidered to be tolerably fecure; various inftances have, however, been known of fhots, between wind and water, finding their way to that retirement.

At the fame time the boatfwain and his mates are employed in fecuring the fail-yards, to prevent them from tumbling down when the fhip is cannonaded, whereby it might be difabled. The yards are fecured by ftrong chains or ropes, befides thofe by which they are ufually fufpended. The boatfwain alfo provides the neceffary materials for repairing the rigging; and the carpenter and his crew prepare fhot-plugs and mauls to clofe up any breach that may be made near the furface of the water, and provide their ironworks neceffary to refit the chain-pumps. The gunner, with his mates and quarter-gunners, examine the cannon of the different batteries, and provide proper charges, &c. The mafter and his mates attend to the number and trimming of the fails, &c. The lieutenants vifit the different decks, taking care that all incumbranees are removed, and giving inftructions to the other officers, that every thing may be ready for the expected engagement at a moment's warning. When the hoftile fhips have approached each other to a competent diftance, the drums beat to arms: the boatfwain and his mates pipe "all hands to quarters!" at every hatch-way. The perfons appointed to manage the great guns immediately repair to their refpective ftations; crows, hand-fpikes, rammers, fpunges, powder-horns, matches, and train-tackles are placed in order by the fide of every cannon. The hatches are laid to prevent any one from efcaping into the lower apartments. The marines are drawn up in rank and file, on the quarter-deck, poop, and forecaftle. The lafhings of the great guns are let loofe, and the tompions withdrawn: the whole artillery, above and below, is run out at the ports, and levelled to the point-blank range ready for firing. When the neceffary preparations are finifhed, the commencement of the action is determined by the mutual diftance and fituation of the adverfe fhips, or by the fignal from the commander in chief of the fleet or fquadron. The cannon being levelled in parallel rows, projecting from the fhip's fide, the moft natural order of battle is evidently to range the fhips a-breaft of each other, efpecially if the engagement is general. The moft convenient diftance is probably within the point-blank range of a mufket, fo that all the artillery may do effectual execution. The combat ufually begins by a vigorous cannonade, accompanied with the united efforts of all the fwivel-guns and fmall arms. Inftead of firing platoons, or vollies of cannon at once, the general rule throughout the fhip on thefe occafions is to load, fpunge, and fire the guns with all poffible expedition, yet without confufion or precipitation. The captain of each gun is enjoined to fire only when the piece is properly directed to its object. The lieutenants who command the different batteries traverfe the deck, to fee that the battle is profecuted with vigour, and to animate the men in their duty. The midfhipmen fecond thefe injunctions, and give affiftance where it is required at the guns committed to their charge. The gunner takes care that the artillery is fupplied with powder, and that the cartridges are conveyed along the decks in covered boxes.

During the action, the captain manœuvres his fhip to the beft advantage; caufing the mafter fo to lay her on the enemies' bows, or quarters, and efpecially under her ftern, as may give thofe favourable refults attendant upon a fafe, but annoying, pofition. Should any intervals arife, owing to the fituations of the feveral fhips, it is employed in clearing the decks, in repairing the damaged rigging, and in providing for a renewal of the engagement. If, as very often happens, the enemy make fail with the view to efcape, the guns are fecured, while all hands turn to for the purpofe of giving chafe: in this inftance, the great object is to come up with the flying foe; therefore all thefe fails which were furled or clued up, with the intention of either having lefs to manage, or to keep them free from danger, are now fpread to the gale, and every effort is made to regain a pofition within fuch a diftance as may caufe the enemy to ftrike his flag, and to furrender. Should he ftill perfift, the engagement muft continue, until, being a complete wreck, he may confider further oppofition ufelefs. So foon as he has ftruck, his fhip is taken poffeffion of by a detachment from the victor's crew, and the whole of the fubdued party are put under hatches in the hold, or, if neceffary, are otherwife fecured in the bilboes, &c. while a prize mafter, generally a lieutenant, is put on board, for the purpofe of navigating the prize, according to fuch orders as he may receive.

It fometimes happens, that, where an enemy is very determined, it is neceffary to board; indeed, this not unfrequently occurs, owing to veffels adventitioufly coming in contact. Previous to the adoption of this defperate meafure, it will be abfolutely neceffary to confider well how far it may be likely to fucceed. If the oppofing crew be numerous, and efpecially if abounding in marines, or if there be any number of military on board, much management, activity, and refolution will be required to carry the point; which is generally effected by laying along the lee waift or quarter, or perhaps upon the bow, and, after having grappled,

grappled, by means of chains, or of fmall boarding grapnails fufpended by chains from the yards, to lower down the boarding platforms, (if there be any,) and thus to rufh upon the enemy's deck. In fome inftances, fhips have been boarded by entering at the ports, ftern, or quarter gallery, &c. either of which modes will often fucceed, where the whole of the oppofing crew rufh with too much precipitation, to the upper works, with the intention of refifting thofe who are about to board upon the deck. The bowfprit is frequently reforted to, as the means of entering an enemy's fhip: this, being laid over the ftern, or tafrail, will generally enable the boarders to proceed with fufficient facility, while the marines are employed in keeping up a fharp fire, to drive the defenders off the poop. It is, however, a very hazardous concern, and chiefly reforted to on defperate occafions, by privateers, or where, though ftrong in point of crew, a veffel may not be of fufficient force to lie alongfide her opponent. A repulfe in boarding is peculiarly dangerous, and very commonly leads to defeat. It almoft invariably happens, that, on fuch occafions, great numbers of the boarders are deftroyed; whereby the refidue of the fhip's company are confiderably difpirited; at leaft, this is an ordinary refult among foreigners; Britifh tars are not fo eafily daunted, but may be again, and again, led to the attack.

When the engagement is concluded, they begin the repair. The cannon are fecured by their breachings and tackles; the fails that have been rendered unferviceable, are unbent; and the wounded mafts and yards ftruck upon the deck, and fifhed or replaced by others. The ftanding rigging is knotted, and the running rigging fpliced wherever this is neceffary. Proper fails are bent in the room of thofe that are become ufelefs. The carpenter and his crew repair breaches in the fhip's hull by fhot-plugs, pieces of plank, and fheet-lead. The gunner and his affiftants replenifh the allotted number of charged cartridges, and refit the damaged furniture of the cannon.

When two fleets or fquadrons are preparing for engagement, it will be the endeavour of the admiral or commander in chief to come to action as foon as poffible. To facilitate the execution of the admiral's orders, the whole fleet is ranged into three fquadrons; each of which is claffed into three divifions, under the command of different officers. Before the action begins, the adverfe fleets are commonly drawn up in two lines parallel to each other, and clofe-hauled. When the admiral difplays the fignal for the line of battle, the feveral divifions feparate from the colours in which they were difpofed according to the ufual order of failing, and every fhip crowds into its ftation in the wake of the next a-head, at the diftance generally of about fifty fathom; which diftance is regularly obferved from the van to the rear: though the admiral may fometimes find it neceffary to contract or extend his line, according to the length of that of his adverfary; always taking care that his own line be fecure from being doubled, which might throw his van and rear into confufion. When the reverfe fleets approach each other, the courfes are commonly hauled up in the brails, and the top-gallant fails and ftay-fails, furled; the frigates, tenders, and fire-fhips, being hauled upon the wind; lie at fome diftance behind the line of battle; and tranfports and ftore fhips lie beyond thefe, at a ftill greater diftance from the fcene of action; and if the number of fhips allows it, a body of referve from the different fquadrons is felected to cover the fire-fhips, &c. and ftationed oppofite to the weakeft parts of the line, fo that they may readily fall into the line in cafe of neceffity. Each fhip forming the line fhould keep clofe to its ftation during the engagement; the affault of boarding being feldom permitted unlefs in fingle action: becaufe the regularity of a clofe line conftitutes the principal force of the fleet; and the fkill of the admiral is greatly concerned in keeping his line, notwithftanding unequal attacks and damage, as complete as poffible. If he proves victorious, he fhould profecute his victory as much as poffible, by feizing, burning, or deftroying the enemies' fhips. If he is defeated and reduced to the neceffity of retreating, he may judge it expedient, for greater fecurity, to range his fleet into the form of a half-moon, placing himfelf in the centre. The enemies' fhips that attempt to fall upon his rear will thus be expofed to the fire of the admiral and his feconds, and the efcape of his own fhips will be facilitated, whilft the purfuit of his averfary is retarded. Upon the whole, the real force of fuperiority of a fleet, confifts lefs in the number of veffels and the vivacity of the action, than in good order, dexterity in working the fhips, prefence of mind, and fkilful conduct in the admiral and captains. Falconer's Marine Dict. art. *Engagement.*

There formerly exifted certain fuppofed axioms, in regard to the feveral modes of forming in line of battle a-head, or a-breaft; and much attention was paid to the weather gage, as well as to other fuch matters: fleets ufed then to manœuvre for feveral days, obvioufly intent upon gaining fome particular pofition, which was fuppofed to be indifpenfably neceffary towards a fuccefsful iffue. Of late years this has been totally, or at leaft very generally neglected; for in lieu of fleets, or fingle fhips, now dancing minuets for fuch a purpofe, we fee them ranging up with little ceremony, and intent only on getting into action; whatever may be the ftate of the wind or of the weather. All that a Britifh commander requires of his mafter, nowadays, is, "Lay me alongfide the enemy;" a few guns more or lefs, or even an extra deck, on the part of the enemy, being difregarded. It is to this fpirit, that our fhores are indebted for fafety, and our commerce to that wide range afforded by the univerfal command which Britain holds over the ocean. It is with the utmoft pride and fatisfaction, we witnefs the glorious exertions of our invincible tars: for fuch we may fairly defignate men who, regardlefs of every danger, and urged by the moft patriotic zeal, bear away the palm when, and wherever the enemy, however fuperior in guns, or in numbers, give them the opportunity of difplaying that valour which, though uncontroulable in oppofing a foe, is rapidly metamorphofed into humanity, fo foon as the victory may be proclaimed, or that the voice of diftrefs may be heard! Surely we never can fufficiently reward thofe heroes who, as Hudibras fays, ftand forward—

"To fight our battles in our fteads,
And have their brains beat out o' their heads;
Encounter in defpite of nature,
And fight at once with fire and water,
With pirates, rocks, and ftorms, and feas."

A naval engagement is a branch of warfare in which the Britifh character appears to the utmoft advantage, and in which we ftand confeffedly pre-eminent over the whole univerfe. We derive the more fatisfaction, from the reflection, that our credit and prowefs are not ephemeral, nor dependant upon any temporary weaknefs on the part of our opponents; we contemplate them as heir-looms, bequeathed to us from a noble and brave anceftry, whofe examples have been duly followed, and whofe reputation has, no doubt, contributed to that zeal, and to that emulation, which pervade every part of the Britifh navy, and induce our tars to perfevere in their ftruggles for the prefervation of our rights and liberties as a people; while, at the fame time, each individual aims to uphold his own character for bravery, fubordination, and generofity. See BATTLE, BOARDING, LINE *of Battle*, and SIGNAL.

ENGAGEMENT, in *Englifh Hiftory*, was the obligation impofed by Oliver Cromwell required to be figned by every member of the Firft Parliament in 1654, affembled by his authority, after he was declared Protector, *viz.* "I *A.B.* do hereby freely promife and engage myfelf to be true and faithful to the Lord Protector, and to the commonwealth of England, Scotland, and Ireland, and fhall not (according to the tenure of the indenture whereby I am returned to ferve in this prefent parliament) propofe or give any confent to alter the government, as it is fettled in one fingle perfon and a parliament." Many, who refufed to fign this engagement, were excluded from the houfe.

ENGALLA, in *Zoology*, the Ethiopian hog or African wild boar. See SUS *Æthiopicus*.

ENGALLIM, in *Ancient Geography*, a town of Judea, in the tribe of Benjamin, fituated on the coaft of the Dead fea, where, according to St. Jerom, the river Jordan difcharged itfelf into that fea.

ENGAMOS, in *Natural Hiftory*, the name given by the people of fome parts of Guinea to a root very common there, and much refembling our larger fort of turnips, but not fo fweet or juicy. They commonly boil thefe with their battatas, in the fame kettle with their meat. The latter of thefe roots, which is confiderably different from our potatoe, gives a fine flavour to the whole, and makes the broth and meat tafte as if rofe-water were added to it. The engamos alfo partakes of the flavour, and in this cafe becomes very agreeable. Phil. Tranf. N° 108.

ENGANNIM, in *Ancient Geography*, a city in the plain belonging to Judah, Jofh. xv. 34.—Alfo, a city of Iffachar; given to the Levites of Gerfhon's family. Jofh. xix. 21. xx. 29.

ENGANNO, or DECEIT *Ifland*, in *Geography*, an ifland in the Eaftern fea, at a fmall diftance from the S. W. coaft of the ifland of Sumatra. S. lat. 5° 9'. E. long. 102° 44'.

Ships that pafs the ftraits of Sunda, in the wefterly monfoon, generally run in fight of Enganno. This ifland is 6 or 7 leagues in length, and not quite half as broad. It is not high, and can only be difcerned at the diftance of 5 leagues. It is covered with trees, and always appears green. For a more particular account of this ifland, fee Phil. Tranf. for 1778.

ENGANO, CAPE, a cape on the eaft coaft of the ifland of St. Domingo, N. lat. 18° 27'. W. long. 68° 52'.

ENGANO, or ENGANNO, *Cape*, the N. E. point of the ifland of Luçon, in the Eaft Indian fea. N. lat. 17° 45'. E. long. 121° 20'.

ENGASTRIMANTES, Εγγαστριμαντεις, in *Antiquity*, called alfo *Engaftrimythi*, Εγγαστριμυθοι, a defignation given to fuch diviners as were poffeffed with dæmons, which either lodged or fpoke within their bodies. Pott. Archæol. Græc. lib. ii. cap. 12. tom. i. p. 301.

ENGASTRIMYTHUS, Εγγαστριμυθος, or *Engaftrimander*, a perfon who fpeaks from, or with the belly, without opening his mouth; or, if open, without ftirring the lips.

Thus called by the Greeks, from εν, γαστηρ, *belly*, and μυθος, *fpeech;* and by the Latins, *ventriloquus, quafi ex ventre loquens*.

The ancient philofophers, &c. are divided on the fubject of the engaftrimythi: Hippocrates mentions it as a difeafe. Others will have it a kind of divination, and afcribe the origin and firft difcipline thereof to one Euryclus, whom nobody knows any thing of. Others attribute it to the operation or poffeffion of an evil fpirit; and others, to art and mechanifm.

The moft eminent engaftrimythi were the Pythians or prieftelfes of Apollo, who delivered oracles from within, without any action of the mouth or lips.

St. Chryfoftom and Oecumenius make exprefs mention of a fort of divine men, called by the Greeks engaftrimandri, whofe prophetic bellies pronounced oracles.

M. Schottus, library-keeper to the king of Pruffia, in a Differtation on the Apotheofis of Homer, maintained that the engaftrimythi of the ancients were only poets; who, when the prieftefs could not fpeak in verfe, fupplied the defect, by explaining or delivering in verfe what Apollo dictated in the cavity of the bafon, placed on the facred tripod.

Leo Allatius has an exprefs treatife on the engaftrimythi. See VENTRI-LOQUISTS.

ENGEDI, in *Ancient Geography*, *q. d.* the fountain of the goat, called alfo *Hazazon-Tamar*, or the palm-tree city, from the great quantity of palm trees that furrounded it, a city of Paleftine, in the tribe of Judah (Jofh. xv. 62.), fituated near the lake of Sodom, 300 furlongs from Jerufalem, not far from Jericho, and the mouth of the river Jordan. It was in a cave of the wildernefs of Engedi, that David had an opportunity of killing Saul, and of fparing his life, then in purfuit of him. 1 Sam. xxiv. 1, 2, 3, &c.

ENGEL. See ANGLEN and ANGLES.

ENGELACH, in *Geography*, a town of Germany, in the circle of Lower Saxony, and bifhopric of Hildefheim; 15 miles S. W. of Alfeld.

ENGELBERG, an extenfive narrow valley of Switzerland, in the canton of Underwalden; its length exceeds twelve miles, and it is hardly fix miles broad. It was formerly called the Hahnenberg (Cocks' mountain), but when the abbey church was confecrated, fome inhabitants pretended they had heard the melodious concerts of the angels in heaven, which made them call it *Engelberg*, (the Angels' mountain). The inhabitants are numerous and remarkable for the innocence of their manners, and for their hofpitality to ftrangers.

The abbey of Engelberg is 9 miles S. W. of Altorf. It was founded in the year 1125.

ENGELBRECHTS, a town of Germany, in the archduchy of Auftria; 95 miles N. N. W. of Bavarian Waidhoven.

ENGELHARTZEL, a town of Germany, in the archduchy of Auftria; 9 miles E. of Paffau.

ENGELHAUS, a town of Bohemia, in the circle of Saatz; 2 miles E. S. E. of Carlfbad.

ENGELHOLM, a town of Sweden, in the province of Schonen, or Scania, fituated at the mouth of a river which runs into the Cattegat, 12 miles from Helfingborg. It is the twentieth town in rank among thofe which vote in the Swedifh diet. Its name is faid to be derived from the Angles, who either firft came from this neighbourhood, or paffed over to it from Denmark, and built the place for the conveniency of trade. The latter conjecture is the moft probable.

ENGELSBERG, a town of Silefia, in the principality of Appau; 5 miles N.N.W. of Freudenthal.

ENGELSBURG, a fmall town of Pruffia, in the diftrict of Culm, with an ancient caftle not far from Graudentz.

ENGELSDORF, a town of Bohemia, in the circle of Boleflaw; 10 miles N.N.E. of Krottau.

ENGELSTEIN, a town of Pruffia, in the province of Natangen; 48 miles S.E. of Konigfberg.

ENGELSTETTEN, a town of Germany, in the archduchy of Auftria, 23 miles E. of Vienna.

ENGEN, a town of Germany, in the circle of Swabia, and principality of Stuhlingen; 12 miles N.N.E. of Schaffhaufen, and 20 N.N.W. of Conftance.

ENGENDERING, or INGENDERING, the act of begetting or producing the kind, by way of generation.

The term is likewife applied to other productions of nature: thus, meteors are faid to be engendered in the middle region of the air. Crude fruits engender worms. The ancients believed, that infects were ingendered of putrefaction.

ENGENTHAL, in *Geography*, a town of Germany, in the circle of Franconia; 13 miles E. of Nuremberg.

ENGER, a town of Germany, in the kingdom of Weftphalia, and county of Ravenfburg; 3 miles W. of Hervorden.

ENGER *Sea*, a lake of Carinthia, 10 miles N.N.W. of Feltkirchen.

ENGERSTORFF, a town of Germany, in the archduchy of Auftria; 10 miles S.W. of Zifterfdorf.

ENGETAL, a valley of Switzerland, in the canton of Bafle, remarkable for its abbey, which was fecularized in 1534, and where a bible was printed at the end of the fifteenth century, with N. Lyra's notes.

ENGGISTEIN, a fmall town of Switzerland, one mile from Worbe, remarkable for its mineral fprings, on whofe account it is much vifited in the fummer feafon. The water contains a little copper. The accommodations of the place are very good.

ENGHELBRECHT, CORNELIUS, in *Biography*, a painter, born at Leyden in 1468. Having imitated the works of John Van Eyck, at Bruges, he returned to his own country, and had the honour of being the firft who taught the Dutch to paint in oil; in which he wrought with very great reputation in his time, as well as in diftemper; and was then accounted among thofe moft deferving of eftimation.

He was not quite fo dry or formal in his manner of defign as the painters of that period; and he caft his draperies with more care, and better ftyle, than they. His moft admired performance is the reprefentation of the "Lamb" in the Revelation, which he painted for a chapel in the church of St. Peter at Leyden. The compofition confifts of an immenfe crowd of figures, angels, martyrs, doctors, and fathers of the church, &c. and all the "holy hierarchy of heaven," combined together with an immenfe multitude of perfons of all nations. This picture is very ingenious in the painting of the various parts, but it muft owe its reputation more to the lack of knowledge of the better qualities of art at the time it was painted, than to its own intrinfic worth. This artift died in 1533, at 65.

ENGHIEN, or ENGUIEN, in *Geography*, a fmall town of France, in the department of Jemmappe, chief place of a canton, in the diftrict of Mons, with a population of 3045 individuals. It is 18 miles S.W. of Bruffels, and 15 N. of Mons. N. lat. 50° 40′.

The canton contains 10 communes, and 13,674 inhabitants, on a territorial extent of 140 kiliometres. It is from this place that the eldeft fons of the princes of Condé in France, the laft of whom was fo bafely murdered by the orders of the French emperor Napoleon, derived the title of duke.

ENGIA, an ifland near the coaft of the Morea, anciently called *Ægina*, which fee. Engia gives name to a gulf on the S.E. coaft of European Turkey, formerly denominated *Sinus Saronicus*. See ÆGINA.

ENGINE, in *Mechanics*, a compound machine, confifting of feveral fimple ones, as wheels, fcrews, levers, or the like, combined together, in order to lift, caft, or fuftain a weight, or produce fome other confiderable effect, fo as to save either time or force.

The word is formed of the French *engine;* of the Latin *ingenium*, wit; becaufe of the ingenuity required in the contrivance of engines, to augment the effect of moving powers.

The kinds of engines are innumerable; fome for war, as the balifta, catapulta, fcorpio, aries, &c. others for the arts of peace, as mills, cranes, preffes, clocks, watches; engines to drive piles, to bore cannon and water-pipes (fee BORING), to raife water, wheel and water-works; to extinguifh fire, fee FIRE-*engine*, &c. See HYDROCANISTERIUM. See STEAM-*engine*, &c. See alfo INSTRUMENT.

ENGINE *for cutting Wheels*. See CUTTING-*Engine*.

ENGINE *for cutting Fufees*. See FUSEE-*Engine*.

ENGINE *for ornamenting a Watch-cafe*. See ROWS-*Engine*, or ROSE-*Engine*.

ENGINE *for dividing Circles*, *Quadrants*, *Sextants*, and *Octants*. It is not our intention in this place to enter into the hiftory of the different methods of dividing aftronomical inftruments into degrees and their fub-divifions, as fucceffively practifed by Tycho Brahe, Hevelius, Dr. Hook, Mr. Abraham Sharp, Olaus Roemer, Mr. Graham, Mr. Jon. Siffon, Mr. Bird, Mr. Ramfden, and Mr. Troughton, without the aid of an engine; but, as we propofe to treat the fubject at fome length under our article GRADUATION *of Aftronomical Inftruments*, we beg leave to refer the reader to that head for fuch particulars as relate to the manual operations performed by the beam-compafs and otherwife, which are neceffary for graduating all circles and other inftruments, that are too large to be graduated by an engine.

Among all the improvements in chronometers and nautical inftruments, that owed their origin, during the laft century, to the munificent encouragement of the honourable Board of Longitude, there is none that has fo much contributed to the intereft of navigation, confidered as a fcience, as the engine at prefent to be defcribed; the facility, and at the fame time the accuracy, with which the meafuring portion of any nautical inftrument, however portable, can now be divided by our beft engines, are truly aftonifhing; the fine dividing ftrokes, which, in many inftances, are fcarcely vifible to, and not legible by the naked eye, when magnified by a fuitable lens, are perceived to be laid down with fuch perfect equality, as to relative diftances, that no one who has not examined the means by which they were effected, can conceive the poffibility that the expedition, with which the divifions are made, is equal to the accuracy with which they are meafured and marked down. In Mr. Smeaton's paper, read to the Royal Society of London, on Nov. 17, 1785, on the "Graduation of Aftronomical Inftruments," he mentions an engine, made by Mr. Henry Hindley of York, which indented the edge of any circle in fuch a way, that a fcrew with fifteen threads acting at once, would, by means of a micrometer, read off any given number of divifions, fo as to anfwer the purpofe of fub-dividing the circle. It does not, however, appear that this engine, though it divided the circles of Hindley's equatorial inftruments, was intended or adapted fo much for graduating circles as for cutting the teeth of wheels in clock-work. (See CUTTING-*Engine*.) The year in which it was feen by by Mr. Smeaton was 1741, and, consequently, was in Graham's time, who died in 1751. According to the same author, Mr. Ramsden, in consequence of the reward offered by the Board of Longitude to Mr. Bird, for his method of dividing, in the year 1760, turned his thoughts towards the contrivance of an engine that would divide nautical instruments with sufficient accuracy, without the tediousness of manipulation. Accordingly, considering the nature and properties of the endless screw, and probably contemplating what Hindley had previously done in this way, he completed an engine with an indented plate, or wheel, of thirty inches diameter, which, though it did not completely answer his expectations to their full extent, yet was found very useful for dividing theodolites and such common instruments with great facility. This was effected before the spring of 1768, and, in 1774, a much larger and better engine was produced, with an indented plate of 45 inches diameter, which divided a sextant for Mr. Bird's examination so accurately, that the Board of Longitude, ever ready to remunerate any successful endeavour to promote the lunar method of determining the longitude at sea, did not hesitate to confer an handsome reward on the inventor, but on condition that the said engine might be at the service of the public, and that Mr. Ramsden would publish an explanation of his method of making and using it, which he accordingly did in a quarto pamphlet in the year 1777. The sum of money given to Mr. Ramsden was 615*l.*, of which 300*l.* was considered as a reward for his improvement in the art of dividing instruments by means of his engine, and the remaining 315*l.* was paid in consideration of his making over the property of the said engine to the Commissioners of Longitude, for the good of the public. The description which Mr. Ramsden published, being short and explicit, cannot well be abridged, and the drawings, intended as a guide for other artists to work by, are explanatory of all the parts of the engine, as detached from one another; we have therefore given reduced engravings of all the figures, as they were originally arranged, and propose to copy the description without any other alteration than what the references to our plates required.

Mr. Ramsden's Engine.—"This engine consists of a large wheel of bell-metal, supported on a mahogany stand, having three legs, which are strongly connected together by braces, so as to make it perfectly steady; *fig.* 1. *Plate* VII. of *Engines*, is a perspective representation of the body thus united. On each leg of the stand is placed a conical friction-pulley, whereon the dividing-wheel rests: to prevent the wheel from sliding off the friction-pulleys, the bell-metal centre under it turns in a socket on the top of the stand. The circumference of the wheel is ratched or cut, by a method to be hereafter described, into 2160 teeth, in which an endless screw acts. Six revolutions of the screw will move the wheel a space equal to one degree. Now a circle of brass being fixed on the screw-arbor, having its circumference divided into 60 parts, each division will answer to a motion of the wheel of ten seconds; six of them will be equal to a minute, &c. Several different arbors of tempered steel are truly ground into the socket in the centre of the wheel. The upper parts of the arbor, that stand above the plane, are turned of various sizes, to suit the centres of different pieces of work to be divided. When any instrument is to be divided, the centre of it is very exactly fitted to one of these arbors, and the instrument is fixed down to the plane of the dividing wheel, by means of screws, which fit into holes made in the radii of the wheel for that purpose. The instrument being thus fitted on the plane of the wheel, the frame which carries the dividing-point is connected at one end by finger-screws with the frame which carries the endless screw; while the other end embraces that part of the steel arbor which stands above the instrument to be divided, by an angular notch in a piece of hardened steel; by these means both ends of the frame are kept perfectly steady and free from shake.

The frame carrying the dividing-point, or tracer, is made to slide on the frame which carries the endless screw to any distance from the centre of the wheel, that the radius of the instrument to be divided may require, and may be there fastened by a pair of clamps; and the dividing-point, being connected with the clamps by the double-jointed frame, admits a free and easy motion towards or from the centre, for cutting the divisions without any lateral shake. From what has been said it appears, that an instrument thus fitted on the dividing-wheel may be moved to any angle by the screw and divided micrometer circle on its arbor, and that this angle may be marked on the limb of the instrument with the greatest exactness by the dividing-point, which can only move in a direct line tending to the centre, and is altogether freed from those inconveniences that attend cutting by means of a straight edge. This method of drawing lines will also prevent any error that might arise from an expansion or contraction of the metal, during the time of dividing. The screw-frame is fixed on the top of a conical pillar, which turns freely round its axis, and also moves freely towards or from the centre of the wheel, so that the screw-frame may be entirely guided by the frame which connects it with the centre: by these means any eccentricity of the wheel and the arbor would not produce any error in the dividing; and by a particular contrivance, hereafter described, the screw, when pressed against the teeth of the wheel, always moves parallel to itself; so that a line joining the centre of the arbor and the dividing-point, continued, will always make equal angles with the screw. The rest of the parts are represented in *Plates* VIII. and IX. of *Engines*, where the figures are numbered in succession from 2 to 14 inclusively, which are more easily referred to than the figures in the original plates. *Fig.* 2 is a plan of reduced dimensions, of which *fig.* 3 represents a section on the line H A. The large wheel, A, is 45 inches in diameter, and has 10 radii, each supported by edge-bars, as seen in *fig.* 3. These bars and radii are connected by the circular ring B, 24 inches in diameter, and 3 deep; and, for greater strength, the whole is cast in one piece in bell-metal. As the whole weight of the wheel, A, rests on its ring B, the edge-bars are deepest where they join it; and from thence their depth diminishes, both towards the centre and circumference, as seen in the figure. The surface of the wheel, A, was worked very even and flat, and its circumference turned true. The ring C, of which a section is seen in *fig.* 3, made of fine brass, was fitted very exactly on the circumference of the wheel, and was fastened thereon with screws, which, after being screwed as tight as possible, were well rivetted. The face of a large chuck being turned very true and flat in the lathe, the flattened surface, A, of the wheel was fastened against it with hold-fasts; and the two surfaces and circumference of the ring C, a hole through the centre, and the plane part round it, together with the lower edge of the ring B, were all turned at the same time. D is a piece of hard bell-metal, having the hole that receives the steel-arbor made very straight and true. This bell-metal was turned very true on its arbor, and its face, that rests against the wheel, was made very flat, so that the steel-arbor might stand perpendicular to the plane of the wheel: this bell-metal was fastened to the wheel by six steel screws. A brass socket, Z, is fastened on the centre of the mahogany stand, and

and receives the lower part of the bell-metal piece D, being made to touch the bell-metal in a narrow part near the mouth, to prevent any obliquity of the wheel from bending the arbor: good fitting is by no means neceſſary here, ſince any ſhake in this ſocket will produce no bad effect, as will appear when the cutting-frame is deſcribed. The wheel was then put on its ſtand, the lower edge of the ring, B, reſting on the circumference of the three conical friction-pulleys W, to facilitate its motion round its centre. The axis of one of thoſe pulleys is in a line joining the centre of the wheel and the middle of the endleſs ſcrew, and the other two placed ſo as to be at equal diſtances from each other. F is a block of wood (*fig.* 1.), ſtrongly faſtened to one of the legs of the ſtand; the piece, *g* (*figs.* 1 and 12.), is ſcrewed to the upper ſide of the block, and has half holes, in which the tranſverſe axis, *h*, (*figs.* 1 and 11.) turns; the half holes are kept together by the ſcrews *i*. The lower extremity of the conical pillar, P, (*figs.* 1 and 11.) terminates in a cylindrical ſteel pin *k*, which paſſes through and turns in the tranſverſe axis *h*, and is confined by a cheek and ſcrew. To the upper end of the ſaid conical pillar is faſtened the frame G, (*figs.* 5 and 9.), in which the endleſs ſcrew turns; the pivots of the ſcrew are formed in the manner of two fruſta of cones joined by a cylinder, as repreſented at X, in *fig.* 9. Theſe pivots are confined between half holes, which preſs only on the conical parts, but do not touch the cylindrical parts; the half holes are kept together by ſcrews, *a*, *a*, which may be tightened at any time, to prevent the ſcrew from ſhaking in the frame. On the ſcrew-arbor is a ſmall wheel of braſs, K, having its outſide edge divided into 60 parts, and numbered at every 6th diviſion with 1, 2, &c. to 10. The motion of this wheel is ſhewn by the index, *y*, on the ſcrew-frame G. H repreſents part of the ſtand (*fig.* 1.) having a parallel ſlit in the direction towards the centre of the wheel, large enough to receive the upper part of the conical braſs pillar P, which carries the ſcrew and its frame; and as the reſiſtance, when the wheel is moved by the endleſs ſcrew, is againſt that ſide of the ſlit, H, which is towards the left hand, that ſide of the ſlit is faced with braſs, and the pillar is preſſed againſt it by a ſteel ſpring on the oppoſite ſide: thus is the pillar ſtrongly ſupported laterally, and yet the ſcrew may be eaſily moved from or againſt the circumference of the wheel, and the pillar will turn freely on its axis, to take any direction given it by the frame L, lying over the wheel in *fig.* 1, and ſeen more diſtinctly in *fig.* 13.

At each corner of the piece I, ſeen in *fig.* 1, and alſo detached in *fig.* 8, are as many ſcrews, *n*, of tempered ſteel with poliſhed conical points: two of them turn in conical holes in the ſcrew-frame, near *o*, *fig.* 9; and the points of the other two turn in holes in the piece Q, *fig.* 7; the ſmall end ſcrews, *p*, are of ſteel, which, being tightened, prevent the conical pointed ſcrews from unturning, when the frame is moved. The braſs frame L, *figs.* 1 and 13, ſerves to connect the endleſs ſcrew, its frame, &c. with the centre of the wheel; each arm of this frame is terminated by a ſteel ſcrew, that may be paſſed through any of the holes, *q*, in the piece Q, *fig.* 7, as the thickneſs of the work to be divided on the wheel may require, and are faſtened by the finger-nuts *r*, ſeen in *figs.* 1 and 2. At the other end of this frame is a flat piece of tempered ſteel *b*, wherein is an angular notch: when the endleſs ſcrew is preſſed againſt the teeth of the circumference of the wheel, which may be done by turning the finger-ſcrew S, ſeen in *figs.* 1 and 2, to preſs againſt the ſpring *t*, this notch embraces and preſſes againſt the ſteel-arbor *d*. This end of the frame, too, may be raiſed or depreſſed, by moving the triangular or priſmatic ſlide *u* (*fig.* 14.), which may be fixed at any height by the four ſteel ſcrews *v*. The bottom of this ſlide has a notch *k*, having its plane parallel to the endleſs ſcrew; and by the point of the arbor *d*, reſting in this notch, this end of the frame is prevented from tilting: the ſcrew, S, alſo is kept faſt by the finger-nut *w*, in *fig.* 2.

The teeth on the circumference of the wheel were cut by the following method. Having conſidered what number of teeth on the circumference would be moſt convenient, which in this engine is 2160 or $\overline{360 \times 6}$, I made, ſays Mr. Ramſden, two ſcrews of the ſame dimenſions of tempered ſteel, the interval between the threads of which being ſuch as I knew by calculation would come within the limits of what might be turned off the circumference of the wheel; one of theſe ſcrews, which was intended for ratching or cutting the teeth, was notched acroſs the threads, ſo that the ſcrew, when preſſed againſt the edge of the wheel and turned round, cut in the manner of a ſaw. Then having a ſegment of a circle a little greater than 60°, of about the ſame radius with the wheel, and its circumference made true from a very fine centre, I deſcribed an arch near the edge, and ſet off the chord of 60° on this arch. This ſegment was ſubſtituted for the wheel, and had its edge ratched or indented; and the number of revolutions and parts of the ſcrew head contained within the arch of 60° were counted. The radius was corrected in the proportion of 360 revolutions, which ought to have been in 60°, to the number actually found; and the radius ſo corrected was taken in a pair of beam compaſſes: while the wheel was on the lathe, one foot of the compaſſes was put in the centre, and with the other a circle was deſcribed on the ring; then half the depth of the threads of the ſcrew being taken in the dividers, was ſet from this circle outwards, and another circle was deſcribed cutting this point; a hollow was then turned on the edge of the wheel of the ſame curvature as that of the ſcrew, at the bottom of its threads; the bottom of this hollow was turned to the ſame radius as the outward one of the two circles before-mentioned.

The wheel was now taken off the lathe, and the bell-metal piece D, *fig.* 3, was again ſcrewed to its place, not to be removed any more. From a very exact centre, a circle was deſcribed on the ring C, *fig.* 4, about $\frac{4}{10}$ths of an inch within where the bottom of the teeth would come; this circle was divided with the greateſt poſſible exactneſs, firſt into 5 parts, and each of theſe again into 3; theſe parts were then biſected 4 times; *i. e.* ſuppoſing the whole circumference of the wheel to contain 2160 teeth, a fifth part would be 432, a fifteenth part (or 5×3) would be 144, and this laſt number biſected four times would give 72, 36, 18, and 9 reſpectively; but as it was apprehended that ſome inaccuracy would ariſe from quinqueſection and triſection, another circle was deſcribed on the ſame ring, at $\frac{1}{10}$th of an inch within the former circle, and divided by continual biſections into the portions 2160, 1080, 540, 270, 135, $67\frac{1}{2}$, and $33\frac{3}{4}$; and as the fixed wire, to be deſcribed preſently, croſſed both the circles, it was a check on their agreement at every 135 revolutions, and after ratching at every $33\frac{3}{4}$; but as no ſenſible difference was perceived in the two circles, the former was choſen for ratching: and as the coincidence of the fixed wire with an interſection would be more exactly determined than with a dot or diviſion, the interſections in both circles were uſed.

The arms of the frame L, *figs.* 1 and 13, were connected by a thin piece of braſs $\frac{3}{4}$ of an inch broad, having a hole of $\frac{4}{10}$ths of an inch diameter in the middle; acroſs this hole a ſilver wire was fixed exactly in a line to the centre of the wheel;

wheel; the coincidence of this wire with the interfections was examined by a lens of $\frac{7}{10}$ths of an inch focus, fixed in a tube, that was attached to one of the arms L. Now a handle, or winch, being fixed on the end of the fcrew-arbor, the divifion marked 10 on the circle K was fet to its index, and, by means of a clamp and adjufting fcrew for that purpofe, the interfection marked 1 on the circle C was fet exactly to coincide with the fixed wire; the fcrew was then carefully preffed againft the circumference of the wheel, by turning the finger-fcrew S; then, the clamp being removed, the fcrew was turned by its handle juft 9 revolutions, till the interfection marked 240, *fig.* 4, came nearly to the wire; the finger-fcrew S was now turned back, and the dividing fcrew releafed from the edge of the wheel, which was here turned back till the interfection marked 2 exactly coincided with the wire; the divifion 10 on the micrometer circle was then fet to its index as before, and the fcrew preffed againft the edge of the wheel by the finger-fcrew S; then, the clamps being removed, the fcrew was turned a fecond 9 revolutions, till the interfection marked 1 nearly coincided with the fixed wire; the fcrew was again releafed, and the fame operation was repeated till the teeth were faintly marked all round the circumference of the wheel. The impreffion was made deeper by thus going three times round; after which the wheel was ratched continually round 300 times in the fame direction, without difengaging the fcrew, when the teeth were found fufficiently indented. Now, it is evident, that, if the circumference of the wheel were even a whole tooth or ten minutes fpace greater than the fcrew would require, this error would, in the firft inftance, be reduced to $\frac{1}{240}$th part of a revolution, or two feconds and a half; and thefe errors or inequalities of the teeth were equally diftributed round the wheel at the diftance of 9 teeth from each other; but, as the fcrew in ratching had continually hold of feveral teeth at the fame time, and as thefe were conftantly changing, the above-mentioned inequalities foon corrected themfelves, and the teeth were reduced into a perfect equality.

The piece of brafs which carries the wire was now taken away, and the cutting-fcrew alfo removed, and replaced by the plane one of the fame dimenfions; on one end of its arbor was put the micrometer circular plate divided into 60, and numbered at every fix divifions, as already ftated; and on the other end was placed a ratchet-wheel of 60 teeth, feen in *fig.* 6, which is covered by the hollowed circle *d*, carrying two clicks, that catch upon the oppofite fides of the ratchet, when the fcrew is to be moved forwards. The cylinder S, *figs.* 5 and 9, turns on a ftrong fteel arbor F, feen in *fig.* 5, which paffes through, and is firmly fcrewed to the piece Y; this piece, for greater firmnefs, is attached to the fcrew frame G by the braces *v*: a fpiral groove or thread is cut on the outfide of the cylinder S, which ferves both for holding the ftring, and alfo for giving motion to the lever J on its centre, *figs.* 9 and 10, by means of a fteel tooth *n* that works between the threads of the fpiral. To the lever is attached a ftrong fteel pin *m*, *fig.* 10, on which a brafs focket *r* turns: this focket paffes through a flit in the piece *p*, and may be tightened in any part of the flit by the finger-nut *f*: this piece ferves to regulate a number of revolutions of the fcrew for each tread of the treadle R, feen in *fig.* 1. T, in *fig.* 1, is a brafs box, containing a fpiral fpring: a ftrong gut is faftened and turned three or four times round the circumference of this box; the gut then paffes feveral times round the cylinder S, *figs.* 1 and 9, and from thence down to the treadle R. Now, when the treadle is preffed down, the ftring pulls the cylinder S round its axis, and the clicks laying hold of the teeth on the ratchet, carry the fcrew round with it, till, by the tooth *n* working in the fpiral groove, the lever J is brought near the wheel *d*, *fig.* 6, and the cylinder is ftopped by the fcrew-head *x*, *fig.* 9, ftriking on the top of the lever J; at the fame time the fpring is wound up by the other end of the gut paffing round the box T, *fig* 1. Now, when the foot is taken from the treadle, the fpring in the box unbending itfelf, pulls back the cylinder, the clicks leaving the ratchet and attached fcrew at reft till the piece *t* ftrikes on the end of the piece *p*, *fig.* 10; and the number of revolutions of the fcrew at each tread is limited by the number of revolutions that the cylinder is allowed to turn back before the ftop ftrikes on the piece *p*. When the endlefs fcrew is moved round its axis with a confiderable velocity, it will continue that motion a little after the cylinder S is ftopped; to prevent which angular motion, the angular lever η was made, that when the lever J comes near to ftop the fcrew *x*, it, by a fmall chamfre, preffes down the piece κ of the angular lever; this brings the other end η of the fame lever forwards, and ftops the endlefs fcrew by the fteel pin μ ftriking on its top; the foot of the lever is again raifed by a fmall fpring preffing on the brace *v*.

Two clamps D, *fig.* 13, connected by the piece *a*, *fig.* 1, flide, one on each arm of the frame L, and may be fixed at pleafure by the four finger-fcrews ϵ, which prefs againft fteel fprings, to avoid fpoiling the arms; the piece *q*, *fig.* 13, is made to turn without fhake between the two conical pointed fcrews *f*, *f*, fet faft by the finger-nuts N, N. The piece M is made to turn on the piece *q*, by the conical pointed fcrews refting in the hollow centres *e*, *e*. As there is frequent occafion to cut divifions on inclined planes, for that purpofe the piece γ, in which the tracer or dividing point is fixed, has a conical axis at each end, which turn in half holes; fo that when the tracer is fet to any inclination, it may be fixed there, by tightening the fteel fcrews $\beta\beta$."

Subfequently to the time of Mr. Ramfden's dividing engine being conftructed, Mr. Edward Troughton conftructed one to anfwer the fame purpofe, which it does in the moft perfect manner; and it was our intention to have defcribed it alfo in this place, but on application to him for permiffion to infpect its parts and manner of operating, we were forry to learn that he has pledged himfelf to give an account of it himfelf in another work.

Engine (by Ramfden) *for cutting the Screws of the circular Dividing-Engine.*—We mean not to enter here into the hiftory of the fcrew-engine, as it may be, and has been applied to various purpofes, but to defcribe the engine made and ufed by Mr. Ramfden for making the individual fcrews which he ufed for ratching his engine for dividing circles, &c., and for meafuring the angular diftance on his circle when ratched. This apparatus, indeed, may be confidered as an appendage to the other, and therefore ought to be introduced in this place. *Fig.* 1. of *Plate* X. of *Engines*, reprefents this engine as feen from one fide of reduced dimenfions; and *fig.* 2, the fame as feen from above, of the fame dimenfions. A reprefents a triangular bar of fteel, to which the triangular holes in the pieces B and C are accurately fitted, and may be fixed on any part of the bar by the fcrew D. E is a piece of fteel whereon the fcrew is intended to be cut, which, after being hardened and tempered, has its pivots turned in the form of two frufta of cones, as reprefented in the drawings of the dividing-engine. Thefe pivots were very exactly fitted to the half holes F and T, which were kept together by the fcrews Z. H reprefents a fcrew of untempered fteel, having a pivot I, which turns in the hole K. At the other end of the fcrew is a hollow centre, which receives the hardened conical point of the fteel pin M. When this point is fufficiently preffed againft the fcrew, to prevent its fhaking, the fteel pin may be fixed by tightening the fcrews Y. N is a cylindrical nut, moveable on the fcrew H, which, to prevent any fhake, may be tightened by the fcrews O. This nut is connected with the faddle-piece P, by means of the intermediate univerfal joint W, through which the arbor of the fcrew H paffes. A front view of this piece, with a fection acrofs the fcrew-arbor, is reprefented at X, *fig.* 3. This joint is connected with the nut by means of two fteel flips S, which turn on pins between the cheeks T, on the nut N. The other end of thefe flips S turn in like manner on pins *a*. One axis of this joint turns in a hole in the cock *b*, which is fixed to the faddle-piece, and the other turns in a hole *d*, made for that purpofe in the fame piece on which the cock *b* is fixed. By thefe means, when the fcrew is turned round, the faddle-piece will flide uniformly along the triangular bar A. K is a fmall triangular bar of well-tempered fteel, which flides in a groove of the fame form on the faddle-piece P. The point of this bar or cutter is formed to the fhape of the thread intended to be cut on the endlefs fcrew. When the cutter is to take proper hold of the intended fcrew, it may be fixed by tightening the fcrew *e*, which prefs the two pieces of brafs G upon it. Having meafured the circumference of the dividing-wheel, it was found to require about one thread in a hundred, coarfer than the guide-fcrew H. The wheels on the guide-fcrew arbor H, and that on the fteel arbor E, on which the fcrew was to be cut, were proportioned to each other to produce that effect, by giving the wheel L 198 teeth, and the wheel Q 200. Thefe wheels communicated with each other by means of the intermediate wheel R, which alfo ferved to give the threads on the two fcrews the fame direction. The faddle-piece P is confined on the bar A by means of the pieces *g*, and may be made to flide with a proper degree of tightnefs by the fcrews *n*.

Engine *for cutting the Screw of Ramfden's Engine for dividing Straight Lines.*—The exactnefs of the ftraight line engine, as made by Ramfden, depends very much on the correctnefs of the endlefs fcrew, which requires fome properties that are not abfolutely neceffary in the endlefs fcrew for the *circular engine.* In that, as there are but a few threads of the endlefs fcrew engaged in the teeth of the wheel, it required only that thofe threads fhould have a fimilar inclination to the axis of the fcrew all round; but in the ftraight-line engine, where the whole length of the fcrew is engaged in the moveable plate, it is neceffary that the diftances alfo between the threads fhould be precifely the fame throughout the whole length of the fcrew: as this is effected in a manner in fome refpects different from the mode of cutting the fcrew we have juft defcribed, we fhall fubjoin it here, that the reader may take a comparative view of the two methods adopted by that great artift Ramfden. In *fig.* 1. of *Plate* XI. of *Engines*, is a plan of the engine for cutting the fcrew for dividing *ftraight lines;* and in *fig.* 2, is an elevation of the fame. The fection, as given in the original account publifhed in 1779, does not feem to be neceffary for explaining the engine, and is therefore omitted in our account. A, in *fig.* 1, reprefents a ftrong circular plate of brafs, having its edge ratched, as defcribed in our account of the circular dividing-engine; on its centre is firmly fixed the pulley B by four fcrews, having a groove turned on its cylindrical part, perfectly concentric with the plate A. C, in *fig.* 2, is a fteel axis two feet long, terminating in a point, whereon it refts; the upper part of the axis being firmly fcrewed to the plate A, and turning in the collar D. E reprefents an endlefs fcrew, *fig.* 1, which being turned on its horizontal axis, moves the circular plate A round its centre: F is a circular divided fmall plate, or micrometer-head, which may be turned with or without the endlefs fcrew; and on the other end of this fcrew-arbor is a large pinion *a*, with levelled teeth on its edge, together with the winch X to turn it by. G, feen in both figures, is a triangular bar of fteel, which paffes over the circular plate A, and is firmly fcrewed to the frame of the engine at H, *fig.* 1, and I, *fig.* 2. K is a piece of fteel forming the arbor of the fcrew intended to be cut, having a wheel L, on one end acting with the pinion *a* before-mentioned. M and N, *fig.* 1, are two ftrong pieces of brafs, in which the arbor juft mentioned turns, and are firmly fixed to the triangular bar G, by means of the fcrews *n*, *n*, feen at I, in *fig.* 2. O, feen in both figures, is a piece of brafs that flides on the triangular bar G, the two extremities of which are made exactly to fit the bar; it flides regularly thereon, and is prevented from rifing by the two fpring pieces *c*, *c*; near one end of the piece O is an angular groove *q*, *fig.* 1, that holds the tool by which the threads are cut, and is pointed with a diamond, in order to cut the fteel after it is hardened and tempered: the cock *w* ferves to faften the tool, which may be fet to take proper hold on the fteel by turning the finger-fcrew *s*, and is fixed there by the fcrew *v*.

To make a perfect fcrew, it is only required to give the point that cuts the threads an uniform motion parallel to itfelf, and alfo to the axis of the intended fcrew, and that this motion be proportioned to the revolutions of the intended fcrew as the number of threads may require. To effect this, a piece of thin tempered fteel *t*, exactly of the fame thicknefs throughout, is faftened to the flide O at *r*; the other end of the fpring being faftened to the pulley B in the groove: now while the circle A, with the pulley, is turned round its centre by turning the endlefs fcrew to the right hand, the fpring *t* draws the flider O, with the attached cutter *q*, along the triangular bar; at the fame time the fteel-arbor K of the fcrew to be cut revolves by means of the communication of its wheel L with the revolving pinion *a*.

The fcrew, E, of the circular plate has 20 threads *per* inch, therefore if the number of teeth on the pinion, *a*, be to the number in the wheel L, as the number of teeth on the circular plate, A, is to the number of 20ths of an inch round the circumference of the pulley B, allowing for part of the thicknefs at the fpring *t*, the fpaces between each of the threads of the fcrew to be cut will be alfo 20ths of an inch. The fize of the pulley, B, was determined thus: the endlefs fcrew, E, being difengaged from the circular plate A, the flider, O, was drawn back till the end of it came nearly to the piece M; the endlefs fcrew was again engaged in the plate A; then having two very fmall dots on the flider O, fet off parallel to one fide, at exactly five inches diftance from each other, the flider was moved by turning the endlefs fcrew E, till one of its dots was bifected by a fmall filver wire fixed acrofs a hole made in a thin piece of brafs faft to the piece N; then O on the micrometer head, F, being put to the index without moving the fcrew, the pulley was tried and reduced, till juft 600 revolutions of the endlefs fcrew, E, brought the fecond dot to be exactly bifected by the fixed wire. Thefe bifections were examined by a lens of half an inch focus, fet in a fmall brafs tube, that was fixed perpendicularly over the wire.

Engine *for dividing ftraight Lines, by Ramfden.*—When Mr. Ramfden had fucceeded in dividing fextants, &c. by his circular dividing engine, and was rewarded by the honourable Board of Longitude, he turned his mind towards

wards the contrivance of an engine that would divide ſtraight lines into any number of aſſignable parts, and that might be uſeful in laying down with extreme accuracy the lines of ſines, tangents, ſecants, &c. on ſectors and plane ſcales. The project was realized, and the account was ordered to be publiſhed by the Board of Longitude, in the year 1779. We do not find, however, that the original model, which we come now to deſcribe, has been found deſirable to copy by ſucceeding mathematical inſtrument makers: more ſimple and leſs expenſive means have been adopted, which are found to anſwer practically as good a purpoſe. A beam-compaſs, aided by proper tables, is quite accurate enough for the niceſt purpoſes of dividing unequal, as well as equal, diviſions by biſection; and a pattern once carefully laid down can be uſed, for transferring the diviſions on the common caſes of inſtruments, with greater facility than the engine itſelf can be worked; and, provided great care be taken to prevent the parallax of the transferring point, the accuracy will be ſufficient for all ordinary uſes. This engine, which profeſſes to divide any line without an error of $\frac{1}{4000}$th of an inch, has its principal parts repreſented in *Plate* XII. of *Engines;* where *fig.* 1, repreſents a plan of the dividing portion, as ſeen from above; *fig.* 2, an elevation of the ſame ſeen acroſs; and *fig.* 3, the under ſide of *fig.* 1, when turned up. The original account contains ſome ſections, which are more uſeful for the workmen as patterns, than for a general deſcription, which may diſpenſe with them altogether. A, in *fig.* 1, is a ſtrong braſs plate, 27 inches long, 4 broad, and $\frac{7}{10}$ths thick; worked exceedingly flat, and of the ſame thickneſs throughout, with its two edges parallel. One of theſe edges is ratched, or cut into teeth, of which there are juſt 20 in an inch, and is moved by an endleſs ſcrew, containing juſt 20 threads in an inch, which actuates the teeth. (See ENGINE *for cutting the Screw of Ramſden's ſtraight-line Engine.*) Each revolution of the endleſs ſcrew round its axis will move the plate $\frac{5}{100}$ths of an inch along an iron frame, hereafter to be deſcribed. A micrometer head is fixed at one end of the ſcrew arbor, divided into 50 diviſions, which, by means of a vernier ſubdividing into 5 parts, meaſures $\frac{2}{10000}$ths of an inch along the frame. Any rule or other inſtrument may be faſtened on this plate, and may have a line drawn on it divided by a point or tracer, fixed in a proper frame, whereby it has a rectilinear motion without any lateral ſhake. When lines are to be divided by diviſions not commenſurable with Engliſh inches, which conſtitute the ſcale, the line to be ſo divided may be laid down, not parallel to the plate A, but obliquely, ſo as to make an angle with it, or become the hypothenuſe line of a right-angled triangle; which line, by calculation, ſhall be to the baſe as the denomination of meaſure, when longer, is to the Engliſh inch; that is, as the ſecant is to the radius of the triangle, provided the tracer draws lines at right angles to the ſide of the plate; but if the traced lines be at right angles to the line to be divided, then the diviſions on that line will be ſhorter than they would be on a parallel line of the plate, and in the proportion of the co-ſine of the angle of inclination to radius. In order to adjuſt the inclination of a ruler laid on the plate A, two ſectoral portions of a circle are laid down on one of its ends, with an extent from the point J, near the fixing ſcrews on the edge of this plate. The outer ſector is divided into proper degrees, and is numbered from 1 to 9, which degrees are ſubdivided into 6, or 10 minutes ſpaces; but the inner ſector is divided into the proportion of the coſines to radius 10,000, and its diviſions are numbered 10, 20, 30, &c. to 140. The uſe of this contrivance will be beſt underſtood by an example: for inſtance, if a line of $9\frac{999}{1000}$ were to be divided into the ſame number of diviſions, and in the ſame manner as if it were 10 inches long exactly; put the ruler to be divided to the cutting frame, hereafter deſcribed, and turn the handle, T, that moves the apparatus, till the ſame edge of the ruler cuts the central point J, and the firſt diviſion from the O of the inner ſector; then ſcrew the ruler faſt to the plate A, and when it has moved ten inches in its own direction, the whole length of the diviſions on the line divided will be only $9\frac{999}{1000}$ inches, though the divided ſpaces will be reſpectively equal among themſelves. It is not neceſſary for us to particularize the precautions taken, in making all the ſpaces of the teeth ratched equal to each other, during the act of ratching, which was done with a notched ſcrew: this was done by means of points previouſly made and examined, with a wire at every 16 revolutions of the ſcrew, till the teeth were a little indented to guide the ſcrew along the whole line by continual revolutions, as was the caſe in the circular dividing inſtrument, more particularly deſcribed, becauſe found more particularly uſeful. B, in *fig.* 1, is a ſtrong iron frame, 48 inches long, having two edges, *a* and *b*, riſing half an inch above its ſurface; theſe two edges are made very ſtraight, and are in the ſame plane; the inſide of the edge *a* is alſo made as ſtraight as poſſible. The plate, A, ſlides on the two edges of the iron frame; beneath it are two ſprings, *c*, *c*, ſeen in *fig.* 3, each faſtened at the extreme ends to the plate A, by the ſcrews, *s*, *s*; at the other end of each ſpring is a roller, *e*, of tempered ſteel, turning on an axis in theſe ſprings; there is alſo a third roller, *d*, of tempered ſteel, let into the iron frame, not ſeen, near where the threads of the endleſs ſcrew act; this roller has a long axis, ſo ſituated that it may be raiſed or depreſſed as occaſion may require, to bear the weight of the plate A, and rule or inſtrument placed on it. C, in *figs.* 1 and 2, is the endleſs ſcrew of tempered ſteel, with pivots of two fruſta of inverted cones, ſimilar to thoſe deſcribed in the engine for dividing circles, &c. which turn in adjuſtable half holes in braſs cocks ſcrewed to the iron frame. G, G, in *fig.* 3, are two ſmall ſteel frames turning on centres, *k*, faſtened to the underſide of the plate A, and equidiſtant from the edge of it; in each frame is a roller, *y*, of tempered ſteel, turning very concentric with their pivots, and exactly of the ſame diameter. The two ſmall frames are connected together by the long braſs bar E, which turns on a ſtud in each frame, and which preſerves its paralleliſm, on the principle of a common parallel ruler. This apparatus ſerves to preſs the edge of the plate, A, with a motion parallel to itſelf againſt the threads of the endleſs ſcrew. On the end of the plate, A, is a ſpring of tempered ſteel, acting as a bent lever. The ſpring end of this lever has a ketch which paſſes under the head of the ſtud *l*, that is on the end of the connecting piece E. While the other end of the lever is preſſed gradually down towards the plate A, by turning the finger-ſcrew F, the connecting piece, E, is drawn forward, ſo that the ſteel rollers, borne by the ſprings T, in *fig.* 3, preſſing againſt the edge, *a*, of the iron frame, in *fig.* 1, may force the ſide of the plate againſt the endleſs ſcrew.

Beſides the micrometer head, already named, the arbor of the dividing ſcrew, which has its threads ſimilar to thoſe of the notched ratching ſcrew, has at its oppoſite end two ſets of ratched wheels; one ſet for turning the ſcrew, and the other ſet for ſtopping it at the proper times. Theſe ſets are each compoſed of three wheels, of which one has 32 teeth, another 48, and the third 50, which afford the means of ſubdividing the inch into ſpaces of different denominations; thoſe wheels uſed in ſtopping the ſcrew are ratched, with the teeth pointing in a contrary direction to thoſe thofe of the wheels for putting it in motion. I reprefents a cylinder of brafs, having on one end two fteel rings, *a* and *b*, with their contiguous edges cut into ratched teeth, in contrary directions, fo as to fit each other as feen in the figure; on one of thefe rings is an index, and the other has its teeth numbered 10, 20, &c. up to 50; the other end of the cylinder is made hollow, and contains one of the fets of ratched wheels, already named. There are two flits oppofite each other, pierced through the hollow part of the cylinder W; in each of which flits is a click turning on an axis, and preffed into the teeth of the ratched wheel by a fmall fpring; thefe clicks may be moved along their axis, fo as to catch in any one of the three ratched wheels, and may be faftened at that place by a fmall tightening fcrew *s*. The cylinder I, with the clicks, &c. turns on a fteel axis, attached to the piece K, in a line with the axis of the endlefs fcrew. Motion is given to this cylinder round its axis by a piece of catgut, which hath one end faftened to the ratched ring *b*; and the other end, after paffing four or five times round the cylinder, is faftened to a treadle, and, on preffing the treadle down, the clicks, *s*, catch in the teeth of one of the ratched wheels; by which contrivance the cylinder I, together with the endlefs fcrew, is turned round its axis, and its motion carries the plate, A, along the iron frame, and at the fame time winds up the fpiral fpring *u*; but on releafing the treadle, the faid fpring unbends itfelf, the clicks quit the ratched wheel, and leave the endlefs fcrew at reft, whilft the cylinder, I, turns in an oppofite direction, and raifes the treadle to its former fituation. V, in *fig.* 2, is a fmall fquare bar of fteel, having both its extremities cylindrical; thefe cylinders move in holes lined with hardened fteel, one in the piece D, and the other in the piece K. This bar carries three different pieces, which are of tempered fteel; the middle one, *t*, is made to lie in the interval between the threads of the fcrew cut on the cylinder, and paffes nearly half round its circumference: it is kept in the threads by a fpring, *e*, that preffes on a piece, *q*, fcrewed to the iron frame; this piece being attached to the bar, V, by a fcrew, turning the cylinder, I, on its axis, will give a longitudinal motion to the bar V. The upper end of the piece *f*, *fig.* 2, is formed into a hook, and may be fet to catch in the teeth of any of the ratchet wheels, and then be faftened to the bar, V, by a fcrew *i*; towards the other end of the bar is a piece *j*, which ferves to ftop the cylinder in turning back, fo as to limit the number of revolutions and parts of a revolution required, and is faftened to any required place on the bar, V, by the finger-fcrew *s*.

When the engine is ufed, the treadle is preffed down, and the catgut turns the cylinder I; in the mean time, the piece, *t*, moves along the thread till a ftud, *r*, on the cylinder, ftriking on the top of the curved piece *t*, bends the fpring *e*, until that piece refts on the piece *q*; by bending this fpring, the fquare bar is turned a little on its axis, and pulls the hook, *f*, into the teeth on the ratched wheel R: then the treadle being releafed, the fpiral fpring turns back the cylinder till the piece, *j*, is brought under the ftop on the ratchet ring *b*. The parts of a revolution are regulated by fetting the number required on the ratchet ring, *b*, to the index on the fixed ring *a*; each of the teeth anfwers to the motion of $\frac{1}{1000}$th of an inch of the plate A; and the number of revolutions, each of which moves the plate, A, $\frac{1}{10}$ths of an inch, is regulated by fetting the piece, *j*, on the bar. I, in *fig.* 1, reprefents the fteel frame in which the tracer is fixed; this frame turns between the conical points of two fcrews, *n*, *n*, of tempered fteel, which are fcrewed in the frame Q, *fig.* 2; there are alfo two fimilar fcrews in the fame frame Q, at *m*, *m*; the points of thefe fcrews, which are alfo of tempered fteel, turn in conical holes in the piece P; by means of this parallel motion, the tracing point, by which the dividing lines are cut, will always defcribe the fame line without any lateral bending; the tracer is put on the hole in the axis *b*, *fig.* 1, and is fixed there by the four tightening fcrews, *f*, that prefs the holding piece, *c*, againft the flattened part of the axis of motion. This fmall axis, which has its pivots formed of double cones, turns between half holes, and may be fixed when the tracer is fet to any required inclination, by tightening the fcrews of preffure, *s*, *s*, *s*, *s*. Befides thefe parts of the engine, there is a brafs ruler made as an appendage for fetting the line to be divided in its true fituation, but is not neceffary to be particularly defcribed: this ruler may be fet parallel to the edge of the plate A, or to any angle of inclination, by turning the handle T, which moves the piece P, with the cutting frame and ruler, on the centre *x*; and the required pofition may be rendered permanent by tightening the capftan fcrew *p*.

ENGINE-*Shaft*, in *Mining*, is generally applied to the fhaft or well wherein the pumps are erected for freeing a mine of its water; but in diftricts where the mines are relieved of water by foughs, as in the mountainous part of Derbyfhire, it is common to find the fhafts at which they draw ore by a horfe-gin, called the engine-fhaft, and the gin itfelf an engine.

ENGINE *to draw Fuzes*, in *Gunnery*, confifts of a wheel with a handle to it, to raife a certain weight, and to let it fall upon the driver, by which the ftrokes become more equal.

ENGINE *to draw Fuzes* has a fcrew fixed upon a three-legged ftand, the bottom of which has a ring to place it upon the fhell; and at the end of the fcrew is fixed a hand-fcrew, by means of a collar, which, being fcrewed on the fuze, by turning the upper fcrew, draws out or raifes the fuze.

ENGINEER, or INGINEER, in its general fenfe, is applied to a contriver or maker of any kind of ufeful engines or machines.

In its more proper fenfe, it denotes an officer in an army or fortified place, whofe bufinefs it is to contrive and infpect attacks, defences, works, &c. The term engineer is faid to be of modern date, and to have been firft ufed in the year 1650, when one Cap. Thomas Rudd had the title of chief engineer to the king. In 1634 an engineer was called camp-mafter general, and fometimes engine-mafter, being always fubordinate to the mafter of the ordnance.

An engineer fhould be an able and expert mathematician, particularly verfed in military architecture and gunnery; being often fent to view and examine the places intended to be attacked; to choofe out and fhew the general the weakeft place; to draw the trenches, affign the places of arms, galleries, lodgments on the counterfcarp and half-moons; conduct the works, faps, mines, &c. and appoint the workmen their nightly tafk; he is alfo to make the lines of contravallation; with the redoubts, &c.

Under the eftablifhment of the office of his majefty's ordnance in England, the corps of *royal engineers* confifts of one colonel in chief, one colonel in fecond, three colonels commandant, fix colonels, 12 lieutenant-colonels, 27 captains, 28 fecond-captains, 55 firft-lieutenants, 28 fecond-lieutenants, an infpector-general of fortifications, his deputy brigade-major, adjutant, and quarter-mafter.

The eftablifhment of the corps of *invalid engineers* comprehends a colonel, lieutenant-colonel, captain, captain-lieutenant and captain, firft-lieutenant and fecond-lieutenant.

The

The corps of *royal engineers* in Ireland confifts of a director, colonel, lieutenant-colonel, major, captain, captain-lieutenant, and captain, and two firft-lieutenants. See Ordnance.

Engineers, *Civil*, a denomination which comprifes an order or profeffion of perfons highly refpectable for their talents and fcientific attainments, and eminently ufeful under this appellation, as the canals, docks, harbours, light houfes, &c. amply and honourably teftify. This order of artifts is faid to have commenced in this country about the year 1760, at which period the advancement of the arts and fciences was fingularly rapid. In 1771, Mr. Smeaton, fo well known in this department of fcience, projected and eftablifhed an affociation, or fociety of engineers. During an interval of 20 years, the number of members of this fociety increafed to 65, of whom 15 were real engineers, and the refidue being compofed either of amateurs, or of ingenious workmen and artificers. In May 1792 this fociety was diffolved in confequence of an unpleafant circumftance, which had interrupted its harmony; but a renewal of it, under a better form, was foon intended, though not accomplifhed during the life-time of Mr. Smeaton. His death happened in October 1792, and the firft meeting of the new inftitution, entitled "The Society of Civil Engineers," was held on April 15, 1793, by Mr. Jeffop, Mr. Mylne, Mr. Rennie, and Mr. Whitworth. According to the new conftitution of the fociety, it is divided into three claffes. The firft clafs, as ordinary members, confifts of real engineers. The fecond clafs, as honorary members, is compofed of men of fcience, and gentlemen of rank and fortune, who have attended to the fubject of civil engineering. The third clafs, as honorary members alfo, confifts of artifts, whofe profeffions and employments are connected with what is called civil engineering. The meetings are held at the Crown and Anchor, in the Strand, every other Friday, during the feffion of parliament. See Reports of the late Mr. John Smeaton, F.R.S. &c. vol. i. 4to. 1797.

ENGISOMA, from ἐγγίζω, *to draw near*, in *Surgery*, an inftrument formerly ufed by furgeons in cafes of fractures of the fkull. Hence, the word has been applied to fuch fractures of the cranium as are attended with a depreffion of the bone in the middle, fo as to produce preffure on the membranes of the brain.

ENGLAND, in *Geography*. The fouthern, moft opulent, and moft important part of Britain, has been diftinguifhed among European nations, ever fince the days of venerable Bede, by the appellation of "Anglia," or England; which has been generally afcribed to the Angles, who conquered and took poffeffion of a confiderable part of the country. (See Anglen, Angles, and *Cimbric* Chersonesus.) England is bounded on the eaft by the German ocean; on the fouth by the Englifh channel; on the weft by St. George's channel; on the north by the Cheviot hills, by the river Tweed, and an imaginary line extending fouth-weft to the Frith of Solway. The extent of England and Wales is eftimated at 49,450 fquare miles, and if we allow the population to be 9,500,000, the number of inhabitants to a fquare mile will be 192. The original population of England is involved in obfcurity; but as far as it can be traced by any authentic records of hiftory, it feems to have confifted of a tribe of Celtæ (fee Celts), denominated Gael or Southern Celts, and diftinguifhed by the Welfh under the appellation of "Gnydels," who migrated hither from the neareft fhores of France and Flanders. Thefe fouthern Celts were compelled to evacuate the country, and to retire to Ireland, by another tribe, compofed of the Cimbri of the north, whence the modern Welfh derive their origin and name of Cymru. The Cimbri, or Northern Celts, were difplaced by the Scythians, or Goths, who, at a period long preceding the Chriftian era, fettled in that part of Gaul which is neareft to Great Britain, and acquired the provincial denomination of Belgæ. (See Belgæ.) We learn from Cæfar (lib. v. c. 10.) that the primitive inhabitants were driven into the interior parts of the country by Belgic colonies, which occupied the regions on the fouth-eaft, probably about three centuries before the Chriftian era. Thefe Belgæ feem to have conftituted the chief anceftors of the Englifh nation; but during a fubjection of four centuries to the Roman power, after Britain was rendered a Roman province by the talents and virtue of Agricola, (fee Agricola,) they loft their primitive valour, and were unable to contend with their fierce invaders from Scotland and Ireland. In thefe circumftances the continent fupplied them either by accident or at their own requeft, with new emigrants. The Jutes arrived in the year 449, and about the year 460 founded the kingdom of Kent. The Saxons firft appeared in 477, and the kingdom of the South Saxons commenced about this period. The Weft Saxons arrived in the year 495, and the Eaft Saxons in the year 527. The Angles, who gave their name to the country, were led by the valiant Ida to Bernicia, in the year 547. The Eaft Angles took poffeffion of Norfolk in 575; and the coafts on the fouth and eaft were over-run by them. Hence they foon penetrated into the interior of the country, and in 585 founded the kingdom of Mercia, which was the laft of the heptarchy. (See Heptarchy and Saxons.) The kingdom of Northumberland exifted under its peculiar fovereign, the laft of whom was Eric, till the year 950; and the three counties of modern Northumberland, Cumberland, and Weftmoreland, were regarded at that period, when Domefday-book was compiled, as part of Scotland. Bernicia (which fee) extended at one period to the Frith of Forth; but in the later Saxon times the boundaries of England on the north fell confiderably within the prefent extent. On the weft the Welfh were reftricted by Offa's dyke, (fee Dyke,) which extended from the river Wye, through the counties of Hereford and Radnor, into that of Montgomery, where it entered North Wales. It afterwards paffes by Chirk-caftle to the river Dee, and terminates in the parifh of Mold. During the Norman period, the northern limits of England were extended to their prefent circuit. Cumberland and Weftmoreland were wrefted from the Scots, and the provinces north of the Humber were completely incorporated. The dominion of the Danes commenced in the year 1016, but returned to the Saxon line in the year 1042. On the death of Edward the Confeffor, the conqueft, as it is called, under William the Norman, took place in 1066. (See Conquest.) For a farther account of the hiftory of England, fee Britain, and the fequel of this article.

The antiquities of England are diftributed by Mr. Pinkerton (Geog. vol. i.) into fix claffes, *viz.* thofe belonging to the primitive Celtic inhabitants; thofe of the Belgic colonies; thofe of the Romans; thofe of the Saxons; relics of the Danes; and Norman monuments. It is not eafy, fays our author, to difcriminate the remains of the earlieft inhabitants from thofe of the Druidic period, which he fuppofes to have originated with the Phœnician factories, eftablifhed in wooden fortreffes on the coaft, which was the ufual practice of commercial nations, when trading with a favage or barbarous race. The tenets of Druidifm correfpond, as he conceives, with the little that is known of Phœnician mythology, in the diffufion of which the miffionaries of thefe refined people might be not a little zealous. However this

be,

be, the ancient authors, from whom we derive our only authentic information concerning the Druids, minutely defcribe their religious rites; but they are altogether filent concerning any monuments of ftone being ufed among them. On the contrary, they mention gloomy groves, and fpreading oaks, as the only fcenes of the Druidic ceremonies. (See Druids.) Neverthelefs, our learned antiquarian, Borlafe, refers to the clafs of Druidic monuments fuch as follow, *viz.* fingle ftones erect; rock idols and pierced ftones; rocking-ftones ufed as ordeals; fepulchres of two, three, or more ftones; circular temples, or rather circles of erect ftones; rock-bafons, fuppofed to have been ufed in the expiations of the Druids; and caves, ufed as places of retreat in time of war. But Mr. Pinkerton obferving, that moft of thefe relics may be found in Germany, (where no Druids exifted,) and Scandinavia, thinks it hazardous to pronounce whether they be Gothic or Celtic. It is moft probable, he imagines, that the earlieft inhabitants, like others who exift in the infancy of fociety, made ufe of wood, not ftone, in their religions, as well as in their domeftic ftructures. He thinks it moft reafonable to refer monuments of this kind to a more advanced ftage of fociety, when the Belgic colonies introduced agriculture, and had made fomewhat farther progrefs in the rude arts of barbarifm. See Barrow and Cromlech, Stone-henge, &c.

The Roman relics are amphitheatres, caftles, ways, or roads, pavements, hypocaufts, walls, infcriptions, altars, &c. &c. which are defcribed under thefe articles refpectively; to thefe we might add coins, gems, weapons, ornaments, and the like. The Saxon antiquities in England are chiefly edifices, facred or fecular, caftles, vaults, fhrines, illuminated manufcripts, &c. The relics of the Danes are caftles, ftones with Runic infcriptions, and camps, which were conftructed in a circular form, like thofe of the Belgæ and Saxons, while thofe of the Roman armies are diftinguifhed by their fquare form. The Norman monuments are reputed to commence after the conqueft, and to extend to the 14th century, when that which is called the rich Gothic began to appear. This latter was fupplanted, in the 16th century, by the mixed, which in its turn yielded to the Grecian. The Norman ftyle in general far exceeds the Saxon in the fize of the edifices, and the decorations of the parts. The churches became more extenfive and lofty; and though the windows retain the circular arch, they are larger and more diverfified, the circular doors are feftooned with more freedom and elegance; and uncouth animals begin to yield to wreaths of leaves and flowers. The folitary keep, or tower, of the Saxon caftle, is furrounded with a double wall, inclofing courts and dwellings of large extent, defended by turrets and double ditches, with a feparate watch-tower, called the Barbican. Among others the cathedrals of Durham and Winchefter may be mentioned as venerable monuments of Anglo-Norman architecture; and the caftles are numerous and well-known. What is called the Gothic, or pointed arch, is generally fuppofed to have firft appeared in the 13th century; and in the next it became univerfal in religious edifices. The windows diffufed to great breadth and loftinefs, and divided into branching interftices, enriched with painted glafs, the cluftering pillars of exceffive height, fpreading into various fret-work on the roof, conftitute, with decorations of fmaller note, what is called the rich Gothic ftyle, vifible in the chapel of King's college at Cambridge, and many other grand fpecimens in the kingdom. The fpire correfponds with the interior; and begins, about the 13th century, to rife boldly from the ancient tower, and diminifhes from the fight in a gradation of pinnacles and ornaments. See Gothic.

England is now diftributed into 40 fhires or counties. See County and Shire.

		Population.	Chief Towns.
Six Northern Counties.	Northumberland,	157,101	Newcaftle.
	Cumberland,	117,230	Carlifle.
	Durham,	160,361	Durham.
	Yorkfhire,	563,953	York.
	Weftmorland,	41,617	Appleby.
	Lancafhire,	672,731	Lancafter.
Four bordering on Wales.	Chefhire,	191,751	Chefter.
	Shropfhire,	167,639	Shrewfbury.
	Herefordfhire,	81,191	Hereford.
	Monmouthfhire,	45,582	Monmouth.
TwelveMidland.	Nottinghamfhire,	140,350	Nottingham.
	Derbyfhire,	161,142	Derby.
	Staffordfhire,	239,153	Stafford.
	Leicefterfhire,	130,081	Leicefter.
	Rutlandfhire,	16,356	Okeham.
	Northamptonfhire,	131,757	Northampton
	Warwickfhire,	208,190	Warwick.
	Worcefterfhire,	139,333	Worcefter.
	Gloucefterfhire,	250,809	Gloucefter.
	Oxfordfhire,	1[illegible]9,620	Oxford.
	Buckinghamfhire,	107,444	Aylefbury.
	Bedfordfhire,	63,393	Bedford.
Eight Eaftern.	Lincolnfhire,	208,557	Lincoln.
	Huntingdonfhire,	37,568	Huntingdon.
	Cambridgefhire,	89,346	Cambridge.
	Norfolk,	273,371	Norwich.
	Suffolk,	210,431	Ipfwich.
	Effex,	226,437	Chelmsford.
	Hertfordfhire,	97,577	Hertford.
	Middlefex, (capital excluded,)	535,329	London.
Three Southern.	Surry,	269,043	Guilford.
	Kent,	307,624	Maidftone.
	Suffex,	159,311	Lewes.
Four Southern.	Berkfhire,	109,215	Reading.
	Wiltfhire,	185,107	Salifbury.
	Hampfhire,	219,656	Winchefter.
	Dorfetfhire,	115,319	Dorchefter.
Three Southern.	Somerfefhire,	273,750	Taunton.
	Devonfhire,	343,001	Exeter.
	Cornwall,	188,269	Launcefton.

For a more particular account of each county, fee the feparate articles.

It is hardly neceffary to mention, that London is the capital of England, or in this place to enumerate its principal towns, which are defcribed under their feveral appellations. Canterbury and York are the fees of archbifhops: Oxford and Cambridge are univerfities. The principal rivers of England are the Thames, the Severn, the Humber, the Merfey, &c. which fee refpectively. For an account of our inland navigation, fee Canal; and for our bridges, fee Bridge. The mountains, with their productions, will occur under that article. For the climate, fee Britain; and of the foil, and agriculture, &c. an account will be found under the name and defcription of each county; and under the appropriate terms of cattle, dog, hog, horfe, fheep, goats, &c. and wheat, rye, barley, oats, apples and cyder, pears and perry. Our forefts (fee Forest) anciently abounded in ftags and rein-deer, as the cultivated lands now do with fheep and cattle. The principal wild animals, wolves and bears having been totally deftroyed, are the fox, wild-cat, badger, fitchet, martin, otter, fquirrel, &c. Among our birds of prey may be reckoned the black eagle, and many kinds of hawks. Our fmalleft bird is the gold-crefted wren, and our largeft the buftard. Our poultry feem to have been originally derived from Afia; our peacocks from India; our pheafants from Colchis; the guinea fowl from Africa; and our turkeys from America. One of the moft fingular of our water-fowl is the long-legged plover, and the moft ufeful is the mallard or wild duck, chiefly abounding in the fens of Lincolnfhire. The reptiles of England are the coriaceous tortoife, frogs, toads, and feveral kinds of lizards; among our ferpents are the viper, which alone is venomous, the ringed fnake and the blind worm, all of which, together with other fpecies, are enumerated and defcribed in their proper places. Our edible fea-fifh are very numerous; among which we may reckon the turbot, dorie, feal, cod, plaife, fmelt, mullet, &c. Herrings and mackarel extend to moft parts of the kingdom; but pilchards are reftricted to the coafts of Cornwall. The whale feldom appears on the Englifh coaft, nor the dolphin; but the porpoife is not uncommon. Our principal river fifh comprehend the falmon and trout. The lobfter is found on moft of the rocky coafts, particularly of Scarborough. The craw-fifh, mufcle and oyfters, are abundant. The flora of Britain contains as great a variety of genera and fpecies as any other country of equal extent; and thofe that are moft worthy of notice, on account either of their variety or utility, or other peculiar circumftances attending them, are enumerated and defcribed under their proper heads. Our native fruits are few, but others have been introduced and our own improved, fo that plumbs, cherries, peaches, nectarines, apricots, figs, grapes, &c. are by the fkill and care of the Englifh gardeners raifed in the greateft plenty and variety. The oak and beech are natives of England: the elm is probably an exotic; but there are few plants in any part of the known world, which have not been introduced into our plantations, nurferies, green-houfes, and hot-houfes.

The conftitution of England is a limited monarchy counterpoifed by two fenates, one of hereditary peers, the other of reprefentatives chofen by the people. (See CONSTITUTION, CROWN, KING, COMMONS, PEERS, PARLIAMENT.) For an account of the judicature of England, we refer to the articles JUDGE, JURY, COURT, CIRCUIT, JUSTICE, SHERIFF, &c. The eftablifhed religion of England is that of the reformed church under the adminiftration of the king, as fupreme head, archbifhops, bifhops, deans, archdeacons, rectors, vicars, curates, &c. See each of thefe titles. See alfo CHURCH, CLERGY, CONVOCATION, *Ecclefiaftical* COURTS, &c. Befides thofe who are members of the eftablifhed church, England abounds with diffidents or diffenters of various defcriptions. See thefe terms, and alfo INDEPENDENTS, PRESBYTERIANS, BAPTISTS, QUAKERS, METHODISTS, PAPISTS, &c. For the army and navy of England; its manufactures and commerce; its land and revenue; its population; and various other particulars; fee BRITAIN, and the appropriate articles in this work.

ENGLAND, *hiftory of.* The principal events belonging to the hiftory of our country will be found under the names of the feveral kings who have reigned over it. To the articles attached to thofe names we might refer generally for a compreffed detail of all the changes and revolutions to which England has, at its feveral periods, been fubject; but in conformity to the plan fketched out in the article BRITAIN, we muft in this place give a very brief outline of the hiftory of England, from the Norman conqueft to the acceffion of James I.; and likewife the hiftory from that period to the prefent times. After the conqueft, our hiftory is reprefented in fo clear a light, as leaves little either obfcure or uncertain. The only difficulty we fhall find will be in condenfing into a fmall fpace the leading facts that are not immediately connected with the lives of the fovereigns.

The Saxon monarchy (fee SAXONS) had continued for more than fix hundred years: during which, as we fhall hereafter fee, they enforced many of their own laws and cuftoms, though they readily adopted others congenial to the country; and which were derived, as well from the Romans, as the ancient Britons, and which they found in the ifland upon their invafion of it. The habits and manners of this race were melted down and amalgamated with thofe of Norman inftitutions. Every thing was changed; the laws in fome refpects were improved, but there was ftill little tafte for literature and fcience. From this period, however, we are to date the commencement of certain inftitutions which, though they required centuries to ripen into maturity, have neverthelefs given this country a fuperiority over every other in the civilized world. The variety of difpofitions of feveral foreign countries being imported into our ifland, at length blended into one national character, celebrated for its courage, its love of freedom, and its pride.

Immediately after the victory of Haftings, the conqueror marched towards London, carrying before him a ftandard which had been bleffed by the pope; and to this the clergy, as is ufual, haftily reforted. The bifhops and magiftrates came out to meet him, and offered him the crown, which he had won by his intrigues and valour. They ftipulated terms to which he readily acceded, being defirous of a fovereignty by the free choice of the people rather than as claimed by the power of the fword. Though he knew himfelf to be their conqueror, he defired to be thought their lawful king. William felt that he had power to enforce obedience, but affecting the voice of the people, they imputed his elevation to their own generofity; and when they felt themfelves oppreffed or aggrieved, did not fcruple to refift his power by open revolt and infurrection. The Englifh hated the Normans, and were jealous of the power which they fuftained in the new government; they envied the wealth which went to enrich thofe who were truly denominated adventurers in a foreign land, and which was raifed by loading the natives with heavy taxes, that in thofe times were with difficulty fuftained. At length William faw he muft act with energy if he meant to reign, and from this time he feems to have regarded England rather as a conqueft, than a juftly acquired dominion. He deprived the bifhops of all judgment in civil caufes, a right which they had affumed during the Saxon fucceffion. He reftrained the clergy to the exercife of their ecclefiaftical power, and he endeavoured to abolifh trials by ordeal and camp fight. See CAMP-*fight*, and ORDEAL.

We do not intend to recount the acts of the kings of England in this article, but fhall rather give a general fketch of the changes and revolutions in the conftitution, government, manners, &c. of England. The changes introduced by the Norman conqueft were not very material to the interefts of the people. Thofe who occupied the loweft ranks, ftill continued in a ftate of flavery; and their numbers were rather increafed than diminifhed. The conquerors treated their flaves with fo much feverity, that a contemporary writer declined to give a defcription of it, left its inhuman cruelty fhould appear incredible to pofterity. As the children of flaves were alfo flaves, this order of the people would have increafed exceedingly, if many of them had not from time to time obtained their freedom, either by fidelity, or uncommon acts of diligence. In fome cafes the clergy had the power of granting freedom to flaves, and fometimes the

the office was performed voluntarily by penitents, who hoped thereby to obtain the pardon of their fins. The middle ranks in fociety, that filled up the interval between the freedmen and the barons, were compofed of different bodies of men, from whom, in procefs of time, the yeomanry and many of the gentry of England are defcended. The inhabitants of towns and cities were generally of this middle rank. The barons were a numerous, opulent, and powerful body of men, and comprehended all the confiderable proprietors of land in England. The acceffion of the Normans produced many important changes in the political circumftances of the people—in the tenures by which they held their lands—the fervices to which they were fubjected—the magiftrates by whom they were governed—the courts in which they were judged,—and the laws they were obliged to obey. Thefe changes were chiefly owing to the eftablifhment of the *feudal fyftem* (which fee) of police and government in England, by William, in the fame ftate of maturity to which it had then attained in his dominions on the continent.

As the moft important changes in the Englifh conftitution were made either in the reign of John, by the limitation of the feverities of that fyftem, it will not be neceffary to dwell on the intermediate reigns. The fucceffion of the crown of England, after the death of Edward the Confeffor, became fo unfettled, that it feemed to be the object of ambition to every bold invader, who poffeffed the flighteft pretence, together with power and courage, to feize the glittering prize. The fecond William, Henry, and Stephen, are regarded as ufurpers, and did, at the time, reign with a difputed title. This was a fortunate circumftance to the natives and their pofterity, as it contributed not a little to raife them from that infignificancy into which they had been depreffed, to the prefervation of what was left, and to the reftoration of what had been loft of their ancient liberties. For the Norman barons, having eftates both in Normandy and England, were anxious that the ducal and royal crown fhould reft on the fame head, that they might enjoy their eftates in both countries. Many of thefe barons therefore favoured the pretenfions of Robert duke of Normandy, eldeft fon of William I., to the crown of England. This obliged his opponents William and Henry to have recourfe to the native Englifh, who were ftill formidable by their numbers, after all the loffes which they had fuftained. Hence they felt their own importance in the fcale of being, and obtained for themfelves certain rights and immunities which their fovereigns were ill difpofed to grant of their own free will. Henry I. granted them a charter, which proved a model on which the famous charter of liberties in the reign of John was formed. He alfo promulgated a fyftem of laws confifting chiefly of thofe of Edward the Confeffor. Stephen, as his title to the throne was more difputed, was more liberal of his promifes; but as he was lefs difpofed to perform what he had bound himfelf to do, his whole reign was a fcene of contention and civil war. At this period the civil law was brought into England from Rome, but not without confiderable oppofition on the part of the people, who were fo much enraged againft it, that whenever they met with a copy of the Roman law, they deftroyed it with every mark of indignation. Henry II. conciliated the affections of his fubjects by granting them a charter, confirming that of his grandfather Henry I. To this prince, whofe reign was protracted to a great length, the country was indebted for many improvements in the law, as well in its adminiftration, as in the forms and practice of the courts. At this period the clergy, who were fcreened from punifhment on account of their profeffion, committed every fpecies of crime, which led (A. D. 1164,) to the enactment of the celebrated conftitutions which had the effect of reducing the clergy to the rank of fubjects. Still, however, juftice was not always adminiftered in thofe ancient times with wifdom and impartiality, partly owing to the ignorance of the judges, and partly to the prevalence of faction among the fuitors of the courts. Nor was it an eafy matter to procure relief from an iniquitous fentence pronounced by a baron or fheriff, on account of the great diftance and unfettled ftate of the king's court, which conftantly attended his perfon. To remedy this inconvenience Henry II. with the advice of a great council of his prelates, earls and barons, at Northampton, A.D. 1176, divided the whole kingdom into fix circuits, and appointed three judges to hold courts in each of thefe, by a commiffion from the king, impowering them to hear and determine all caufes not exceeding the value of one half of a knight's fee, unlefs the matter was of fuch importance or difficulty as to require the judgment of the king's court in the royal prefence. Thefe itinerant jufticcs took an oath to adminifter juftice to all perfons with impartiality. They had alfo authority to judge in all criminal caufes and pleas of the crown, and to tranfact a variety of other affairs for the public good. Under the reign of Richard, befides laws relating to the voyage of his fleet to the Holy Land, and thofe connected with commerce, were others of an excellent nature, in which he attempted to eftablifh an uniformity of weights and meafures over the whole kingdom, a thing greatly wanted, but which has not even yet been accomplifhed. The changes introduced by John have been recited under the article CONSTITUTION. The barons, who procured the famous charter, have been viewed as acting in two capacities, 1, as military vaffals of the crown: 2, as fubjects of the kingdom. They confulted their own intereft in the firft capacity, by the limitations of the rigours of the feudal tenures which they procured, and in which all who held lands by military fervices fhared with them. They confulted their intereft in the fecond capacity, by the amendments which they procured in the general police of the kingdom, in which all their fellow fubjects were partakers. Thefe amendments tended to remove or alleviate the feveral grievances of which the people in general complained; of thefe, the greateft and moft important was, that the mere will and command of the fovereign were fubftituted in the place of law, and men were feized, imprifoned, ftripped of their eftates, outlawed, banifhed, and even deftroyed, without the form of trial. Next to the fubftitution of arbitrary will in place of law, was the king's perfonal interference in law-fuits depending before his courts, in order to interrupt or pervert the regular courfe of juftice. Thefe flagrant outrages at length wrought their own cure, and thofe who had tyrannized over the people were obliged to fubmit to their power.

The common, as well as the ftatute law of England, received confiderable improvements in the reign of Henry III.; but his fucceffor Edward I. was, as a general and legiflator, equalled by few of the kings of England, and furpaffed by none. He was fatisfied with a moderate degree of power, and only laboured to render himfelf terrible to his enemies. The Englifh, now incorporated with their fierce Norman conquerors, were no longer the tame confenting people they formerly appeared, but were always prepared to reafon with that authority which could not eafily be refifted. This fpirit of oppofition was tinctured with cruelty; regardlefs of their own lives, the people did not feem very folicitous about the lives of others. Penal laws began to affume more rigour: in the times of William the Conqueror, it was a law, that no man fhould be punifhed with death; in the

the reign of Edward, that law was entirely laid aside, and several crimes were rendered capital. But what gave permanence to the reputation of this monarch, was the degree of power the people began to assume during this period. The clergy and barons he regarded as rivals; and to weaken their force, he gave authority to the commons: a law was enacted, by which no tax could be levied without their consent. On account of the many wise laws made in this reign, the monarch has been styled the English Justinian. Some of these statutes respected the church, and were intended to set bounds to the power of the pope, the riches of the clergy, and the encroachments of the spiritual courts. Others were calculated for explaining, confirming, and enlarging the liberties which had been granted by the great charter. According to sir Matthew Hale, "the model of the common law, especially in relation to the administration of common justice between party and party, as it was rectified by this king, so in a great measure it has continued the same in all succeeding ages to this day; so that the mark or epocha we are to take for the true stating of the law of England, what it is, is to be considered, stated, and estimated, from what it was when this king left it. Before his time it was in a great measure rude and unpolished, in comparison of what it was thus polished and ordered by him, so hath it stood hitherto, without any great or considerable alteration." Edward made great efforts to reduce the whole island of Britain into one kingdom, governed by the same sovereign, and subject to the same laws; and with respect to Wales, he completely succeeded so as to introduce into it many of the English laws, customs, courts, and magistrates. His efforts to unite Scotland with England finally failed, and they served only to kindle a most violent and implacable animosity between the people of these two kingdoms, which graduallyrendered their manners, laws, and customs more dissimilar than they had been in more ancient and amicable times. In the following reign, the Scots gained a complete victory over the greatest army ever sent into their country: but Edward III., the next in order of succession, contested, with Philip de Valois, his right to the kingdom of France. He therefore made an expedition into that country, and in the celebrated battles of Cressy and Poictiers, entirely destroyed the French army, and carried the monarch captive to England. See EDWARD III.

This wise prince never neglected to consult his parliament in affairs of moment. There are still extant his writs of summons to no fewer than seventy parliaments and great councils. The distinction between these assemblies was this; when he desired only the advice and assistance of his great barons who still possessed the greatest part of the power and property of the kingdom, he called the great council, consisting of all the great men, both of the clergy and laity, who held of the crown by barony, and were entitled to a particular summons. When he stood in need of the counsel and aid of all his subjects, he called a full parliament, which consisted not only of the barons spiritual and temporal, but also of the representatives of the inferior clergy,—of the smaller barons, or freeholders,—and of the citizens and burgesses of the kingdom; and those representatives of the clergy and laity, below the rank of barons, were called the spiritual and temporal commons.

Richard II. came to the crown a minor, and by his heroism in crushing the rebellion of Wat Tyler excited considerable expectation, which was completely disappointed by all the subsequent acts of his life. He submitted himself to evil counsellors, who took possession of his mind, and by their advice he sacrificed his best and ablest friends, and endeavoured to render himself despotic. But he was overpowered, subdued, and obliged to resign his crown in favour of his cousin Henry duke of Lancaster; and this was the commencement of those contests between the houses of York and Lancaster, which for several years after deluged the kingdom with blood, and which nevertheless contributed in no small degree to give strength and consistency to the constitution. In the reign of Richard, Wickliffe began the great work of reformation. The deposed monarch was murdered with a pole-ax in Pontefract castle in the 34th year of his age, having reigned 22 years. His successor, Henry IV. surnamed Bolingbroke, had to contend with much internal trouble, and had so little claim to the sovereignty which he assumed, that conspiracies were speedily formed against him; these, however, were quelled and the leaders of them were executed. "If," says a good writer, "we compare the times at this period of our history with those of king John, or those of some reigns before him, we shall find a great change with respect to the insurgent barons. In the former period they made frequent insurrections, were often taken in open rebellion, and as frequently pardoned: but in this period they were seldom taken without suffering the utmost rigour of the law. This plainly shews how much the power of the barons was sunk in the course of a couple of centuries. This revolution of power is, notwithstanding, natural and obvious: as the people began to share the government with the nobles, the king was fixed upon as a third person to secure the balance, and both were contented to make him great from a jealousy of each other. Noblemen were therefore now executed, not as petty monarchs, but offending subjects, and none but kings were considered as exempt from penal laws."

In this reign the suppression of one rebellion seemed only to make way for another more formidable than the former, and more extensive in its consequences. The calamities of this period were not, however, confined to internal factions excited by discontented barons: the country was threatened with foreign invasions, and the clergy added not a little to the disturbance of the public peace. Ever since Wickliffe had published his opinions, his doctrine had been gaining ground, and the clergy were in dread of its prevailing to the exclusion of their system and to the ruin of their emoluments. Henry joined the clergy, considering that they might be made a powerful engine in establishing his usurped throne, and he recommended the parliament to the care of the church. At first the house of commons seemed reluctant in drawing the sword of persecution; they had not, however, vigour sufficient to oppose the power of the court and the clamours of the priests, but became instruments in their hands for the perpetration of much mischief. An act was passed for burning obstinate heretics; and William Sawfre, a follower of Wickliffe, was, by virtue of the king's writ, delivered to the mayor of London, and burned alive. This was the first martyr in England, on account of religion; but the fires, being once lighted, were not suffered to be extinguished. The clergy, under a mask of hypocrisy, and pretending a regard to truth, took every means that cruelty could suggest of establishing that degree of temporal power, which they had possessed three centuries before. They succeeded, but with this striking difference, that, as in the times of the Saxon heptarchy, their power was founded in the love of the people, in the present case it had its origin in, and was wholly maintained by, their fears. By these means, Henry surmounted all his troubles, and the kingdom enjoyed tranquillity. Towards the close of life he determined to embark upon an expedition to Jerusalem, as well to expiate, as he imagined, the sins of former years, as to induce his maker to protract the term of his life. His increafing infirmities prevented him from executing his plan; and in his 46th year he refigned, by death, his crown to his fon Henry V. During this reign, if allowance be made for the rancour of the priefts, to whom the king was too fubfervient, the government may be faid to have affumed a form and liberty; the diftinction between the nobility and the people was rendered lefs confiderable, and the magiftrates were lefs arbitrary and lefs venal.

Henry V. was the great hero of his age, and the courage which he had manifefted from his earlieft years laid claim to the efteem and affection of the people over whom he was deftined to reign. At this period, courage in the great was regarded as almoft the only virtue: courage and fuperftition then made up the whole fyftem of human duty. The clergy, notwithftanding their revenues, paid very little attention to the morals of the people, and were, if poffible, lefs folicitous about their own character: the vices in which they openly indulged, and the paffions to which they gave free reins, drew upon them a juft degree of contempt; of which they avenged themfelves, by having recourfe to the engine of perfecution. In this they were encouraged by the king, who, by not oppofing, may be regarded as a participator of their crimes. One of the early acts of this reign was an attempt to fupprefs the doctrines of Wickliffe; and John Oldcaftle, baron Cobham, was the principal fufferer in their defence. This excellent man was doomed to bear the moft excruciating torments: he was hung up by the middle with a chain, and by a flow fire literally roafted alive. The deed was fcarcely perpetrated when the king, probably difgufted with the cruelty that had been perpetrated by his fanction and authority, refolved to take advantage of the troubles exifting in France to make a conqueft of that country. Thither he led a very large army, with which he defeated and almoft wholly deftroyed one fix times larger than his own: he immediately advanced into the heart of the country, making himfelf mafter of many towns. At length he married Catherine, daughter of the French king, and acquired thereby the adminiftration of affairs in that kingdom, during the life of his father-in-law, fully expecting to be appointed his fucceffor. But his death, in the year 1422, fruftrated his own and the nation's hopes. His fon, an infant, was afterwards declared king of France and England; but, poffeffing none of his father's heroifm, he foon loft in France all that Henry V. had acquired. The triumphs in France produced fcarcely any advantages at home. As the Englifh grew more warlike, they became more brutal; and in their eagernefs after foreign poffeffions, they neglected the cultivation and improvement of thofe at home. The language became more barbarous. Chaucer and others, about a century before, feemed to have drawn it from obfcurity, and enriched it with new terms and combinations; but at this period it relapfed into its former groffnefs.

The reign of Henry VI. witneffed much bloodfhed, owing to the rival families of York and Lancafter. Thefe calamities did not fubfide till the reign of Henry VII., who was himfelf of the houfe of Lancafter, and married the daughter of Edward IV. of the houfe of York, when an end was put to the diffenfions between the different factions of the white and red rofe. In the famous battle that fixed Edward IV. on the throne of England, it is faid that 40,000 men were left dead in the field. In this dreadful conteft, each party, as it happened to be victorious, called in the executioner to complete the bloody tragedy begun in the field. In the reign of Henry VI. the art of printing was firft practifed in England by William Caxton. He tranflated fome French works, which he printed; and, by his new art, gave currency and celebrity to the tranflations of others. The priefts at this period poffeffed no fmall fhare of erudition, as is evident from fome Latin productions ftill extant; but learning was feparated from the purpofes of common life, and though not neglected by the clergy, yet it defcended no lower, the people at large not confidering it as any concern of theirs.

The wars in which Edward IV. engaged were long and bloody; and, upon a fufpenfion of arms at home, he proclaimed war with France, which he knew would gratify his fubjects, who have been, at almoft every period of their hiftory, more fond of fplendid than ufeful acquifitions. To profecute this fcheme, he fent to his ally, the duke of Burgundy, a reinforcement of 8000 men; and foon after followed himfelf, at the head of a very numerous army. The French king was alarmed at this formidable invafion, and feeling that he was unable to contend with his antagonift, he had recourfe to treaty; and for a ftipulated fum, Edward agreed to lead back his forces to England. Towards the clofe of life he indulged the hope of invading France again: his parliament confented, and in that affembly of the nation the project was unanimoufly declared to be juft and neceffary. The people feemed pleafed with the profpect, and great preparations were made for the expedition, when, fortunately for the interefts of humanity, Edward died after a reign of little more than 22 years.

Edward V. fucceeded, as we have feen, (fee EDWARD,) to the kingdom in name, but not in fact: for, long before he was capable of acting for himfelf, he was depofed and murdered at the inftigation of his uncle, the duke of Glocefter, who fecured to himfelf the crown under the title of Richard III. The infamy of this prince's character has been fully defcribed by every hiftorian of authority. As he obtained the government by treachery and murder, fo he loft his life in fupport of what he had unlawfully gained. At the battle of Bofworth Richard had to contend with Henry, earl of Richmond, who was not only completely victorious, but was proclaimed king by the unanimous voice of the army, on the very fpot in which the cruel Richard was flain. By the death of this king, the Plantagenet race, which had been in poffeffion of the throne more than 300 years, became extinct. With him alfo terminated the contefts between the houfes of York and Lancafter, in which, in the courfe of about 30 years, an hundred thoufand lives were loft either in battle or by the hands of the executioner. Thefe diffenfions had reduced the kingdom to a ftate of almoft favage barbarity: laws, arts, and commerce were entirely neglected; every thing laudable gave place to the practice of arms. The people had attained no ideas of pacific government, nor could they applaud or juftify thofe who cultivated it. In their wars, it is recorded to their credit, that the women, however formidable and active, were exempted from capital punifhment, unlefs accufed of the undefined and undefinable crime of witchcraft. The clergy were diftinct from the laity in cuftoms, conftitutions, and learning: they were governed by the common law, which was delivered to them by the traditions of their anceftors. As a body, they did not intereft themfelves in the civil polity; and were not difpleafed to fee the laity, whom they did not deign to regard as fellow-fubjects, but rivals for power, weakening themfelves by continual contefts: the laity, on the other hand, regarded the clergy with blind veneration, which leffened their refpect and attachment to the monarch on the throne. There was little virtue among individuals of the nation, and the government was fubject to diforders of the moft fatal kind, which perpetually produced all the horrors of civil war.

With

With the reign of Henry VII. we commence a new era in the hiftory of our country. Under his fway we behold one of the greateft revolutions that was ever effected by the prudence and perfeverance of one great prince: a nation of tumult reduced to civil fubordination; a haughty ariftocracy humbled; wife laws enacted; commerce reftored; and the arts of peace cultivated and encouraged by a people, to whom before, war only was delightful. The whole government put on a new form, and Henry was one of the moft ufeful monarchs that ever held the fceptre of thefe kingdoms.

The firft care of Henry was to unite the interefts of the houfes of Lancafter and York, by marrying Elizabeth, the daughter of Edward IV. His reign began very aufpicioufly by a ftrict obedience to the laws, which he ever after enforced with firmnefs and dignity. Before his reign it had been ufual to take away the lives of thofe attainted of treafon; but Henry thought it fufficient, in moft cafes, to deprive thofe taken in arms of their fortune and eftates, which he applied to his own ufe. By thefe means he deprived his enemies of the power of injuring him; and he was enabled, by new acceffions of wealth, to perform many acts of liberality. He is faid to have releafed all prifoners for debt in his dominions, whofe debts did not amount to forty fhillings, and paid the creditors their whole demand from his own coffers. He has been accufed of avarice, but it is doubtful whether his conduct in this refpect does not rather merit the applaufe of ufeful economy. His government was difturbed by attempts at fetting on the throne Lambert Simnel, as earl of Warwick; and afterwards by a fimilar attempt with regard to Perkin Warbeck. In the year 1499 he freed himfelf from thefe confpiracies, by the conviction and execution of Perkin and the feigned earl of Warwick. After this, the reign of Henry was truly refpectable: his government was formidable to his own fubjects, and claimed the refpect of rival potentates. He paid much attention to the wants of the lower claffes, and was anxious to deprefs in the fcale of power the nobility and clergy. From thefe moft of the calamities of former reigns had refulted; and on that account he contrived means to leffen their authority in the ftate. He allowed the nobility, by a law paffed in his reign, to alienate their eftates; and he diminifhed, as far as he was able, the privileges claimed by the clergy as their right. He was, at the fame time, a friend to the people, who in former periods were the fure victims of powerful ambition and revenge. They, in all cafes, were the fufferers, on whatever fide they fought, if they had the misfortune to lofe the victory. To remedy this, in a great degree, Henry procured the paffing of an act, by which it was eftablifhed that no perfon fhould be impeached or attainted for affifting the king for the time being. This wife ftatute ferved to reprefs the defire of civil war, as multitudes would naturally take arms in defence of that fide on which they were fure of lofing nothing by defeat, and their numbers would intimidate infurgents. But the greateft efforts of this king were directed to promote trade and commerce, which naturally introduced a fpirit of liberty among the people, and difengaged them from their dependence on the nobility. Before this era, the towns owed their original to fome ftrong caftle in the neighbourhood, where the great lord generally refided, maintaining at his expence a very large retinue, who, as dependents on his bounty, were on all occafions bound to vindicate his caufe. The number of thefe drew together, in or near the fame place, artificers, victuallers, and fhop-keepers, to furnifh the lord and his attendants with the neceffaries of which they ftood in need. It was the wife policy of Henry to bring the towns from fuch a neighbourhood, by inviting the inhabitants to a more commercial fituation. He attempted to teach them frugality and the payment of debts; the life of induftry, by his own example; and never omitted to include the rights and principles of commerce, in all his treaties with foreign princes.

At this period the continent, as well as the Britifh ifles, feemed to be making great advances to improvement. The fovereigns of Sweden, France, and Spain, were the encouragers and protectors of the rifing arts. The Portuguefe had failed round the Cape of Good Hope, and Columbus had juft made the difcovery of a new world. Henry was defirous of following the example fet him, and granted to certain enterprizing merchants to go in queft of new countries. By thefe and fimilar exertions the king faw his country civilized, the people pay their taxes without infurrection; the nobility learning a juft fubordination, the laws alone fuffered to inflict punifhment, towns begun to feparate from the caftles of the nobility; commerce every day increafed, and the fpirit of faction was in a great meafure extinguifhed. He was at peace with all the world, and having iffued a general pardon to his own fubjects, he had reafon to expect the happinefs to which wife meafures and true patriotifm are juftly entitled; when, at the age of 52, he died of the gout in his ftomach. In fome refpects he has been regarded as the fecond Alfred, a title to which he has a good claim, on account of the great changes which he introduced in his kingdom;—changes which had the moft favourable tendency to effect the improvement and happinefs of his fubjects.

Henry VIII., the fon to the late king, affumed the reins of power under the moft fortunate aufpices. He found himfelf in poffeffion of a peaceable and flourifhing kingdom; prudent minifters, who knew the wants of the people, and were ready to provide for them; and a well-ftored treafury. The young king, however, made but an ill ufe of the bounties of providence, with which he was fo abundantly furrounded. He had been diligently inftructed in all the learning of the times; but his ftock of knowledge ferved only to inflame his pride, and not to control his vicious affections. The love of his fubjects was teftified by an adulation, which produced the moft mifchievous effects. His vaft wealth, inftead of relieving his fubjects, or of increafing the national honour, only contributed to fupply his debaucheries, or gratify the rapacity of the minifters of his pleafure. The acts of his life will come more properly under the article devoted to his name. In this place it will be fufficient to obferve, that he was perpetually falling from one extreme to another, and agitated by contrary paffions; it became doubtful to his fubjects in what manner they fhould act, or what they fhould believe, fo as to obtain his approbation. His conduct as a king was marked with the moft atrocious acts of tyranny; he expected every one to fubmit to his will, however frequently that will was changed: yet his reign is memorable on account of the great revolution that was achieved in it by the celebrated Luther, for a full account of which we refer to the article LUTHER. At firft the king wrote againft the doctrines avowed by the former; and for his ability and learning, obtained from the pope the title of "Defender of the Faith," a title which has been continued to his fucceffors to the prefent time. He afterwards revolted from the Roman church, and required that his fubjects fhould acknowledge him, and him only as head of the church of England. The parliament, entirely dependent on the king, fided with him in his views of feparating from the church of Rome, and readily complied with his other meafures to ftrengthen the reformation. Henry, who was an artful politician, knowing that his parliament was devoted to his will, made uſe of the opportunity to render himſelf abſolute. He accordingly oppoſed the parliament againſt the monks, and obtained their ſuppreſſion. While parliament was buſy in ſuppreſſing the religious houſes, moſt of which were houſes of infamy, the king was deviſing methods of deſtroying the power of the ſuppreſſors. This was the origin of the unlimited power which he now aſſumed: he had a moſt complying parliament, ready to ſanction not only what he did, which in many inſtances were deeds of the darkeſt hue, but likewiſe what he intended to do. He was not wanting to ſtrengthen his own power, and claimed the ſame obedience to his proclamation as to the acts of the whole legiſlature. No king of England, as will be ſeen hereafter, lived ſo much the terror of his people. Some perſons wielding a ſceptre have been tyrants, from the frequent revolt of their ſubjects; ſome, from being miſled by favourites; and ſome, from a ſpirit of party: but Henry VIII. was cruel, from a diſpoſition which ſeemed prone to inflict miſery on all about him; he was a ſavage in government, in religion, and in his own family: yet ſuch are the inſcrutable diſpenſations of heaven, that while the harmleſs Henry VI. was dethroned, impriſoned, and aſſaſſinated, the preſent tyrant was permitted to die a peaceable and natural death, if we except the ſufferings which a guilty conſcience cannot fail to inflict. Fortunately perhaps for the people, Henry contrived to diſſipate all thoſe treaſures of which his tyranny plundered his ſubjects: he died poor, and tranſmitted the crown to his ſon and ſucceſſor as dependent on the people for their ſupplies in parliament as at any former period. The wanton profuſion of princes is always hurtful to themſelves; but in many inſtances it has been beneficial to their ſubjects, by preventing greater evils. If Henry VIII. had been more frugal, he would probably have been more dangerous.

The character of Edward VI. has, under his own name, been deſcribed. He died at too early an age to act for himſelf; but during his ſhort reign, the principles of the reformation were encouraged; people were allowed to uſe or diſuſe the practice of confeſſion, as they thought fit; images were taken from the churches, prieſts were allowed to marry, the maſs was aboliſhed, and a liturgy was drawn up, which, with very few alterations, has been continued to the preſent times. Such important changes could not be effected without danger: inſurrections were excited in many parts of the kingdom, which were without much difficulty ſuppreſſed, though many were the victims of the unhappy conteſts.

The reign of queen Mary was marked with cruelty and bloodſhed. She reſtored the Roman Catholic religion, and without heſitation burnt, or otherwiſe deſtroyed, all who fearleſsly oppoſed her will, and the will of her infamous miniſters, Bonner and Gardiner. The reign of this ſovereign was fortunately ſhort; yet, in ſomewhat leſs than four years, five eminent and conſcientious prelates, twenty-one miniſters, and more than eight hundred ſubjects of lower rank in life, were conſigned to the flames for maintaining what they believed to be truth: beſides theſe, we have no accurate account of the numbers who died in priſon, by more lingering and more cruel deaths than even the flames of Smithfield could inflict; nor has it been recorded how many, through fear of death, ſacrificed a good conſcience, and thereby endured for the remainder of their lives ſufferings a thouſand times worſe than the death which a tyrant is enabled to order.

Elizabeth, whoſe character and government have been delineated in the laſt volume, reſtored the principles of the reformation, and advanced the kingdom to the higheſt pitch of ſplendour. She had been nurtured in the ſchool of adverſity, and drew from it leſſons of the higheſt importance to her future conduct. While ſecluded from the buſy world in a loneſome priſon, ſhe was employed in the improvement of her mind, and in deviſing methods of reforming the church, ſo ſoon as providence ſhould make way for her government; and one of her earlieſt acts as ſovereign was to eſtabliſh the reformed religion. The people readily ſeconded her deſigns: they perceived the ill uſe which the papiſts had made of their power in the laſt reign; and they were willing to ſuppoſe that the ſavage acts, which had been committed by Mary and her biſhops, were the neceſſary conſequences of the faith which they eſpouſed, and in behalf of which they effected their cruel purpoſes. Elizabeth ſoon aſſembled her parliament, the reformation was finiſhed, and that form of religion was eſtabliſhed which is now deemed the religion of the country. The clergy, in general, ſubſcribed to the new forms: of nearly ten thouſand who were in poſſeſſion of benefices of different degrees of rank and value, ſcarcely more than an hundred choſe to quit the emoluments of their office, rather than abandon the principles to which they had adhered in the laſt reign. "Thus," ſays an hiſtorian, "England changed its belief four times ſince the acceſſion of Henry VIII." Strange that a people, who are ſo reſolute, ſhould be guilty of ſo much inconſiſtency! that the ſame people, who this day publicly burn heretics, ſhould the next not only think them guiltleſs, but conform to their opinions. Elizabeth, though firmly fixed on her throne, had enemies in almoſt all the neighbouring potentates; who endeavoured by every means in their power to excite diſcontent among her own Catholic ſubjects. In this ſituation, ſhe could only rely upon the reſources which proceeded from the affection of her ſubjects, and the wiſdom of her adminiſtration. Her governing maxim was unqueſtionably founded in wiſdom; it conſiſted in acquiring the eſteem and affection of her people. She was an economiſt of the nation's money, and ſparing in her rewards to her favourites. She diſtributed rewards and puniſhments with impartiality; knew when to flatter and when to upbraid; could diſſemble ſubmiſſion and preſerve her prerogatives; ſhe ſtudied the people ſhe was to govern, and not unfrequently flattered their follies in order to ſecure their hearts.

The errors of this ſovereign, and the acts of cruelty to which ſhe gave her ſanction, have been deſcribed in her own life, or in that of archbiſhop Cranmer, or will be found hereafter in the article Mary queen of Scots, or in other parts of this work of minor conſideration; but it muſt be obſerved here, that whatever puniſhments or cruelties were exerciſed in this reign, they moſtly fell upon the great, and in no inſtance were the people more happy internally, or more formidable abroad, than during this period. It will, however, be readily admitted, that it was not owing entirely to the queen that the nation was ſo completely proſperous at this period; the people, as if ſpontaneouſly, began to exert their native powers, and every art, and every genius put forth all their vigour. The Engliſh could not boaſt of new or ſplendid acquiſitions: their influence in foreign courts was extremely limited, but commerce grew up and flouriſhed. The people began to feel the effects of their own exertions, and to underſtand in what conſiſted the independency of a great nation; and England became at once laborious, enterprizing, powerful, and in a degree poliſhed and polite. The ſucceſsful voyages of the Spaniards and Portugueſe excited their emulation: they fitted out ſeveral expeditions with a view of diſcovering a northern paſſage to China, and, though

though difappointed in their firft and principal object, their voyages were not wholly fruitlefs. Our countrymen, Cavendifh and fir Francis Drake, circumnavigated the globe, and difcovered in the profecution of their voyages a fkill and prowefs very fuperior to the moft experienced navigators of thofe nations who led the way in nautical difcovery. Sir Walter Raleigh, without any affiftance from government, colonized New England; and thefe expeditions at length formed one of the moft powerful marines of Europe, which in a very fhort time was enabled to oppofe the fleet of Spain. (See ARMADA.) The fuperiority obtained by the Englifh at fea, at this period, gave them a fort of naval fovereignty which they have ever fince inviolably preferved, and which, we truft, they will very long maintain, notwithftanding the boaftful language of the prefent emperor of France. If, for wife purpofes, he muft fubject the continent to his power and controul, we truft that our own iflands will, by union among the people, be freed from the tyranny which he has for many years been exercifing among other nations, which have evidently been facrificed by their own want of unanimity, and by the mifmanagement of their fovereigns.

In the reign of Elizabeth, external commerce was not more cultivated than internal manufactures. Flemifh manufacturers, who had been perfecuted at home, fled to England for an afylum, which they found, and for which they made ample amends by the arts which they introduced, and the induftry which was excited by their example, and by the wealth which their labours acquired. In polite arts and in literature the Englifh excelled all other nations. The reign of Elizabeth has by fome writers been denominated the Auguftan age of literature. The difputes caufed by the reformation of religion had retarded the progrefs of our language among the powerful, but they excited a fpirit of enquiry among the middling and lower orders of fociety. The people began to read, and being allowed to perufe the bible in their own language, their morals, and perhaps their tafte, rapidly improved. The reformers, who had fled from the perfecutions of Mary, returned to promulgate their doctrines at home, and by a refidence abroad their language was corrupted by foreign idioms and barbarous phrafes. Thefe archbifhop Parker fet himfelf affiduoufly to reform, as well by his own excellent example as by precept. He corrected the Englifh tranflation of the bible, and printed it with royal magnificence. His own ftyle poffeffed all the eloquence of the times; it was manly and concife, but wanted fmoothnefs.

Such were the leading improvements in Elizabeth's reign; and, fays a good writer, "if we look through hiftory and confider the rife of kingdoms, we fhall not find, in all its volumes, fuch an inftance of a nation becoming wife, powerful, and happy in fo fhort a time. The fource of our felicity may be traced to the reign of Henry VII., and though the ftream was interrupted by intervening tyrannies, yet, before the end of Elizabeth's life, who was his grand-daughter, the people became the moft polifhed and the moft happy people upon earth. Liberty, it is true, as yet continued to fluctuate: Elizabeth knew her own power, and often ftretched it to the very limits of defpotifm; but when commerce was introduced, liberty neceffarily entered in its train; for there never was a nation completely commercial, and at the fame time perfectly defpotic."

On the death of Elizabeth James VI. of Scotland fucceeded to the throne of England, with the univerfal approbation of all orders of the ftate. Elizabeth bequeathed him her crown almoft with her laft breath; he was the neareft in the order of fucceffion, and he had all the fanction which parliament could confer. He began his reign by a laudable attempt to unite both kingdoms into one, which he effected without much difficulty, and from that period the two kingdoms have been governed by one fovereign. James, though ufed to arbitrary power, fet himfelf to ftudy the Englifh laws, by the authority of which he refolved to govern. Whether he did not comprehend their full import, or that his habits were too much fixed to fubmit to the neceffary changes which his new fituation required, it would be ufelefs to enquire; but it is certain that his whole reign was marked with difputes between him and his parliament. The king was ever attempting to keep the royal fplendour unfullied; the other aiming at leffening the dangerous part of the prerogative: the one labouring to preferve the laws and inftitutions of former reigns; the other as ftedfaft in afferting the inherent privileges of mankind. When the parliament refufed a fubfidy, the king was defirous of availing himfelf of the precedents fet by other monarchs, by extorting a benevolence. The houfe of commons felt their confequence as the protectors of the people, and remonftrated againft every act of arbitrary power, as incompatible with their rights and privileges. Thefe attempts of the crown, and the refiftance of the people, continued through the whole reign, and firft gave rife to that fpirit of party which has ever fubfifted in England, the one fide declaring for the king's prerogative, the other for the rights and liberties of the fubject.

James exhibited much moderation with regard to thofe who did not think on religious fubjects as he was accuftomed to think, and who did not conform to the eftablifhed forms of church difcipline, wifely judging that men fhould be punifhed for evil actions, and not for erroneous opinions. The confpirators againft his government, as will be feen in his life, were feverely punifhed; but he cultivated the arts of peace, and obtained as a juft reward the general good will of the nation. It has been afcribed to this monarch that the Englifh have attained to a noble freedom of thought, and the dignity of juftifying their opinions. James neither cultivated nor underftood foreign negociations or alliances. His reign was marked with none of the fplendours of triumph, nor with new conquefts and acquired dominions; but the arts were filently advancing in improvement: reafon was extending her influence, and defcrying a thoufand errors in religion and government that had been rivetted by long prefcription. The people began to think for themfelves, to eftimate their rights and confequence: the reformation had introduced a fpirit of liberty, even at the time that the conftitution and the laws were built upon arbitrary power. "James," fays the hiftorian, "taught them, by his own example, to argue upon thefe topics: he vindicated the divine right of kings againft the natural privileges of the people: the fubject began in the controverfy, and it was foon difcovered that the monarch's was the weakeft fide of the queftion."

Charles I. afcended the throne in the year 1625, and was extremely popular, as well on account of his own virtues and addrefs, as in refpect to the fortunate circumftances in which he was placed. The country was in a peaceable and flourifhing ftate: his title to the crown was undifputed, and he had formed an alliance with one of the moft powerful monarchs that ever reigned in France, whofe fifter he had married. The pleafing profpect was of fhort continuance; the people had learned to reafon: they felt their own power, and it was determined in parliament to oppofe the ancient claims of the crown. Charles had been taught to confider the royal privileges as facred pledges, which it was his duty to defend; his father had implanted the doctrines of hereditary and indefeafible right early in his mind. James contemplated these doctrines in theory, but it was soon the fate of Charles to assert and defend them by action. He mistook the genius of the people he had to govern; they had imbibed the principles of liberty; but he wished to act by maxims and precedents that had their origin in times of ignorance and slavery. The late king had been forced into breach with Spain, and Charles gave early indications of a despotic temper, which rendered the parliament remiss in furnishing him with money for carrying on the war. In a short time his favourite Buckingham persuaded him to take the part of the French Hugonots, in their quarrel with the crown. They were ill supported, and the protestant interest received an irrecoverable blow in France. The blame was attributed by the people and parliament to Buckingham, who was assassinated by Felton. This the king laid seriously to heart, though it did not deter him from his arbitrary proceedings. For several years Charles reigned without assembling a parliament, during which he did as he pleased, promulgating laws, and imposing taxes on his subjects to the great mortification of those who felt for their liberties as men and Englishmen. He laid arbitrary impositions upon trade, which many resisted: he levied monies upon monopolies of salt, soap, and other necessaries of life. His government became every day more unpopular, and Burton and Prynne wrote against the proceedings of the court. They were prosecuted for their writings in the star-chamber in a very arbitrary and cruel manner, and punished with so much severity as excited an almost universal indignation against the authors of their sufferings. The king next made use of Laud and Strafford as instruments in carrying on his despotic measures. These he was in a short time obliged to abandon to an ignominious death on the scaffold. Charles, in the early part of his reign, had passed the petition of rights into a law, which was intended by parliament for the future security of the liberty of the subject, by which it was enacted "that no man hereafter should be compelled to make any gift, loan, benevolence, tax, &c. without common consent of parliament." This principle he perpetually violated till at length a civil war broke out. Notwithstanding the many acts of tyranny and oppression, of which the king and his ministers had been guilty, yet multitudes sided with the court and joined the standard of Charles. Many of the nobility and gentry were attached to the crown, and considered their own honours as connected with it, and no inconsiderable part of the landed interest joined the king. The parliament claimed for themselves the executive power, and were favoured by most of the trading towns and corporations; but its great resource lay in London. The first battle was fought at Edge-hill, in Warwickshire, in which the royalists were so far triumphant that parliament was obliged to invite the assistance of the Scots, who entered England with 20,000 horse and foot. From this period war was carried on with various success, till at length the king was overpowered, reduced, imprisoned, tried, and finally beheaded. The character of this prince will be found under the article CHARLES I. With the death of the king, the miseries of civil war terminated, and the parliament, which was triumphant, had now no enemy to fear, except those very troops which hitherto had been instruments in their hands, in achieving their designs. At first they hoped to disband the troops; but Cromwell, who was the rival power in the state, had other projects to accomplish. He had already rendered the army in a great measure independent of the parliament; and now formed a council of officers, and another of common soldiers, called agitators, who were appointed to enquire into the grievances of the military, and lay them before parliament. As the commons, from necessity, granted their requests, the army rose in their demands, till at length the parliament enjoyed but the shadow of authority. It, however, passed an act, making it high treason to acknowledge Charles Stewart, son of the deceased king, as successor to the throne. They likewise voted the house of lords useless and dangerous, and passed an act for the abolition of all kingly power. A great seal was made, on one side of which were engraved the arms of England and Ireland, and on the reverse was represented the house of commons sitting, with the motto, "The first year of freedom, by God's blessing restored 1648." No measure was omitted that could probably establish the power of the usurper, and exclude for ever the kingly power in England. Much was done for retrieving the glory of England at sea. Cromwell and Ireton excited the jealousy of the republicans, who contrived first to employ them in the reduction of Ireland, and afterwards against the Scots, who had acknowledged and received Charles II. as their king. Almost immediately, by the most unparalleled exertions, a fleet was produced superior to any that had ever been seen in Europe. An act of navigation was passed, and war was declared against the Dutch, who were till then regarded as invincible at sea. Cromwell, from his successes in Scotland, found little difficulty in obtaining the honour of being declared commander in chief of the English army. Admiral Blake, and other naval commanders, carried the terror of the English name by sea to all quarters of the globe, and Cromwell, having little employment, began to think how he might establish his own authority paramount to that of the state. On the 20th of April 1653, at the head of 300 musqueteers, he dissolved the parliament, opprobriously driving the members, about one hundred in number, out of their house. He next annihilated the council of state, with which the executive power was lodged, and transferred the administration of government to about 140 persons, whom he summoned to Whitehall on the 4th of July 1653. After this he was declared lord protector; which, however, did not comport with his ambitious views; he was desirous of the name, as well as the power of king, to which he could never arrive; and in September 1658, he died after an usurpation of nearly five years. See CROMWELL.

From Charles's death in 1648, to the decease of Cromwell in 1658, England was unquestionably improved equally in riches and power; besides the introduction of the navigation act, which was established in the reign of Charles II. and which has been regarded as the palladium of English trade; monopolies of all kinds were abolished, and liberty of conscience to all sects was granted, which was highly advantageous to the population and manufactures of the country. Under Cromwell, the arts, sciences, and literature were not much encouraged, yet he did many things worthy of praise; and as his genius and capacity led him to the choice of fit persons for the several parts of administration, so he paid some regard to men of learning, and particularly to those entrusted with the care of youth at the universities. Richard, his successor, possessed none of the talents for business, nor indeed any activity of disposition, for which his late brother was so celebrated, and was in a very short time driven, without resistance, into that obscurity for which his temper was better adapted, than for the business of government. The resignation of his power made way for

Charles II. who returned to the throne of his father by the general concurrence of the people; this was in the year 1660, and for some time he seemed desirous of promoting the people's happiness, though he did not forget to avenge himself on the enemies of the late king; the bodies of Cromwell, Ireton, and Bradshaw were taken from the tomb,

and

and treated with every indignity. Of thofe who fat in judgment on Charles I. fome were dead, others had left the country, and fome the reigning prince thought deferving of mercy, but ten were devoted to almoft immediate deftruction. Thefe bore their fufferings with the conftancy of martyrs dying in a good caufe, thanking heaven in the extreme of their torments, that they were allowed to be witneffes of the truth. It was now to be feared that the tide of loyalty would bear away in its courfe all the former mounds of freedom. Parliament feemed to concur in all the defigns of the court, and even to anticipate its wifhes; but the monarch was by no means attentive to thofe who had followed him in his misfortunes; his pleafures and his flatteries engroffed all his cares, and exhaufted his finances, fo that he had nothing left, and, apparently, no wifh to pay the debt of gratitude. From thofe who would willingly have expoftulated with him on his mifconduct, he fled, and endeavoured to forget every kind of ferious bufinefs in fcenes of mirth, riot, and debauchery. By his own example, he undermined the principles of religion, and the nation, prone to extremes, exhibited every fpecies of licentioufnefs, which was practifed in the moft diffolute court that ever exifted in England. Charles II. though without a pretence to religion, permitted the perfecution of fectaries, which excited among thofe, who were objects of it, a plan for a general infurrection. The plot was difcovered, and the confpirators were taken and executed. This circumftance afforded a pretext for continuing the parliament then fitting; and repealing the act for triennial parliaments, as being dangerous in times of commotion. This parliament was fo completely fubfervient to the will of the king, that he might, with activity, have become abfolute. They confirmed the infamous doctrine of paffive obedience by a folemn act, and affigned the king a revenue of twelve hundred thoufand pounds, a fum which none of his predeceffors had ever poffeffed; neverthelefs his prodigality rendered him indigent, and inftead of defiring an afcendancy over his parliament, he was content to be a perpetual dependent on their bounty. His prodigality and libertinifm foon alienated the affections of his fubjects, which in the fhort period of two years were changed to a contempt of his perfon and adminiftration. The war, in which he engaged with the Dutch, was unattended with any brilliant fuccefs, and the enemy's attempting to fail up the river Thames excited clamours againft the government. The people began to compare the prefent ftate of things with the meafures and adminiftration of Cromwell; in the one cafe they enjoyed fecurity at home, and claimed the higheft refpect from furrounding nations; in the other every principle, private and public, was forced to give way to the paffions of the fovereign, which he was determined to gratify at any expence. Uniformity in religion became the popular cry, and, in 1673, the teft act was paffed, obliging every perfon in or under government, not only to take the oaths of allegiance and fupremacy, but receive the facrament of the Lord's-fupper in fome parifh church, before competent witneffes, and fubfcribe a declaration renouncing the doctrine of tranfubftantiation. This was levelled againft the duke of York, the king's brother, who was an avowed papift, and whom the parliament wifhed to exclude from the throne. The fears and difcontents of the nation were vented without reftraint, which gave great offence to the court. A great degree of feverity was exercifed againft the nonconformifts to epifcopacy, and every means taken that was likely to reprefs the rifing fpirit of the country. It was known or violently fufpected that Charles was a penfioner on the court of France, his parliament in 1677, addreffed him to make war upon that country, which he refufed. The people became exafperated againft almoft all public meafures; the king was alarmed with the profpect of a civil war, and made confiderable conceffions to avoid the odium which his paft conduct had juftly incurred. Many of the leading members of parliament had however determined on fuch a change as fhould exclude the duke of York from the crown. To forward this the famous plot of Titus Oates was contrived, which charged the papifts with a defign of murdering the king, and of introducing popery by means of the Jefuits, as the eftablifhed religion of the country. Several refpectable perfons were tried and convicted, principally on the evidence of Oates, who was unworthy of credit. A bill was brought into parliament to exclude the duke from the throne, which was paffed in the commons, but was thrown out in the houfe of lords. A plot was now invented on the other fide, in which the principal proteftants were accufed of an endeavour to deftroy the king. For this, on the evidence of lord Howard, a man of infamous character, lord Ruffel, who had been zealous in his oppofition to the popifh fucceffion, Algernon Sidney, and other diftinguifhed characters, were tried and executed. The terror which the meafure carried with it intimidated the beft friends to their country; it filenced the oppofition of the city of London and other corporations, and the duke of York triumphed in the victory which had been obtained by perjury. From this period the reign of Charles was as abfolute as that of any monarch in Chriftendom, but the fpirit of freedom, which the people had imbibed, ftruggled hard againft the fpirit of obedience, which the clergy attempted to inculcate. Another civil war threatened the nation ftill more dreadful than the former, as the forces were more equally divided; but fortunately for the peace of the country, the king was fuddenly feized with an apoplectic fit, and died in the fifty-fourth year of his age.

Though England, during the reign of the fecond Charles, was agitated by contending interefts, yet commerce continued to increafe; its good effects had been duly appreciated, and multitudes were ready to turn their wealth and induftry into this courfe. Many new manufactures were introduced, and many old ones brought to perfection. When France, by fhameful and wicked policy, banifhed her beft fubjects, the proteftants, England opened her arms to receive them, and with them fhe received large acceffions of national wealth. To the afflictions and exile of this monarch we are indebted for many of our beft vegetables which were introduced by his followers from the continent. Science and literature made rapid progrefs during this reign: Newton and Tillotfon; Burnet and Shaftfbury; Butler and Dryden flourifhed at this period: the Royal Society was inftituted, and from this time our countrymen took the lead in every ufeful fcience, and they have maintained their fuperiority to the prefent hour. Nor muft it be forgotten, that if Charles was the firft of our monarchs who claimed the protection of ftanding forces, yet to him and his brother we are indebted for fome very important improvements in the art of fhip-building, an art which has given us a preponderating balance among the nations of the world, and which, we truft, will, in the hands of an over-ruling providence, preferve us from that overwhelming ruin in which almoft all the empires of the continent are involved.

The oppofition, which during the late reign had fhaken the throne, vanifhed almoft entirely at the acceffion of James II. The affection of the people feemed to know no bounds when the king, as it were, fpontaneoufly made a declaration in favour of the church of England. That church, to flatter the prejudices of the prefent and late monarchs, had authoritatively from the pulpit and prefs pronounced all refiftance to a reigning sovereign unlawful: a doctrine which, however pleasing it might be to the feelings of the king, proved fatal to his peace, and, in the event, drove him from the kingdom. The army and people supported him in crushing an ill-concerted rebellion of the duke of Monmouth, who pretended to be the lawful son and heir of Charles II., and had assumed the title of king. The duke was taken and was beheaded; and some hundreds of his adherents lost their lives likewise by the instrumentality of judge Jeffries and colonel Kirke, names that have been deservedly handed down to posterity with every infamy that can attach to human nature. James, with such assistance, determined to try how far the church of England would agree in the practical assertion of the doctrine of non-resistance. He was set upon introducing popery as the established religion of the country. He laid pretensions to a power of dispensing with the known laws; he instituted an illegal ecclesiastical court, and openly received and admitted into his privy council the pope's emissaries, and gave them more respect than was due to the ministers of a sovereign prince. He sent an embassy to Rome, and received, at his court, the pope's nuncio, and, to crown all, his encroachments upon the civil and religious liberties of his people were carried beyond all bounds, even to the disgust of Roman catholics themselves; and the pope was too good a politician not to know that the course taken by James must eventually ruin the cause which he professed to advocate. The church of England took the alarm, when the king had ordered a declaration to be read, by which every restraint on popery was removed. Seven bishops refused to comply with their sovereign's order, and presented a petition to excuse their refusal. They were cited before the council to answer for their conduct, and adhering to their resolution, were committed to the Tower, prosecuted by the attorney-general for sedition, tried, and gloriously acquitted. The joy of the people, on this occasion, was inexpressible: the city and the country seemed at once to catch the shouts of exultation. James heard the intelligence with sullen silence, and evident indignation, while he was at dinner in his camp. From the church he turned to his army, who proved equally hostile to his views. Opposition, however, served only to increase his zeal, till at length some of the principal people in the country resolved to apply for relief to William, prince of Orange, who was at once the nephew and son-in-law of James II. William, who was an able politician, and ambitious of wearing the crown of England, readily listened to the proposals made him, embarked in their cause, and landed a large army almost before his designs were suspected by the court of James, who, in a few days deserted their old master, and sought protection from the new. The old king was now deeply convinced of his errors, and would gladly have retracted his measures, but it was too late: he found himself abandoned by his army and fleet, and learnt, with apparent consternation and horror, that the prince of Denmark and his favourite daughter Anne had gone over to the prince of Orange. On this intelligence he is said to have wept bitterly, exclaiming, "God help me, my own children have forsaken me." He now hung over the precipice of destruction, invaded by one son-in-law, abandoned by another, hated by his subjects, and held in utter detestation by the friends and relations of those who had suffered by his cruelty. He assembled the few noblemen who still adhered to his cause, and demanded their advice and assistance. Addressing himself to the earl of Bedford, father to lord Russel, who had been beheaded at the instigation of James in the preceding reign, "My lord," said the dejected monarch, "you are an honest man, have great credit, and can do me signal service." "Alas! sir," replied the earl, "I am old, and very feeble, and can afford you but little service, but *I once had* a son that could have assisted you in this extremity, but he is no more." James was so struck with the reply, that he could not speak for many minutes. After this he almost instantly resolved to abandon his country, and seek for himself, his queen, and his son, real or pretended, then only six months old, an asylum in France, where he passed the remainder of his life among a people who pitied, ridiculed, and despised him.

From this moment the constitution of England, which had fluctuated for ages, was fixed. The nation, represented by its parliament, determined the long contested limits between the king and the people: they prescribed to the prince of Orange the terms by which he was to rule, and appointed him king jointly with Mary, who was the next protestant heir to the crown. They were shortly after crowned by the titles of William III. and Mary, king and queen of England. The prince had his ambition amply gratified, and his wisdom was repaid with that crown which the folly of his predecessor had thrown away.

The power of William was limited on every side, and he met with an opposition from parliament which he did not expect. His chief object was to humble the power of France, and he fully anticipated the utmost efforts of the English to second his views, but he found them more intent upon guarding their domestic liberties than eager against continental powers; notwithstanding this, his reign was spent in an almost uninterrupted course of hostilities with France, at an expence she had never known before. The nation had grown cautious through the experience of the two last reigns, and he gave his consent to the "bill of rights," by which the liberties of the people were confirmed and secured, though not in so ample a manner as might have been done at a crisis when a crown was bestowed by the free voice of the people. The last two kings had made a very bad use of the whole national revenue, of which they had an unlimited use, and it was found in their hands quite sufficient to raise and maintain a standing army. The revenue was now divided, part of it was allotted for the national service of the year, and was to be accounted for to parliament; and part, which has ever since been denominated the civil list money, was given to the king for the support of his house and dignity.

William was averse from persecution, and began his reign by attempting a repeal of those laws that enjoined uniformity of worship, and though he could not do all he wished, yet he obtained practical toleration for the dissenters; and the laws against the papists were rarely executed. He was, however, a stickler for what he regarded as the privileges of the crown, and often controverted, and remonstrated against the views of his parliament, and was, not unfrequently, arbitrary in his councils. He opposed with the utmost vehemence the bill for triennial parliaments, and, when it had actually passed the two houses, he refused to give it his royal assent. The house of commons, who are or ought to be the representatives of every individual in the country, took fire at this abuse of the royal prerogative, and voted, with becoming spirit, "that whoever advised the king to this measure was an enemy to his country," and no king has since ventured upon so outrageous a proceeding. The bill, thus rejected, lay dormant till the next sessions, when William found himself obliged to comply. The same opposition and the same success attended a bill for regulating trials in cases of high treason, by which the accused was allowed a copy of his indictment, and a list of the names of his jury, two days before his trial, together with counsel to plead in his defence, and that no person should be indicted

but

but upon the oaths of two witneffes. It was by inceffant ftruggles againft the crown that the invaluable rights of the people have been tranfmitted to their pofterity; and a juft regard to thefe rights, civil and religious, was what led them to agree to the revolution. In other refpects they had no reafon to defire a change, nor can it with juftice be imputed to the Englifh that they affect important national revolutions. When James was difmiffed, the wealth and profperity of the nation were at their higheft pitch, the tonnage of their fhipping, both for merchandize and war, had been nearly doubled in the laft 25 years: the increafe of the cuftoms, the fureft teft of increafing commerce, and the annual rental were nearly in the fame proportion. Hence a ftrong party was formed againft the king's ambitious and warlike purfuits, which were not always fuccefsful, and which drained the country of much wealth. The Irifh were ftill defirous of a Stuart king, as were many of the Englifh, though they fpurned the idea of having even James forced upon them by the right of conqueft. Parliament enabled the king to reduce Ireland, and to gain the famous battle of Boyne, (fee BOYNE,) which crufhed all the hopes of the exile king, and in 1692 the marine of France, which had hitherto vied with that of England, received an irrecoverable blow in the defeat at La Hogue.

Invafions were threatened, and confpiracies difcovered every day againft the government, and the fupplies required to carry on a continental war obliged the parliament to open new refources for money. A land-tax was impofed, and every one's lands were taxed according to their valuations given in by the feveral counties. To this reign alfo we are indebted for the moft important operation in finances that ever took place, which was the carrying on the war by borrowing money upon parliamentary fecurities, and which form what are called the public funds. The projector of this fcheme, which has been acted upon, beyond the limits of human imagination, (fee DEBT, *National*,) was Mr. Charles Montague, afterwards lord Halifax. The argument on which he depended to carry his plan into effect, was that it would oblige the moneyed part of the nation to become the zealous and fteady friends of the revolution, becaufe, after having lent their money to the nation, they could have no hopes of repayment or even of intereft for it, but by fupporting the exifting government.

Notwithftanding the advantages which the nation derived from the adminiftration of William, he was fubject to fo many mortifications from his parliament, that he ferioufly refolved to abdicate his throne, a refolution which he with difficulty abandoned, and certainly with the hope of being fupported more effectually in the war with France, but he was in a great meafure difappointed, and obliged to conclude the peace of Ryfwick in the year 1697; and in the general pacification, the only equivalent obtained by the nation for an immenfe wafte of blood and treafure, was the king of France's acknowledgment of king William's title to the crown.

One of the laft and moft important acts of this reign was the paffing of a bill for fettling the fucceffion to the crown in the houfe of Hanover, which received the royal affent in June 1701. Shortly after this the king felt his conftitution giving way, which he endeavoured to counteract by the exercife of riding, and in one of his excurfions to Hampton court, his horfe fell under him, and he himfelf was thrown off with fuch violence that his collar-bone was feverely fractured, an accident which, in a few days, put an end to his life, in the 52d year of his age, and the eleventh of his reign. The character of this prince will be more particularly given under his own name. It may, however, be obferved in this place, that he was ill formed for acquiring popularity: his manners were cold and forbidding, and he fometimes feemed almoft loft to thofe principles of liberty, for the fupport of which he had been raifed to the throne. Neverthelefs, the refcue and prefervation of religion, and public liberty, were the chief glory of William's reign, for under his aufpices England fuffered grievoufly in her actions both by fea and land, and the public debt at the time of his death amounted to the fum of fourteen millions fterling.

The fucceffor to William was Anne, the fecond daughter of king James by his firft wife. She afcended the throne in the thirty-eighth year of her age, having fuffered many fevere mortifications during the reign of the late king, but upon her acceffion fhe followed his fteps, and fhortly after declared war againft France, appointing the earl, afterwards the duke of Marlborough, to the command of her armies. Under this general many important victories were achieved. Thofe of Blenheim and Ramillies gave the firft effectual checks to the French power. By the former, in 1704, the emperor of Germany was faved from impending deftruction, and 20,000 of the enemy were faid to have been killed, wounded, or drowned in the Danube. About the fame time fir George Rooke reduced the famous fortrefs of Gibraltar, which ftill remains in our poffeffion a monument of the bravery and talents of the Englifh admiral. The battle of Ramillies, fought in 1706, was of the utmoft importance to the caufe for which the war was undertaken; *viz.* to place Charles duke of Auftria on the throne of Spain, for immediately after that victory, the ftates of Flanders affembled at Ghent, and recognized Charles for their fovereign. In Spain itfelf the Englifh were unfuccefsful; the burdens of the war falling chiefly on this country, the people, who are ever delighted at victory, began to murmur at the taxes impofed on them. Other circumftances led to difputes refpecting the prerogative, the fucceffion, and religion, which created great ferments in the nation and parliament. Negociations for peace were carried on fome time, but without fuccefs. At this period the leading parties in the nation were whigs and tories, at the head of the former was the duke of Marlborough, who fupported by the queen was for a continuance of the war, in which her majefty concurred, till means were found to convince her, that it would finally prove ruinous to her and the people, and that the whigs were inimical to the national religion. The cry of "the church is in danger," at length difplaced the whigs, and even drove the duke of Marlborough from the command of the army, an act which excited the aftonifhment of all Europe, for fo numerous had been the victories acquired by his valour, and fo high was his reputation, that his name was equivalent to an army. There is little doubt that whatever the faults of the whigs might have been, the honour and interefts of the nation were facrificed to court intrigues and private cabals. In the midft of all the difputes the whigs accomplifhed the union between the two kingdoms of England and Scotland, which has proved of great benefit to both, but which at the time excited the moft violent clamours againft the projectors. The Englifh expected nothing from the union of fo poor a nation, but a participation of their neceffities: they contended it were unjuft that while Scotland was granted an eighth part of the legiflature, it yet fhould be taxed only a fortieth part of the fupplies. The Scots, on the other hand, conceived that their independency would be wholly deftroyed, and the dignity of the crown betrayed; they dreaded an increafe of taxes, and were not very anxious for an increafe of trade. After fome ineffectual ftruggles the Union was effected: Scotland was no longer to have a parliament, but to fend ſixteen peers, choſen by their nobility, and forty-five commoners, to the Engliſh parliament, and from that period the two kingdoms were called by the common name of Great Britain, and all the ſubjects of both were to enjoy a communication of privileges and advantages.

In 1712 conferences for negociation between England and France were opened, which led to peace. This was condemned by the whigs as injurious to the honour and intereſt of the nation. The majority of the houſe of lords inclined to that party, but that of the other houſe was tories. The queen, dreading that the lords might reject the terms of peace, by an unprecedented exerciſe of her authority, created twelve peers at one time, which ſecured the approbation of the parliament for the peace. The remainder of this reign was a ſcene of contention between the two parties. Each reviled the other in turn, and theſe commotions ſerved ſtill more to impair the queen's health, till at length ſhe felt herſelf unequal to the duties of her ſtation. She ſunk into a ſtate of inſenſibility, and found a refuge from her anxiety and cares in lethargic ſlumber. Every precaution was taken to ſecure the ſucceſſion in the houſe of Hanover, and orders were ſent to the heralds at arms to be in readineſs to proclaim the elector of Brunſwick king of Great Britain. The day before the queen died ſhe ſeemed to revive, roſe from her bed, and walked about, when, caſting her eyes on the clock that ſtood in her chamber, ſhe continued to gaze for ſome time, and being aſked what ſhe ſaw more than uſual, ſhe replied only with an expreſſive but dying look, and about ſeven o'clock the next morning, Aug. 1, 1714, ſhe expired in the thirteenth year of her reign. The national debt had, during this reign, encreaſed from fourteen to fifty millions. See Anne, Churchill, &c.

With this princeſs terminated the line of Stuarts, which, from the acceſſion of James I. 1603, had ſwayed the ſceptre of England one hundred and eleven years, and that of Scotland 343 years. On the death of queen Anne, there was ſtill left the ſon or ſuppoſed ſon of James II. who had been acknowledged king by the court of France on the deceaſe of his father in 1701. In behalf of this prince, rebellions were excited in England in 1715 and 1745. He reſided at Rome, and kept up an appearance of a court till his death in 1765, leaving two ſons, who are ſince dead and without iſſue.

By the act of ſucceſſion George I. ſon of Erneſt Auguſtus, firſt elector of Brunſwick, and Sophia grand-daughter of James I. aſcended the Britiſh throne; his mother, who would have been next in ſucceſſion, having died a ſhort time before. He arrived in England with ſtrong prepoſſeſſions againſt the tory miniſtry, moſt of whom he diſplaced, without producing much effect in England, but in Scotland a rebellion was excited by ſome of the leading men of that country, who paid for their temerity the forfeit of their lives. Commotions and riots were raiſed in London, Oxford, and other parts, but theſe were happily ſuppreſſed, and the ringleaders in various inſtances were made examples of juſtice. The earl of Oxford, who had negociated the peace of Utrecht, was charged with high treaſon on that account, but the proſecution was abandoned. The ſituation of affairs would not permit the miniſtry to venture upon a new parliament, and the members of that which now exiſted voted a continuance of their duration from three to ſeven years, one of the greateſt and moſt indefenſible ſtretches of parliamentary power ever known. Several other meaſures, hoſtile to liberty and the principles of the exiſting conſtitution, took place at the ſame time. Mr. Shippen, a member of parliament, was committed to the Tower for aſſerting in his place, that the king's ſpeech was better calculated for the meridian of Hanover than of London; and a young man, a printer, was actually hanged for a pamphlet, ſaid to have been ſcarcely deſerving of animadverſion. George I. however ſagacious, and in many reſpects moderate, was too much attached to his German dominions, and rendered England in a great meaſure ſubſervient to them. He quarrelled with the czar of Muſcovy about their German concerns, and had nearly involved this country in a war with Charles XII. of Sweden, for having as elector of Hanover purchaſed Bremen and Verden of the Danes. In 1718, he quarrelled with Spain on account of the quadruple alliance that had been formed between Great Britain, France, Germany, and the States General, and admiral ſir George Byng, by his orders, deſtroyed the Spaniſh fleet. The war was quickly terminated by the Spaniards delivering up Sardinia and Sicily, the former to the duke of Savoy, and the latter to the emperor, and by the king of Spain conſenting to ſign the quadruple alliance; in which England was very little if at all intereſted. See Alliance.

The next thing of importance was the ſecuring the dependency of the Iriſh parliament upon that of Great Britain. The houſe of peers in England had reverſed a decree made by the Iriſh houſe, which excited long, animated, and even bitter diſcuſſions, till at length a bill was brought into the Engliſh parliament, by which the Iriſh houſe of lords was deprived of all right of final juriſdiction, which, notwithſtanding the moſt violent oppoſition from ſeveral leading members of both houſes, was carried by a great majority. The ferment occaſioned by theſe diſcuſſions was followed by the South Sea ſcheme, which promiſed immenſe wealth to thoſe who engaged in it, but which left a large part of the nation in diſtreſs and ruin. (See Bubble.) Juſtice was demanded, by petitions from all parts, upon the contrivers of the ſcheme, and the nation ſeemed, as to a man, highly exaſperated. During theſe tranſactions, the king, with ſerenity and wiſdom, preſided at the helm, influenced his parliament to purſue equitable meaſures, and, by his councils, endeavoured to reſtore the credit of the nation. The diſcontented availed themſelves of public calamities, and made another attempt againſt the reigning ſovereign. Their deſigns were ſoon detected, and Chriſtopher Layer, a young gentleman of the Middle Temple, was convicted of treaſonable acts, and ſuffered death on the account. Several noblemen and other perſons of diſtinction were ſuſpected of being in the plot, but of theſe the biſhop of Rocheſter was the only victim who was baniſhed the kingdom for life. After the ferment which this plot occaſioned was over, the tranſactions of the reign were few and leſs important in their conſequences. The miniſtry, who were all in the intereſt of Hanover, ventured upon ſeveral bold meaſures, in ſome of which the national intereſt, if not honour, was evidently ſacrificed to that of the electorate. The crown of Great Britain was engaged in every continental diſpute, however remote it was from her own intereſt. Treaties lately concluded with Spain were again broken, and admiral Hoſier was ſent to intercept the Spaniſh galleons from America, an expedition which proved as fatal as it was inglorious. The admiral and moſt of his men periſhed by epidemical diſeaſes, and the hulks of his ſhips rotted ſo as to render them utterly unfit for ſervice. To retaliate, the Spaniards undertook the ſiege of Gibraltar, and with ſimilar ſucceſs. New treaties were ſet on foot, France offered its mediation, and a reconciliation was effected. The king died, as he was travelling to his Hanoverian dominions, at Oſnaburgh, on the 11th June 1727, in the thirteenth year of his reign. During his reign the ſinking fund for diminiſhing the national debt was inſtituted. See Debt *National*, Funds, &c.

Upon

Upon the death of George I. his ſon George II. aſcended the throne, with a predilection for his Hanoverian dominions ſimilar to that of the late king. He choſe for his firſt miniſter ſir Robert Walpole, who had filled the ſame high office under his father. This able miniſter was a decided enemy to war, which, in ſome inſtances, led him into difficulties both at home and abroad. His adminiſtration will be more properly conſidered under the article attached to his name, (ſee WALPOLE,) but juſtice requires of us to obſerve, that notwithſtanding ſome of his meaſures, as an attempt at the introduction of the exciſe laws, were liable to great cenſure, yet he was friendly to the exiſting laws: he filled the courts with able and upright judges, and he has not been charged with any attempt at the violation of the known law of the kingdom, and under his adminiſtration the preſs was under little or no reſtraint. His pacific ſyſtem more than repaid to the nation all that was required to ſupport it, by the increaſe of her trade and the improvement of her manufactures. The great objects of controverſy during the early part of this reign were the national debt, and a ſtanding army. Demands for new ſupplies were made every ſeſſion of parliament, either for the purpoſe of ſecuring friends on the continent, or of guarding the internal polity, or for enabling the miniſtry to act vigorouſly in conjunction with their allies abroad. Theſe were as regularly oppoſed as they were made: the ſpeakers of the country party ever inſiſted, that the Engliſh had no buſineſs to embroil themſelves with the affairs of the continent; that expences were incurred without prudence or neceſſity; and that the increaſe of the national debt by multiplying taxes, would in the end become intolerable to the people. A motion was made to revert to the old ſyſtem of triennial parliaments, as they had been ſettled at the revolution. The advocates for this meaſure aſſerted that the ſeptennial act was an encroachment on the rights of the people; that it was introductory to the monſtrous corruptions of government: that during the continuance of that parliament which prolonged its exiſtence from three to ſeven years ſeveral ſevere laws had been enacted; that by one of theſe a man might be removed, and tried at any place where the jury might be found favourable to the crown, and where a priſoner's witneſſes could not and dared not come; that by another, a juſtice of peace was empowered to put the beſt ſubjects to death after reading the riot act. The miniſtry was, however, triumphant, and the oppoſition, who, unqueſtionably, had the weight of argument on their ſides, complained that debate was uſeleſs, and that it was wholly impoſſible that reaſoning could prevail over the corruptions that were ſecretly practiſed by the miniſter. Deſpairing, therefore, of being able to ſtem the torrent of corruption, they retired to their ſeats in the country, and left the miniſtry an undiſputed majority in the houſe.

In November 1737, queen Caroline, conſort to the king died; at this time the king and his ſon Frederick the prince of Wales were at variance. The latter complained that through Walpole's influence he was deprived not only of the power but the proviſion to which his birth was entitled. The king forbade him his preſence, and gave orders that none of his friends ſhould be admitted at court. A motion was made in the houſe of commons for increaſing the prince's ſettlement, which was fifty thouſand pounds; this was oppoſed by ſir Robert Walpole, and rejected by a large majority. The prince now placed himſelf at the head of the oppoſition with ſo much firmneſs, that it was ſeen Walpole's power was drawing to a criſis; but it was not till the year 1742 that he reſigned his employments and was created earl of Orford. The king bore the loſs of his miniſter with the greateſt equanimity, and even conferred titles of honour, and poſts of diſtinction upon the heads of oppoſition. Circumſtances alſo aroſe which induced him to take a leading part in a continental war: in oppoſition to which a rebellion in behalf of the pretender was excited in 1745 in Scotland. Charles, the ſon of the pretender, landed in the Scottiſh iſlands, and ſoon found himſelf at the head of 1500 men. Manifeſtoes were widely diſperſed, inviting the highlanders to join in the cauſe: few, however, ſeemed willing to hazard the dangers of the enterprize. Its boldneſs aſtoniſhed Europe; it awakened the fears of the puſillanimous, the pity of the wiſe, and the loyalty of all. The whole kingdom ſeemed unanimouſly bent upon oppoſing the enterprize which they were ſenſible, as being ſupported only by papiſts, would be inſtrumental in reſtoring popery. The rebels advanced to Perth, where, inſtead of proceeding with increaſed rapidity, they ſtaid to proclaim the prince's father king. The prince was again ſucceſsful at Preſton Pans, and marched to Edinburgh; here he waſted his time in diſſipation and parade, till an opportunity was given to the king to ſend againſt him an effectual force under the duke of Cumberland. The battle of Culloden on the 15th of April 1746, put an end to all hopes of the pretender: the victory on behalf of the king was complete, but the mercileſs fury of the conquerors upon the fallen diſgraced the cauſe, to which every friend of his country wiſhed ſucceſs. The duke ordered nearly forty deſerters to inſtant execution, and the royal army ſpread terror wherever it came, and after a few days the whole country was one ſcene of ſlaughter, deſolation, and plunder; juſtice was forgotten, and every virtue ſeemed to be loſt in the moſt ſavage vengeance. The government on this occaſion was not a little indebted for the ſupport it received to the national debt. The Jacobite party had hoped to ruin public credit, but common danger aboliſhed all diſtinctions, and united them in defence of private property. The merchants agreed to receive bank notes in payment, which prevented the miſchief that was hoped for by a run upon the bank. The defeat of this rebellion in the year 1746 did not reſtore tranquillity to Europe; it was not till after various ſucceſſes in different parts of the globe that the preliminaries of peace were ſigned in April 1748, and in the October following a definitive treaty was concluded at Aix-la-Chapelle. In the proſecution of this war the balance of gain, as far as wealth was concerned, was evidently in favour of Great Britain, and many private perſons made it ſubſervient to the attainment of vaſt fortunes. In the following year, the intereſt of the national debt was reduced from four to three and a half *per* cent. at which rate it was to continue for the next ſeven years, when it was to ſuffer a farther reduction to three *per* cent. This, ſays the hiſtorian, was the boldeſt ſtroke of financing that ever was attempted perhaps in any country, conſiſtently with public faith, for the creditors of government, after a trifling ineffectual oppoſition, continued their money in the funds, and a few who at firſt ſold out were glad, in a ſhort time, to have it placed under the ſame ſecurity.

At this period Mr. Pelham was the miniſter of the country, who turned his attention to the improvement of commerce, manufactures, and fiſheries, the benefits of which deſcended to poſterity. A new treaty of commerce was ſigned at Madrid, between Great Britain and Spain, by which, in conſideration of 100,000*l.* the South Sea Company gave up all their future claims to the Aſſiento contract, by virtue of which that company had ſupplied the Spaniſh Weſt Indies with ſlaves from the coaſt of Africa. (See ASSIENTO.) In March 1750, his royal highneſs Frederic prince of Wales died, to the regret of the nation: and in the following year an act was paffed for regulating the commencement of the year, by which the old ftyle was abolifhed, and the new ftyle eftablifhed, which was done by finking eleven days in 1752, and from that time the year was to begin the firft of January inftead of March. (See CALENDAR.) In 1753 the famous act was paffed for preventing clandeftine marriages, which at the time excited the moft violent oppofition, as replete with the moft injurious confequences to the liberties and morality of the people, and as making an impaffable line between the rich and the poor: and about the fame time an act equally, or even more unpopular, as attacking the religious prejudices of the people, was paffed. This was a law for naturalizing the Jews, which, though carried through great oppofition, was in the next feffion repealed. The game laws were alfo introduced about this period; by thefe none but men poffeffed of certain property could have the privilege of carrying a gun, or of otherwife deftroying game, though on grounds which they rented themfelves. This meafure was fuppofed to be a violent encroachment on the liberty of the fubject; that it would neceffarily damp the martial fpirit of the lower orders of fociety, by preventing them from handling thofe arms which might one day be neceffary to defend their country; and at the fame time, that it gave the rich the fole enjoyment of a pleafure, which before had been confidered as the common privilege of humanity. "Such," fays a contemporary writer, "were the laws paffed at this period, through all which a fpirit of ariftocracy was difcerned by fome. The body of the rich, no longer fearing oppreffion from the throne, or an infringement of their own liberties, now began to lean heavy on the poor, and to confider the interefts of that ufeful part of the fociety as entirely diftinct from their own. They never omitted, however, their ufual addreffes to the throne; and this feffion (1756) was remarkable for an addrefs of thanks to his majefty, for maintaining, and rendering permanent, the general tranquillity of Europe, at a time when war was kindling in almoft every quarter of the world."

To the conduct of this war Mr. Pitt was called, as fecretary of ftate, and head of the adminiftration. He had long fignalized himfelf as a bold, eloquent, and energetic fpeaker, and he foon proved himfelf a moft able and fpirited minifter. In this war the Englifh in Europe, in Afia, and America, achieved wonders: they were every where victorious: almoft all the poffeffions of the French in North America and in India fell into our hands; and at the battle of Minden, in Germany, feven thoufand of our countrymen defeated an army more than ten times as large. The Englifh for fome time bore the increafing burdens of warfare with cheerfulnefs; and rendered, by every means in their power, the juft tribute of praife to the talents and activity of the minifter. But at length, glutted almoft with victory fucceeding upon victory, they began to reflect upon the proble advantages that might refult from a continuance in war, when it was evident that the conquefts made in Germany muft ever be foreign to the real interefts of Great Britain; that they were waging an unequal war, and adding new loads of taxes to thofe already difficult to be borne, for conquefts which they could neither preferve nor enjoy. Such were the growing difcontents of the people, when the French fhewing fome difpofition to treat for peace, and the charges of the war beginning to amount to eighteen millions a-year, inclined the Britifh miniftry to liften to the propofals offered them. A negociation was accordingly entered upon, but without fuccefs. This was in the autumn of the year 1760, and on the 25th day of October, 1760, George II., without any apparent fymptoms of diforder, was found expiring in his chamber. He had arifen at his ufual hour, intending to walk out, but being left alone, he was heard to fall down upon the floor; the noife of the fall brought his attendants into the room; he defired, in a faint and faultering voice, that the princefs Amelia might be fent for, but before her arrival he expired, in the 77th year of his age, and the 33d of his reign, in the midft of victory, and at that very period, when the univerfal enthufiafm of conqueft began to fubfide into more fober reflections. The character of this prince will be given under his own name. He was fucceeded by his grandfon George III., the prefent fovereign, who afcended the throne with great advantages. He took the opportunity which his firft fpeech to parliament gave him, of appealing to the prejudices and affections of his people. "Born and educated in this country," faid he, "I glory in the name of Briton, and the peculiar happinefs of my life will ever confift in promoting the happinefs of a people whofe loyalty and warm affection to me I confider as the greateft, and moft permanent fecurity of my throne. The civil and religious rights of my loving fubjects are equally dear to me with the moft valuable prerogatives of my crown." The firft acts of this reign were calculated to convince the people that the war in which they were engaged fhould be carried on with energy; very brilliant fucceffes, and important conquefts, were the refult of the plans adopted by Mr. Pitt, who felt himelf refponfible for almoft all public meafures. When, however, he found his influence in the cabinet declining, through the fuppofed intrigues of the earl of Bute, he refigned his high fituation, declaring he would no longer lie under the refponfibility of meafures which he was not allowed to guide. Mr. Pitt retired in October 1761, upon a penfion of 3000*l.* *per ann.* and, at the fame time, a peerage was conferred upon his lady. Thefe grants were, by his enemies, held out as proper fubjects to excite the popular clamours againft the patriotic minifter. At firft they fucceeded, but in a fhort time an almoft general difcontent prevailed in the nation, on account of his removal from office, in the midft of a war, which he had conducted with fo much honour to himfelf and to his country, and in a manner that had excited the aftonifhment of Europe. The war was ftill purfued with vigour, and the plans of Mr. Pitt, of which the new minifter availed himfelf, led to important victories both by fea and land.

Early in the year 1763, peace was agreed upon, and of fo little importance had the war been to the interefts of the Englifh, who had been almoft uniformly victorious, and who had acquired by their valour many foreign poffeffions, that it was agreed a mutual reftitution and oblivion fhould take place, and each party fit down at the end of the war in the fame fituation in which they began it. The peace excited much oppofition, becaufe the terms were thought extremely inadequate to what might have been expected from the numerous and brilliant victories and advantages obtained in the courfe of a long war. From this period various caufes contributed to occafion a fpirit of difcontent in the nation. On the 30th of April, 1763, three of the king's meffengers entered the houfe of Mr. Wilkes, member of parliament for Aylefbury, and feized his perfon by virtue of a warrant from the fecretary of ftate, which directed them to feize the authors, printers, and publifhers, of a feditious and treafonable paper, entitled the North Britain, N° 45. This work contained ftrictures on his majefty's fpeech, and Mr. Wilkes was fufpected to be the author. He was accordingly arrefted, examined, and clofely imprifoned, which gave rife to difcuffions on the legality of general warrants, which were in the end declared illegal, and a grofs violation of the liberty of the fubject. (See WARRANTS, *General.*) Mr. Wilkes was for this and other publications expelled the houfe, houſe, and in 1764 a ſentence of outlawry was iſſued gainſt him.

In 1765, under the adminiſtration of Mr. George Grenville, an act was paſſed for laying a ſtamp-duty on the Britiſh colonies of North America. This kindled a flame in that quarter of the globe, which finally led to a ſeparation of the colonies from the mother country, and eſtabliſhed the independence of America. (See AMERICA and UNITED STATES.) In the year 1768 Mr. Wilkes returned to England, was proſecuted, convicted, and fined in the ſum of 1000*l*. He carried with him the voice of the people, whoſe cauſe he was ſuppoſed to vindicate, and was again elected member for Middleſex; and was again expelled. After the expiration of the term of his impriſonment, in the year 1771, he was elected ſheriff of London, and afterwards choſen member for the county of Middleſex, when he was permitted quietly to take his ſeat; and in the year 1775 he was elected lord mayor of London, an office which he executed to the ſatisfaction of his fellow-citizens. In 1783 all the declarations, orders, and reſolutions of the houſe of commons, reſpecting his election for the county of Middleſex, were ordered to be expunged from the journals of that houſe.

In the year 1772 the clergy petitioned the parliament for relief in matters of ſubſcription to the 39 articles, praying to be reſtored to their undoubted right of interpreting ſcripture for themſelves, without being bound by any human explanation of it, or being required to acknowledge by ſubſcription or declaration, the truth of any formulary of religious faith and doctrine whatever, excepting the Holy Scripture itſelf. The petition was preſented by ſir William Meredith, who, with other members favourable to the principle, enforced it by many arguments drawn from the principles of toleration. It was, however, rejected by a large majority. A bill was ſhortly after brought into the houſe to prevent the deſcendants of his late majeſty from marrying without the conſent of his majeſty, his heirs, and ſucceſſors, which was carried very rapidly through both houſes, and paſſed into a law. A petition was now preſented by the diſſenters, praying to be relieved from the hardſhip of ſubſcribing to the articles of a church to which they did not belong. This petition was received, and a bill brought into the houſe founded upon it, which was carried by a large majority in the commons, but which was rejected in the houſe of lords. From this period the whole intereſt of the country was turned to the conteſts with America, to which we have already referred. The enormous expences occaſioned by this war excited much and almoſt general diſcontent among the people, who began to call aloud for an economical reform in the various departments of the ſtate. Meetings were held in various counties of the kingdom, at which great numbers of freeholders were preſent, who agreed to petition the houſe of commons, "that before any new burdens were laid upon the country, effectual meaſures might be taken by that houſe to inquire into, and correct the abuſes in the expenditure of the public money; to reduce all exorbitant emoluments; to reſcind and aboliſh all ſenecure places, and unmerited penſions; and to appropriate the produce to the neceſſities of the ſtate." In the beginning of the year 1780 theſe petitions were taken into conſideration, and ſome trifling reforms took place. In ſome inſtances, the miniſter, lord North, was left in a minority, and in many others he was obliged to uſe every exertion to carry his meaſures. In a very full houſe, and by a ſmall majority, certain officers under the crown were excluded from having ſeats in the houſe of commons: this they hoped to follow by other arrangements favourable to the rights of the people; but, in a ſhort interval, the miniſter was enabled to apply arguments not generally underſtood, but ſtrongly ſuſpected, which gave him a preponderance in the houſe, and which enabled him to ſtop the progreſs of reform. The people were diſſatisfied, and a ſpirit of diſcontent prevailed in almoſt every part of the kingdom. About this period, the hardſhips which individuals, profeſſing the Roman Catholic religion, had laboured under, awakened the conſideration of the liberal part of the people: and ſome perſons of high conſideration in the ſtate undertook their cauſe, and fully expected they ſhould obtain for them that relief which the nature of their caſe required. The Catholics preſented a dutiful and loyal addreſs to the king, containing the ſtrongeſt aſſurances of affection and fidelity to his perſon and the civil government of the country. This addreſs, which was drawn up with great care, and which contained ſentiments of the moſt unexceptionable nature, was ſigned by ſeveral Roman Catholic peers, and 163 commoners of rank, fortune, and influence in the country. The advocates of the cauſe were aware that the prejudices of the lower claſſes were hoſtile to an extenſion of the privileges of the Catholics, whom they had been accuſtomed to regard as perſecutors from principle, and as deſirous of ſubverting the Proteſtant faith. But ſir George Saville made a motion for the repeal of certain penalties which were attached to the profeſſion of the Catholic religion. He was ſeconded in his exertions by Mr. Dunning, who laid before the houſe an account of the ſtatutes ſtill exiſting againſt the Catholics, by which, among other grievances, it was made high treaſon in any native of theſe realms to teach the doctrines or perform divine ſervice according to the rites of that church; the eſtates of perſons educated abroad in that perſuaſion were forfeited to the next proteſtant heir; a ſon, or any other, the neareſt relation being a Proteſtant, was empowered to take poſſeſſion of his own father's or neareſt of kin's eſtate, during their lives; a Roman Catholic was diſabled from acquiring any legal property by purchaſe. In conſequence of theſe and ſuch like repreſentations, the motion made in favour of the Roman Catholics was received without a diſſenting voice, and a bill in purſuance of its intent was brought in and paſſed both houſes. This act ſeemed to give little offence to perſons of any claſs in England, but in Scotland it excited much indignation, riots enſued, and ſome houſes and chapels were deſtroyed. The contagion at length reached England: a number of perſons aſſembled themſelves together with a view of promoting a petition to parliament for a repeal of the late act in favour of the Papiſts, and they aſſumed the title of "The Proteſtant Aſſociation." Of this aſſociation lord George Gordon was the preſident: who, at the head of 50,000 men, preſented a petition to the houſe of commons on the 2d day of June 1780 At firſt the petitioners behaved with order and decency, but they ſoon became violent againſt the members of the two houſes who had been friendly to the cauſe of toleration, ſome of whom narrowly eſcaped with their lives. From this time till the 7th of June, London was the ſcene of the moſt atrocious crimes: houſes, chapels, and priſons, were broken open, plundered, and burnt. In one night, and at the ſame hour, it is ſaid, there were 36 buildings on fire. Attempts were made on the bank, but ſuch precautions had been taken as to render that place invulnerable. At length by the exertions of the military, who killed and wounded great numbers of the rioters, the tumult was ſuppreſſed, and the metropolis reſtored to order and tranquillity. Numbers were afterwards tried for aiding and abetting in theſe ſcenes; ſome were convicted and executed, and others acquitted; and the preſident lord George Gordon

Gordon was committed to the Tower on a charge of high treafon, for which he was afterwards tried and found ' Not Guilty."

War continued to rage, and from America it had fpread to almoft every part of the world, and the Englifh found themfelves engaged in a conteft with France, Spain, and Holland: but in the beginning of the year 1782 the oppofition fucceeded in forcing minifters to a pacification. Peace was accordingly concluded, but not fuch a peace as met the general wifhes of the people, and thofe who had made it were obliged to refign their places to the famous coalition miniftry under lord North and Mr. Fox. By the latter a bill was brought into parliament, for newly regulating the government of the Eaft India Company, which occafioned a great ferment in the country, and which finally drove the author of it, and his party from the helm, who were fucceeded by the late Mr. Pitt and his friends. One of the firft acts of this minifter was a new Eaft India bill, which was paffed by a great majority: and fhortly after, he became the advo ate of parliamentary reform, a caufe which he had efpoufed before he came into place, and which he pledged himfelf to ufe his utmoft endeavours to carry into effect. His plan was rejected, and from that time he never ferioufly attempted to realize the expectations which he had excited among the friends of liberty. The next important meafure which he introduced to the notice of parliament was the propofal of a finking fund to be applied towards difcharging the national debt. (See Debt, *national. Sinking* Fund, &c.) We fhall alfo refer our readers to the life of that minifter for a more comprehenfive view of his public adminiftration: to the article Revolution, *French*, for the various occurrences that took place in this country from the year 1788; to the article Slave *Trade* for an account of the proceedings on that fubject to its final abolition: to the article Test *act* for the attempts made in this reign to obtain a repeal of thofe obnoxious laws, &c. &c. Henry's Hift. Rapin. Act. Regia. Hume. Belfham. Biog. Brit. &c.

England, *Little, beyond Wales*, in *Geography*, is a portion of country lying along the fouth-weftern coaft of South Wales, inhabited by the defcendants of a colony of Flemings; who came over from Flanders, and fettled here in the reign of king Henry I. Camden fays, the occafion of their emigration was an inundation of the fea, by which a great part of the Low Countries was overflowed. But it has been ftated, with more probability, that it was the policy of that wife monarch to place a people oppofite in their language, manners, and opinions to the Welfh, to affift in his favourite project—the fubjugation of the country. Another colony from the fame country was incorporated with the firft, in the time of Henry II., to which occafionally were added numerous Anglo-Normans, and others from the Englifh army. At firft thefe people were confined to the commot of Rhos, which diftrict ftill more *particularly* retains the name of Little England beyond Wales. But their numbers increafing in the courfe of time, they foon fpread along the whole coaft, from the lordfhip of Comes to the mouth of the river Tave. And this part of the principality is ftill divided into two diftricts, denominated Englifhery, and Welfhery. The latter, occupied by the original inhabitants, contains the cantreves of Comes, Cilgerran, part of Arberth, and Dewifland. The former comprifes the remainder of Arberth, and the cantreves of Rhos, Caftel-Martins, and Dougleddy; and is inhabited by the defcendants of the Flemings. Like their anceftors, they are a hardy, induftrious, and adventurous race. The difpofitions of the two people are equally ftriking and adverfe. While the Welfh are hot, eafily irritated, and obftinately tenacious; thefe are not eafily provoked, are averfe to contention, and avoid litigation. Both are diftinguifhable by their mode of drefs, manner of living, the ftyle of their buildings, particularly in their churches; and the names they refpectively give to places. All thefe ftrongly point out the line of demarcation between them. In the Welfhery, not a word of Englifh is heard fpoken, while in the next village within the Englifhery, not a word of Welfh. The language of the latter diftrict is not much different from the common dialect of England, except in fome parts of Rhos and Caftle-Martin. The two people avoid all commerce as much as poffible, mutually confidering each other in a degrading light; and even a pathway will divide them in the fame parifh. To fuch an extent is this perfonal deteftation carried among the lower claffes, that a matrimonial connection between the oppofite parties is confidered by both an unfortunate event. The Flemings, however, eventually proved a bleffing to Wales, as well as England; by their introduction of the woollen manufactures. And a work, which proves their induftry and improving fpirit, is yet vifible. It is a road of great extent made by them, and ftill called Fleming's way. Evans's Tour in South Wales.

England, *New*, comprehending the *Northern* or *Eaftern States* of North America, lies around the great bay which fets up N.W. between cape Cod and cape Sable, between 41° and 48° N. lat., and between 1° 30′ and 10° 15′ E. long. from Philadelphia, and is bounded N. by Lower Canada; E. by the province of New Brunfwick and the Atlantic ocean; S. by the fame ocean and Long-ifland Sound; and W. by the ftate of New York. It lies in the form of a quarter of a circle; its W. line beginning at the mouth of Byram river, which difcharges itfelf into Long-ifland Sound at the S.W. corner of Connecticut, lat. 41°, runs a little E. of N. until it ftrikes the 45th degree of latitude, and then curves to the eaftward, almoft to the gulf of St. Lawrence. Its extreme length is about 626 miles; its breadth is very unequal, from 100 to 200 miles; containing about 72,000 fquare miles. This grand divifion of the United States comprehends the ftates of Vermont, New Hampfhire, Maffachufetts (including the diftrict of Maine), Rhode Ifland and Providence Plantations, and Connecticut; which fee refpectively. The climate of New England is falubrious, as we may infer from the longevity of its inhabitants; one in feven living to the age of 70 years, and about one in thirteen or fourteen to 80 years and upwards. The moft prevalent winds are the N.W., W., and S.W.; but the E. and N.E winds, which are infalubrious, occur frequently at certain feafons of the year, particularly in April and May, on the fea-coafts. The weather is lefs variable than in the middle, and efpecially the fouthern ftates, and more fo than in Canada. The extremes of heat and cold are, according to Fahrenheit's thermometer, from 20° below to 100° above 0; the medium being from 48° to 50°. The quantity of water which annually falls in New England is from 42 to 48, and yet they fuffer here more from drought than in England, where the annual quantity of water is eftimated at about 24 inches. Hence it is inferred that the atmofphere is remarkably dry, and thus fome have accounted for its fingular falubrity. Winter commonly commences, in its feverity, about the middle of December; fometimes earlier, and fometimes not till Chriftmas. The difeafes moft prevalent in New England are alvine fluxes, St. Anthony's fire, afthma, atrophy, catarrh, colic, inflammatory, flow, nervous, and mixed fevers, pulmonary confumption, quinfy, and rheumatifm. The general condition of the New Englanders, which precludes the luxury of the rich and the extreme diftrefs of the poor, affords them an exemption from a variety of difeafes, to which a greater degree of inequality might expofe them. This country prefents to the traveller a great variety of furface, confifting of extenfive plains, intermixed with vallies of different breadths from 2 to 20 miles, and with mountains of different elevations. Although it may be deemed, upon the whole, to be high and hilly, its mountains are comparatively fmall, and run nearly N. and S., in ridges parallel to one another. The wefternmoft range begins in the county of Fairfield, and, paffing through the counties of Litchfield and Berkfhire, unites with the Green mountains at Williamftown, in the N.W. corner of the Maffachufetts, being feparated only by the narrow valley of Hoofack river. The higheft part of this range is Toghkonnuck mountain in Egremont, the fouth-weftern corner of the fame ftate. Over this mountain, elevated probably more than 3000 feet above the ocean, runs the boundary between Maffachufetts, Connecticut, and New York. The fecond range is that of the Green *mountains;* which fee. The third range has the fame commencement with the fecond at New Haven, in a delightful eminence called the Eaft rock, and paffing through the counties of New Haven, Hartford, and Hampfhire, extends into Canada. The Blue hills in Southington, mount Tom, which is the principal eminence, mount Holyoke, and mount Toby in Sunderland, are the principal fummits of this range S. of New Hampfhire. This range, which is precipitous and romantic, croffes Connecticut river juft below Northampton and Hadley in Maffachufetts. The fouth or eaftern range begins at Lyme in Connecticut, and forms the eaftern boundary of the Connecticut valley, until it unites with the laft-mentioned range in the county of Hampfhire; but is lefs diftinctly marked by eminences than the others. The chief fingle mountains are Saddle-mountain in Maffachufetts, computed to be about 4000 feet above the fea, Watchufett in the county of Worcefter, Afclutney in the ftate of Vermont, Monadnock in New Hampfhire, and the White mountains in the fame ftate, of which the higheft fummit is Mount Wafhington, probably between 10,000 and 11,000 feet above the ocean, and the higheft land in the United States. This mountain is covered during a great part of the year with fnow, and is feen in fair weather at the diftance of 90 miles from the fea, and 160 from its bafe. New England abounds in cataracts and cafcades; thofe of the White mountains being fingularly romantic and beautiful. The principal rivers of New England are the Schoduck, Penobfcot, Kennebeck, Amarifcoggin, Saco, Pifcataqua, Merrimack, Parkers, Charles, Taunton, Providence, Thames, Connecticut, Hooeftonnuck or Stratford, Onion, La Moille, and Miffifconi. The largeft of thefe are Penobfcot, Kennebeck, Merrimack, and Connecticut. The chief lakes are Champlain and Memphremagog, lying partly in Vermont and partly in New York; Winnipifiogee and Umbagog in New Hampfhire; Sebago, Moofehead, Willeguenguagun, and Chilmacook or Grand lake in Maine. The moft important and ufeful harbours are thofe of Machias, Frenchman's bay, Wifcaffet, Portland and Wells, in Maine; Pifcataqua in New Hampfhire; Newbury port, Salem, Marble head, Bofton, Provincetown, and New Bedford, in Maffachufetts Proper; Newport, Briftol, and Providence, in Rhode ifland; and New London, New Haven, and Black rock, in Fairfield, in Connecticut. Burlington bay is the moft confiderable harbour in lake Champlain, on the Vermont fhore.

The foil of New England is diverfified by every variety from a lean and barren fand to the richeft clays and loams. The hills are covered with a brown loam intermixed with gravel, which is favourable to the production of grafs, and in the weftern parts of the country, of wheat, and all other kinds of grain and fruits fuited to the climate. Clayey foils, when well manured, are very productive. A rich loam, varying towards clay, is prevalent in Connecticut, and is favourable to every kind of cultivation. Sand is generally found on the plains; and the yellow pine plains, which are commonly a mixture of fand and gravel, are friendly to every production that does not require a richer foil. The white pine plains are ufually covered with loam, and thefe, as well as fome of the laft-mentioned in the fame condition, are uncommonly fertile. The vallies are a rich mould; and the intervals, bordering the various ftreams, are generally fands formed by earth depofited by the floods in the fpring, and are of the richeft quality.

New England, generally fpeaking, is better adapted for grazing than for grain, though a fufficient quantity of the latter is raifed for home confumption, if we except wheat which is largely imported, particularly into Maffachufetts, from the middle and fouthern ftates. Indian corn, rye, oats, barley, buck-wheat, flax and hemp, generally fucceed very well. Fruits of every kind, which fuit a temperate climate, may be obtained in abundance. The fummer heat brings to perfection peaches, apricots, and nectarines. Orchards of apple-trees cover a confiderable part of the whole country, and cyder is the common drink of the inhabitants. Pears, plums, cherries, currants, goofeberries, whortleberries, blackberries, bilberries, &c. abound. Perry is made in fome parts of the country, but not in great quantities. Various fpecies of the hickery and hazle-nuts, and chefnuts are plentifully furnifhed by the fouthern half of New England. Gardening is much improved, and its productions are daily varying and increafing. But the moft important production of New England is grafs. The high and rocky ground is in many parts covered with clover, and affords excellent pafture to fome of the fineft cattle in the world. The quantity of butter and cheefe made for exportation is very great. Confiderable attention is now paid to the raifing of fheep; and the wool is in a ftate of progreffive improvement. The principal exports of New England are mackarel, falmon, cod, and other fifh; whale-oil and whale-bone, timber, mafts, boards, ftaves, hoops and fhingles; horfes, mules, falted beef, and pork, pot-afh, pearl-afh, flax-feed, apples, cyder, corn, butter, and cheefe. New England is the moft populous part of the United States; it contained, in 1790, 1,009,522 perfons, and, in 1800, 1,233,011. The great body of the inhabitants confifts of landholders and cultivators of the foil. As they poffefs in feefimple the farms which they cultivate, they are all naturally attached to their country; and the cultivation of the foil makes them robuft and healthy. New England has been not unaptly denominated a nurfery of men; and hence are annually tranfplanted into other parts of the United States, thoufands of its natives. They are almoft univerfally of Englifh defcent; and to this circumftance, as well as to the general attention that has been paid to education, it is owing that the Englifh language has been preferved among them in fo confiderable a degree of purity. The New Englanders are generally tall, ftout, and well-made. Their education, laws, and fituation ferve to infpire them with high notions of liberty, of which they are jealous, in fome cafes perhaps, to excefs. A chief foundation of freedom in the New England ftates is a law, by which inteftate eftates defcend to all the children, or other heirs, in equal proportion; and hence it happens, that the people of New England enjoy an equality of condition, that is unknown in any other

other part of the world. Befides, they are frugal and induftrious, and inured to habits of fobriety and temperance. Learning is more generally diffufed among all ranks of people in New England than in any other part of the globe; which is owing to the excellent eftablifhment of fchools in every town. In thefe fchools, generally fupported by a public tax, are taught the elements of reading, writing, and arithmetic; and in fome of the principal and more wealthy towns they are purfuing education in a higher fcale, and introducing the fuperior branches of grammar, geography, and other fciences. Literature is alfo encouraged and diffufed by the circulation of newfpapers and periodical publications, and by the eftablifhment of reading focieties and parochial libraries. Curiofity, and a defire of information, are very prevalent in New England; and the common people, it is faid, are diftinguifhed by attention and civility to ftrangers. In former times the New Englanders were ftrict, to a degree of punctilioufnefs, in their obfervance of the fabbath; and hence, as well as from fome other traits of their character, they acquired the character of a fuperftitious and bigotted people. But fince the war, a catholic, tolerant fpirit, occafioned by a more enlarged intercourfe with mankind, has much increafed, and is becoming univerfal. "If," fays Dr. Morfe, "they do not go beyond the proper bounds, and liberalize away all true religion, of which there is very great danger, they will counteract that ftrong propenfity in human nature which leads men to vibrate from one extreme to its oppofite." A cuftom ftill prevails, tranfmitted to the prefent race from their anceftors, of annually celebrating fafts and thankfgivings. In fpring, the governors of the feveral New England ftates, Rhode ifland excepted, proclaim a day of fafting, humiliation, and prayer; and in autumn, after harveft, they appoint a day of public thankfgiving. Many of the women in New England are handfome. Thofe, who have enjoyed the advantages of a good education, and they are numerous, are genteel, eafy, and agreeable in their manners, and are fprightly and fenfible in their converfation. And it is a laudable practice among the females to accuftom themfelves at an early period to the management of domeftic concerns with neatnefs and economy. Employment at the needle, in cookery, and at the fpinning-wheel, is honourable. The women in country towns manufacture the greater part of the clothing of their families. Their linen and woollen cloths are ftrong and decent. Among the amufements of the people of New England is dancing, of which the young people of both fexes are extremely fond. The athletic and healthy diverfions of cricket, foot-ball, quoits, wreftling, jumping, hopping, foot-races, and prifon-bars, are univerfally practifed in the country, and fome of them in the moft populous places, and by people of almoft all ranks. Of the religion of the New Englanders, and of the provifion that is made for the fupport of it, we fhall have occafion to fpeak under the article United States. We fhall here merely obferve, that the conftitution of thefe ftates provides againft the making of any law refpecting an eftablifhment of religion, or prohibiting the free exercife of it. And in the conftitution of the refpective ftates, religious liberty is a fundamental principle. Without the aid of civil power, religion is left to be fupported by its own evidence, by the lives of its profeffors, and the almighty care of its divine author. Its public teachers are maintained by an equal tax on property, by pew-rents, monies at intereft, marriage and burial fees, fmall glebes, land rents, and voluntary contributions. Chriftians profefs their religion under various forms, and with different ideas of its doctrines, ordinances, and precepts. Accordingly the fects of Chriftians are very numerous and various. Of thefe fects, thofe that are called Congregationalifts are the moft numerous. In New England there are about 1200 congregations of this denomination. Next to thefe in refpect of number are Prefbyterians. In New England there are between 40 and 50 Proteftant epifcopal churches.

New England owes its firft fettlement to religious perfecution; and the inhabitants of this country are defcended from thofe that were called Puritans in the mother-country. The firft attempt to form a regular fettlement in this part of America was at Sagahadock in 1607; but in the following year, the whole number of thofe who furvived the winter returned to England. The firft company, that laid the foundation of the New England ftates, planted themfelves at Plymouth, in November, 1620; though this appellation was given to North Virginia by Capt. Smith in Auguft 1614. The founders of the colony confifted of 101 perfons. In 1640, the importation of fettlers ceafed, in confequence of the abatement of perfecution by the change of affairs in England. At this time the number of emigrants, who had traverfed the feas in 298 veffels, from the commencement of the colony, amounted to 21,200 men, women, and children, forming, perhaps, about 4000 families. In 1760, the number of inhabitants in Maffachufetts bay, New Hampfhire, Connecticut, and Rhode ifland, amounted, probably, to half a million. Morfe.

ENGLANTERIA, in *Botany*. See Eglanteria.

ENGLECHERIE, Engleschery, or *Englefchyre*, a term of great import among our anceftors, though now obfolete; properly fignifying the quality of an Englifhman.

If a man were privately flain or murdered, he was anciently accounted francigena (which comprehended every alien, efpecially the Danes) till englecherie was proved, *i. e.* till it was made to appear that he was an Englifhman. Bracton, lib. iii.

The origin of the cuftom anciently fubfifting among the Goths in Sweden and Denmark, was thus: king Canutus, having conquered England, at the requeft of his nobles, fent back his army into Denmark, only referving a guard of Danes for his perfon; and made a law, that if any perfon was murdered, he fhould be fuppofed to be a Dane, if he was not proved to be an Englifhman by his parents or kindred, and, in default of fuch proof, if the murderer was unknown, or had made his efcape, the townfhip where the man was flain fhould be charged to pay fixty-fix marks into the exchequer: or if by reafon of the poverty of the townfhip, that fum could not be raifed from thence, it was to be paid by the hundred. After this law, which was continued by William the Conqueror, for the like fecurity to his own Normans, whenever a murder was committed, it was neceffary to prove the party flain an Englifhman, that the penalty of fixty-fix marks might not be charged on the village. The manner of proving the perfon killed to be an Englifhman was by two witneffes, who knew the father and mother, before the coroner, &c. This practice was abolifhed by ftatute 14 Edw. III. cap. 4. See Murder.

ENGLESQUEVILLE, in *Geography*, a fmall town of France, in the department of the Lower Seine, 18 miles S.W. of Arques. There are feveral fmall towns of the fame name, in the department which comprifes the former province of Normandy.

ENGLISH, in a general fenfe, fomething that relates to the country or people of England. Thus we fay, the Englifh crown, Englifh copperas, Englifh names, Englifh money, Englifh meafures, Englifh weights, &c. The fweating-ficknefs is called by foreigners *fudor Anglicanus*, the

English sweat. (See SUDOR-ANGLICUS.) Dr. Cheyne calls the vapours the English malady.

ENGLISH *Borough*. See BOROUGH.

ENGLISH *Cape*, in *Geography*, a cape on the south coast of Newfoundland. N. lat. 46° 49′. W. long. 53° 29′.

ENGLISH *Cove*, a harbour, or bay, on the coast of New Ireland, about 3 or 4 miles from cape St. George.

ENGLISH *Drops*, *Guttæ Anglicanæ*. See DROP.

ENGLISH *Harbour*, in *Geography*, one of the best harbours in the island of Antigua, situated on the S.W., a little to the E. of Falmouth harbour. It is well fortified, and has a royal navy-yard and arsenal, with conveniences for careening ships of war. N. lat. 17° 8′ 25″. W. long. 61° 27′ 30″.

ENGLISH *Point*, a cape in the river St. Lawrence, on the coast of Canada. N. lat. 49° 40′. W. long. 61° 45′.

ENGLISH *Reach*, a reach in the straits of Magellan, about 3 leagues broad, between cape Gallant and cape Holland.

ENGLISH *Road*, a road in the island of Eooa, or Middleburgh, in the South Pacific ocean, having 25 fathoms water. S. lat. 21° 20′. W. long. 174° 34′.

ENGLISH *School of Engraving*. See ENGRAVING.

ENGLISH, or the ENGLISH *Tongue*, the language spoken by the people of England; and with some variation, by those of Scotland, as well as part of Ireland, and the rest of the British dominions.

The English is of Gothic, or Teutonic extraction; this was the root or stock upon which several other dialects have been since grafted, particularly the Latin and French. See TEUTONIC, &c.

The language anciently spoken in our island was the British, or Welsh, which was common to the Britons and Gauls; and which still subsists, in more or less purity, in the principality of Wales, the islands and Highlands of Scotland, part of Ireland, and some provinces of France, particularly Bretagne, and very lately subsisted in the county of Cornwall. (See CORNISH *Language*.) This language was the Celtic or Gaelic, which is said to be very copious and expressive, and is, probably, one of the most ancient languages in the world. It once obtained in most of the western regions of Europe: and now remains in the different dialects of the Irish, Welsh, and Erse. See CELTS.

As the Roman empire, extending itself towards the western parts of Europe, under Julius Cæsar, Claudius, and Domitian, came to take in Gaul and Britain, the Roman tongue became propagated therewith; all the edicts, &c. relating to the public affairs, being designedly wrote in that language.

The Latin, however, it is certain, never got so much ground, or prevailed so far in England, as in Lombardy, Spain, and the Gauls; partly on account of its great distance from Rome, and the small resort of Romans hither; and partly, because the entire reduction of the kingdom was not effected till so late as the reign of Claudius, when the empire was on the declining hand, and the new province was forced to be soon deserted by its conquerors, called to defend their territories nearer home.

Britain, thus left naked, became an easy prey to the Angli, or Anglo-Saxons, a strolling nation, from Jutland and Norway, who took an easy possession thereof about the year 450, much about the time that the Franks, another German nation, entered Gaul. The Gauls and Franks, it seems, at length came to terms; found means to unite into one nation; and thus, the ancient Gaulish, with its mixture of Latin, continued the prevailing tongue, only farther intermixed with the Francic or lingua Franca of the new inmates; but the Britons were more constant, and determined absolutely to refuse any such coalition: they had embraced Christianity, Augustine being sent from Rome to convert them about the year 570, and their competitors were heathens; rather than admit of such an union, they therefore chose to be shut up, with their language, in the mountainous parts of Cambria or Wales.

The English Saxons, thus left absolute lords, changed every thing; their own language, a dialect of the Gothic or Teutonic, and altogether distinct from the Celtic, was now fully established, and laid the foundation of the present English tongue: and the very name of the country was henceforth to be Anglo-Saxon. (See ANGLO-SAXON.) The new language remained, in good measure, pure and unmixed, till the Norman invasion: the attempts of the Danes, and the neighbourhood of the Britons, indeed, wrought some lesser innovations therein; but, in the main it preserved itself; for, as to the Danes, their language was, probably, from the same root with the Saxon; and it did not long remain a distinct tongue in any part of England, but was blended with the Anglo-Saxon, and formed a particular dialect of that language.

This Dano-Saxonic dialect was principally spoken in the kingdom of Northumberland, where the Danes chiefly prevailed: that the Anglo-Saxon language was spoken in the S.E. parts of Scotland at this time is undeniable. When Edgar the Peaceable, king of England, yielded Lothian to Kenneth II. king of Scotland, A.D. 975, it was on these express conditions; that the people of that country should still be called Englishmen, be governed by the English laws, and be allowed to speak the English language.

Edward the Confessor, however, who had lived long in France, might possibly bring in a little mixture of the dialect of that country.

But William I. and his Normans, having got possession of England, an alteration was soon attempted: the conquest was not complete, unless the Conqueror's language, the French and Franco-Gallic, were introduced; and accordingly all his acts, diplomas, edicts, pleadings, and other judicial matters, were written, &c. in that tongue.

But his attempts proved unsuccessful; the number of Normans he brought over being very small in comparison of the English, with whom they were incorporated, they lost or forgot their own language, sooner than they could make any change in the English. This, however, did not hinder, but, by the endeavours of the Conqueror, abundance of French words, though many of them of Latin original, crept into the English; and many English words, by degrees, grew out of use. Hence it happened, that the English, which was spoken afterwards, and continues to be spoken now, is a mixture of the ancient Saxon and this Norman French, together with such new and foreign words as commerce and learning have in the progress of time gradually introduced. See ANGLO-SAXON.

Upon the whole it appears, that the Teutonic dialect is the basis of our present speech. It has been imported among us in three different forms, the Saxon, the Danish, and the Norman; all which have mingled together in our language, so that it may be supposed to exist in three different periods, *viz.* Anglo-Saxon, Danish-Saxon, and Norman-Saxon. The first begins with the Saxon invasion, the second with the Danish, and the third with the Norman. Some have made the properly English period to commence with Edward I., towards the close of the 13th century; others have referred it to the 14th century; and others again have thought that it ought rather to commence with Henry VIII.; as the controversies of the Reformation were in fact the cause which then abolished the Norman dialect of the court, and introduced the present common English to our worship and to our literature. Many of our words are alfo plainly derived from the Latin. But thefe were not introduced directly from the Latin; whereas moft of them, probably, entered into our tongue through the channel of that Norman French, which William the Conqueror introduced. For, as the Romans had long been in full poffeffion of Gaul, the language fpoken in that country, when it was invaded by the Franks and Normans, was a fort of corrupted Latin, mingled with Celtic, to which was given the name of Romanfh; and as the Franks and Normans did not, like the Saxons in England, expel the inhabitants, but, after their victories, mingled with them; the language of the country became a compound of the Teutonic dialect imported by thefe conquerors, and of the former corrupted Latin. Hence, the French language has always continued to have a very confiderable affinity with the Latin; and hence, a great number of words of Latin origin, which were in ufe among the Normans in France, were introduced into our tongue at the conqueft: to which, indeed, many have been fince added, directly from the Latin, in confequence of the great diffufion of Roman literature throughout all Europe. From the influx of fo many ftreams, or the junction of fo many diffimilar parts, it naturally follows that the Englifh, like every compounded language, muft neceffarily be fomewhat irregular. We cannot expect from it, fays Dr. Blair (Lectures, &c. vol. i.) that correfpondence of parts, that complete analogy in ftructure, which may be found in thofe fimpler languages, which have been formed in a manner within themfelves, and built on one foundation. Hence, it has but fmall remains of conjugation or declenfion; and its fyntax is narrow, as there are few marks in the words themfelves that can fhew their relation to each other, or, in the grammatical ftyle, point out either their concordance, or their government, in the fentence. Our words having been brought to us from feveral different regions, ftraggle, if we may fo fpeak, afunder from each other; and do not coalefce fo naturally in the ftructure of a fentence, as the words in the Greek and Roman tongues. But thefe difadvantages, if they be fuch, of a compound language, are balanced by other advantages that attend it; particularly by the number and variety of words with which fuch a language is likely to be enriched.

As to the origin and etymology of many of our words, Dr. Wallis lays it down, that fuch words of German original as we have, in common with the French, are to be reckoned as our own, rather than as words borrowed from them; and that the old Gaulifh words, common to the French and the Welfh, which are found in our language, have been likewife taken from the Welfh, rather than from the French. Hence, alfo, the fame author accounts why the names of the divers forts of cattle are Saxon; as ox, cow, calf, fheep, hog, boar, deer, &c. and yet that their flefh, when prepared for food, is French; as beef, veal, mutton, pork, brawn, venifon, &c. the Norman foldiers not concerning themfelves with paftures, parks, and the like places, where fuch creatures are fed and kept, fo much as with markets, kitchens, feafts, and entertainments, where the food was either prepared, fold, or eaten.

Under Henry II., Dr. Swift obferves, the French made a ftill greater progrefs; becaufe of the large territories he poffeffed on that continent, both from his father and his wife, which occafioned frequent journies thither, with numerous retinues, &c. And for fome centuries after, there was a conftant intercourfe between France and England, by the dominions we poffeffed there, and the conquefts we made; fo that the language, two or three hundred years ago, feems to have had much more French than at prefent.

Befides this alteration from the conquerors, the language in procefs of time underwent feveral others; and at length came to have numerous words and phrafes of foreign dialects ingrafted into it, in lieu of the ancient Saxon; particularly, by means of negociations and commerce with other nations; by the marriages of royal families; by the affectation of many writers, in moft ages, who are fond of coining new words, and altering the ufual forms of fpeech, for the greater delicacy; and, by the neceffity of framing or borrowing new words, according as new things and inventions turn up: and by fuch means was the old Anglo-Saxon converted into the prefent Englifh tongue. See ANGLO-SAXON.

Having traced the rife and progrefs of our language hiftorically, we think it may be no incurious amufement to reprefent by actual examples the feveral fucceffive changes and ftages it has paffed through, to arrive at its prefent perfection: in order to which, we fhall make ufe of the collections of the ingenious Mr. Greenwood.

From the Saxon invafion, we have no memorial extant of the language for 250 years: the oldeft Saxon writing in being is a glofs on the evangelifts, written in the year 700, by Eadfride, bifhop of Holy Ifland; in which the three firft articles of the Lord's Prayer run thus:

" Uren Fader thic arth in heofnas, fic gehalgud thin noma, to cymeth thin ryc. Sic thin willa fue is in heofnas, and in eortho," &c. See ANGLO-SAXON.

Two hundred years after, in the year 900, the fame was rendered thus:

" Thu ure Fader the eart on heofinum, fi thin nama gehalgod; cum thin ric. Si thin willa on eorthan fwa, fwa on heofinum."

In the following age it was turned thus in the Saxon Homilies, faid to be tranflated by king Alfred:

" Fæder ure thu the earth on heofenum, fi thin nama gehalgod, to be cume thin rice, gewurthe thin willa on eoarthan fwa, fwa on heofnum," &c.

About the year 1160, under Henry II., near which period the Saxon began to affume a form in which the beginning of the prefent Englifh may be difcovered; it was thus rendered by pope Adrian, an Englifhman, in rhyme:

" Ure Fader in heaven rich,
Thy name be hayled ever lich,
Thou bring us thy michell bliffe:
Als hit in heaven y-doe
Evar in yearth beene it alfo," &c.

About 100 years after, in the time of Henry III., it was tranflated thus:

" Fadir that art in heaven bliffe,
Thin helge nam it wurth the blifs,
Cumen & mot thy kingdom,
Thin holy will be it all don,
In heaven and in erdh alfo," &c.

Two hundred years after, under Henry VI., it was rendered thus:

" Our Fadir that art in hevenes, halewid be the name, thi kingdom come to thee, be thi will don in eerthe, as in hevene."

Dr. Hickes furnifhes an extraordinary fpecimen of the Englifh, as fpoken in the year 1385, in his Thefaur. Liter. Septent. which we fhall the rather amufe the reader with, as it is on this very fubject, the Englifh tongue; and contains not only the hiftory, but the reafon of the changes and differences therein:

" As it is knowe how meny maner peple beeth in this lond; there beeth alfo fo many dyvers longages and tonges. Nothelefs Walfche men and Scots that beeth nought medled with

with other nations, holdeth wel nyh hir firſt longage and ſpeche: but yif the Scottes that were ſometime confederat and woned with the Pictes drawe ſomewhat after hir ſpeche; but the Flemynges that woneth in the weſte ſide of Wales, haveth left her ſtrange ſpech, and ſpeketh Sexonliche now. Alſo Engliſhe men, they had from the bygynnynge thre maner ſpeche; northerne, ſowtherne, and middel ſpeche in the middel of the londe, as they come of three maner of peple of Germania: nothelefs by commyxtion and mellynge firſt with Danes, and afterwards with Normans, in meny the contrary longage is apayred [corrupted.] This appayrynge of the burthe of the tunge is bycauſe of tweie thynges, oon is for children in ſcole agenſt the uſage and maner of all other nations, beeth compelled for to leve hire own longage, and for to conſtrue hir leſſons and here thynges in French, and ſo they haveth ſethe Normans come firſt into Engelond. Alſo gentlemen children beeth taught to ſpeke Frenſche from the tyme that they beeth rokked in here cradel, and kunneth ſpeke and play with a childes broche; and uplondiſſche men will linke hymſelf to gentilmen, and fondeth with great beſyneſſe for to ſpeake Frenſche to be told of. Hit ſeemeth a greet wonder how Engliſche men and her own longage and tonge, is ſo dyverſe of ſown in this oon ilond; and the longage of Normandie is comlynge of another lond, and hath oon manner ſoun amonge alle men that ſpeketh hit arigt in Engelond. Alſo of the foreſaid Saxon tonge that is deled [divided] a three, and is abide ſcarceliche with few uplondiſſche men, is greet wonder. For men of the eſt, with men of the weſt, is, as it were, under the ſame partie of hevene acordeth more in ſownygne of ſpeech, than men of the north, with men of the ſouth. Therefore it is that Mercii, that beeth men of myddel Engelond, as it were parteners of the endes, underſtondeth bettre the ſide longages northerne and ſoutherne, than northerne and ſoutherne underſtondeth either other. All the longage of the Northumbers, and ſpecialliche at York, is ſo ſcharp, ſlitting and frotynge, and unſchape, that we ſoutherne men may that longage unnethe underſtonde. I trow that that is by cauſe that they beeth nyh to ſtrange men and nations, that ſpeketh ſtrongliche, and alſo bycauſe that the kinges of Engelond wonneth alwey fer from that cuntry," &c.

The firſt of our authors, who can properly be ſaid to have written Engliſh, was ſir John Gower, who, in his Confeſſion of a Lover, calls Chaucer his diſciple.

How the Engliſh ſtood about the year 1400, may be ſeen in Chaucer, who refined and improved it very conſiderably; though he is charged with the affectation of mixing too many French and Latin words with his Engliſh, and by that means, with too much altering and corrupting the primitive language.

In the year 1537, the Lord's Prayer was printed according to the following verſion:

" O oure Father which arte in heven, halowed be thy name: let thy kingdome come, thy will be fulfiled as well in erth as it is in heven," &c.

Where the reader will obſerve the diction almoſt brought to the preſent ſtandard; the variations being principally in the orthography. See an hiſtorical view of the progreſs of the Engliſh language, with ſpecimens at different periods, from the age of Alfred to that of Elizabeth, in the Introduction to Dr. Johnſon's Engliſh Dictionary, vol. i. fol.

Spencer, who lived in the ſame age, contributed not a little to the improvement and refining of the tongue: he threw aſide abundance of the outlandiſh ornaments, and wrote a purer Engliſh, yet with more elegance and variety than had been known before. He was ſucceeded by Shakeſpeare, Ben. Johnſon, lord Bacon, Milton, Cowley, Waller, Tillotſon, Dryden, Addiſon, and Pope, &c. whoſe works are in every body's hands; and by whom the language has been tranſmitted to us under all its preſent advantages.

The perfections aſcribed to the Engliſh, and alſo in a degree ſuperior to any of the modern tongues, are, 1. That it is very ſtrong and ſignificant; to which our finely compounded words, formed on the model of the Greeks, do not a little contribute.

This may alſo be partly aſcribed to the national character of the people who ſpeak it, from which language is apt to receive its predominant tincture. Thus, the gravity and thoughtfulneſs, as well as the ſtrength and energy, of the Engliſh, and alſo the gaiety and vivacity of the French, are ſufficiently impreſſed on their native tongues. However, though the Engliſh language poſſeſſes diſtinguiſhing ſtrength and energy, it is naturally prolix, on account of the great number of particles and auxiliary verbs, which in the uſe of it we are obliged conſtantly to employ; and this prolixity muſt, in ſome degree, enfeeble it. We ſeldom can expreſs ſo much by one word as was done by the verbs, and by the nouns, in the Greek and Roman languages. Our ſtyle is leſs compact; our conceptions being ſpread out among more words, and ſplit, as it were, into more parts, make a fainter impreſſion when we utter them. Notwithſtanding this defect, as our language abounds in terms for expreſſing all the ſtrong emotions of the mind, and we have the liberty, in a greater degree than moſt nations, of compounding words, it may be eſteemed to poſſeſs conſiderable force of expreſſion; more eſpecially when we compare it with the other modern tongues, though much below the ancient. The ſtyle of Milton alone, both in poetry and proſe, affords ſufficient evidence, that the Engliſh tongue is far from being deſtitute of nerves and energy.

2. The Engliſh language is copious; of which Mr. Greenwood gives us inſtances in the word ſtriking; which we have above thirty different ſynonymous expreſſions for; as *to ſmite*, *bang*, *beat*, *baſt*, *buffet*, *cuff*, *hit*, *thump*, *thwack*, *ſlap*, *rap*, *tap*, *kick*, *ſpurn*, *box*, *yerke*, *pummel*, *punch*, &c. and the word *anger*, for which he enumerates above forty. So we ſay *to ſeeth* or *boil* fleſh, *ſtew* prunes, *poche* eggs, *coddle* apples, *bake* bread; for which expreſſions, *to ſeeth*, *ſtew*, *poche*, *coddle*, and *bake*, the Latins, with all the boaſted copia of the tongue, have only one word, *coquere;* and the French, as much as they abound with terms of cookery, not many more; the word *cuire* ſerving indifferently for *ſeething*, *boiling*, *baking*, *ſtewing*, and *codling*.

Indeed, few languages are more copious than the Engliſh. In all grave ſubjects eſpecially, hiſtorical, critical, political, and moral, no writer can juſtly complain of the barrenneſs of our tongue. We are alſo rich in the language of poetry. Our poetical ſtyle differs widely from proſe, not in point of numbers only, but in the very words themſelves; which ſhews what a ſtock and compaſs of words we may ſelect and employ, ſuited to different occaſions. In this reſpect we are infinitely ſuperior to the French, whoſe poetical language, if it were not diſtinguiſhed by rhyme, would not be known to differ from their ordinary proſe. It is chiefly, however, on grave ſubjects, and with reſpect to the ſtronger emotions of the mind, that our language diſplays its power of expreſſion. But, in deſcribing the more delicate ſentiments and emotions, our tongue is not ſo fertile; and we muſt acknowledge its inferiority to the French. This is, perhaps, the happieſt language for converſation in the known world; but, on the higher ſubjects of compoſition, it is much excelled by the Engliſh.

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3. The Englifh language is not deftitute of flexibility, This power of accommodation to different ftyles and manners, fo as to be either grave and ftrong, or eafy and flowing, or tender and gentle, or pompous and magnificent, as an author's genius prompts or occafions require, is a quality of great importance both in fpeaking and writing. This property of a language feems to depend upon three things: its copioufnefs; the different arrangements of which its words are fufceptible; and the variety and beauty of the found of thofe words, fo as to correfpond to many different fubjects. The Greek poffeffed this property in a fupereminent degree; the Latin was, in this refpect, inferior to it; and among the modern tongues, the Italian poffeffes flexibility in a greater degree than the French; and though our language has lefs of it than the Italian, it poffeffes a confiderable degree of this quality. If any one will confider the diverfity of ftyle which appears in fome of our claffics; that great difference of manner, for inftance, which is marked by the ftyle of lord Shaftefbury, and that of dean Swift; he will perceive, in our tongue, fuch a circle of expreffion, fuch a power of accommodation to the different tafte of writers, as redounds not a little to its honour.

4. Some have challenged to the Englifh language the praife of being mufical and harmonious; and in this refpect Mr. Dennis makes no fcruple to affert it fuperior even to the French. This, which fome may think ftrange, he proves hence, that we have blank verfe which is harmonious by mere force of numbers and quantity; whereas the French have long ago defifted from all pretenfions to poetical numbers, without the affiftance of rhyme.

It may be added on this laft head, from Mr. Welftead, that the Englifh has many meafures, the iambic and trochee, for inftance, in common with the Greek and Latin; an advantage arifing from the variation of the accent; and that rhyme is peculiarly natural to it, varying itfelf to the ear with exceffive fweetnefs; not to mention the cæfuras, paufes, tranfpofitions, and numberlefs other graces, which the Englifh verfification is capable of, probably beyond every other living language.

The Englifh has, indeed, been reproached on account of its deficiency in harmony of found; but the charge has been extended too far. The melody of our verfification, and the power which our language poffeffes of fupporting poetical numbers, without any affiftance from rhyme, afford fufficient proof that our language is far from being unmufical. Next to the Italian, our verfe is the moft diverfified and harmonious of any of the modern dialects; and far exceeds the French in variety, fweetnefs, and melody. Mr. Sheridan has fhewn, in his Lectures, that we abound more in vowel and diphthong founds than moft languages; and thefe, too, fo divided into long and fhort, as to afford a proper diverfity in the quantity of our fyllables. Our confonants, he obferves, though they appear crowded to the eye on paper, often form combinations not difagreeable to the ear in pronouncing; and, in particular, the objection which has been made to the frequent recurrence of the hiffing confonant *s* in our language is unjuft and ill-founded: for this letter frequently lofes the hiffing found, efpecially in the final fyllables, and is transformed into a *z*, affording a found on which the ear can reft with pleafure. After all, it muft be allowed, that ftrength and expreffivenefs, more than grace and melody, are the diftinguifhing properties of the Englifh tongue. It is a remarkable peculiarity of Englifh pronunciation, that the accent is thrown farther back, or nearer the beginning of a word, than is done by any other nation; and the general effect of this practice of haftening the accent is to give a brifk and a fpirited, but at the fame time a rapid and hurried, and not very mufical tone to the whole pronunciation of a people.

5. The Englifh tongue is, without doubt, the moft fimple in its form and conftruction of all the European dialects. It is free from all intricacy of cafes, declenfions, moods, and tenfes. The words are fubject to fewer variations from their original form than thofe of any other language. Its fubftantives have no diftinction of gender, except what nature has made, and but one variation in cafe. Its adjectives admit of no change at all, except what expreffes the degree of comparifon. Its verbs, inftead of running through all the varieties of ancient conjugation, fuffer no more than four or five changes in termination. By the help of a few prepofitions and auxiliary verbs, all the purpofes of fignificancy in meaning are accomplifhed; while the words commonly preferve their form unchanged; which ftructure, though it has its difadvantages in point of elegance, brevity, and force, contributes to facility. However, bifhop Lowth has obferved in the Preface to his Grammar, that the fimplicity and facility of our language occafion its being frequently written and fpoken with lefs accuracy. See Grammar, Language, Style, Syntax, &c.

Some object to the Englifh, that it confifts too much of monofyllables; which others reprefent as an excellence, becaufe it argues a greater antiquity, if what Salmafius fays be true: Certum quippe eft, linguas omnes, quæ monofyllabis conftant, cæteris effe antiquiores;" he adds, that the "ancient Greek abounded herein, as appears from the ancient poets, and fuch as affected antiquity." De Re Hellenift.

But we have a farther advantage from our monofyllables, *viz.* "concifenefs;" as we are hereby enabled to exprefs more matter in the fame compafs of letters than any other modern tongue. The only thing we fuffer by it, is, fomething in point of foftnefs and numbers; and yet we have verfes compofed wholly of monofyllables, that do not want harmony; as that of Creech,

"Nor could the world have borne fo fierce a flame."

Others object to our language, that it does not equal the foftnefs, the delicacy, of the more fouthern languages, of France, Spain, and Italy. It feems to retain fomewhat of the Gothic roughnefs of the people who framed and introduced it; the foil and climate it was planted in, not tending much to mellow and refine it.

To this purpofe does Dr. Swift fpeak, who accounts for the effect hence, that the Latin tongue was never in its purity in our ifland; and befides, it was removed, in its imperfect ftate, before it could have time to incorporate with the language of the country, and fubdue and foften it, as it did in the other provinces of France and Spain, &c. But it is to be obferved, that, upon the whole, this, fuppofing it true, does not lie as an objection againft the language, but the people: our manners are alfo lefs polifhed than fome of our neighbours; we are not yet arrived at that pitch of moleffe, of delicateffe, of foupleffe, which we cenfure in them; and it is but juft our language correfpond with the reft of our character.

Mr. Welftead is of opinion, that the Englifh language is not capable of a much greater perfection than it has already attained. We have trafficked, he obferves, with every country for the enriching of it; the ancients and moderns have both contributed to give it fplendour and magnificence; the faireft cyons that could be had from the gardens of France and Italy, have been grafted on our old ftocks, to refine the favagenefs of the breed; we have laid

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aſide moſt of our harſh, antique words, and retained few but thoſe of good and ſound energy: the moſt beautiful poliſh is at length given to our tongue that it will bear, without deſtroying and altering the very baſis and ground work of it; its Teutonic ruſt is worn away, and little or nothing is wanting either of copiouſneſs or harmony. He goes on to argue the maturity and perfection of the Engliſh, from another very extrinſic principle, *viz.* by comparing the time and circumſtances of the improvements made ſince the firſt refiners of it; with thoſe of the Greek, Latin, French, and other tongues that confeſſedly have riſen to their height.

Every civilized nation, that author thinks, has its claſſical age; and he ſuggeſts, that the Engliſh are not far from it. So that what remains to be done for the Engliſh tongue, ſhould not be to advance, but to fix it where it is, and prevent its declining. There is, in effect, a point of perfection, which when a language has once arrived at, it cannot exceed, though it may degenerate from it; and thus it happened to the two fineſt languages that the world has known.

It may ſeem odd to talk of fixing ſo unſtable a thing as language: the Greek liturgies of St. Baſil, and St. Chryſoſtom, ſtill uſed in that church, the one for ſolemn, the other for common days, have been a long time unintelligible to the people; ſo much has the vulgar Greek degenerated from its original purity! Polybius teſtifies, that the articles of truce between the Romans and Carthaginians could ſcarcely be underſtood by the moſt learned Roman antiquaries, three hundred and fifty years after the time in which they were made. In effect, from the days of Romulus to thoſe of Julius Cæſar, the Latin was perpetually changing; and what was written three hundred years before Tully, was as unintelligible in his time as the Engliſh and French of the ſame period are now; and theſe two have changed as much ſince William the Conqueror, in about eight hundred years, as the Latin appears to have done in a like term.

Whether our language will decline as faſt as the Roman did, may admit of ſome doubt; there being many circumſtances in the affairs of the nation, which contributed to that ſpeedy corruption, that may not, in all probability, find place among us. The French, for about two centuries paſt, has been poliſhing as much as it will bear; and it appears to be now declining, by the natural inconſtancy of that people, and the affectation of ſome late authors, to introduce cant words, which is the moſt ruinous corruption in any language. But without ſome ſuch conſideration there does not ſeem any abſolute neceſſity, why a language ſhould be perpetually changing.

We find examples to the contrary: from Homer to Plutarch, are above a thouſand years; and ſo long, at leaſt, Dr. Swift thinks, we may allow the purity of the Greek; the Grecians ſpread their colonies round all the coaſts and iſlands of Aſia Minor, and the Ægean ſea, where the language was preſerved entire for many ages after they themſelves became provinces to Rome, and were over-run by the barbarous nations. The Chineſe have books in their language above two thouſand years old; neither have the frequent conqueſts of the Tartars been able to alter it. And the German, Spaniſh, and Italian, have admitted few or no changes for ſome ages paſt.

On ſuch conſiderations, that author moved the then prime miniſter, the earl of Oxford, to eſtabliſh a ſociety, or academy, for the ſettling, and aſcertaining, the purity of our tongue; to ſet a mark on the improprieties which cuſtom has made familiar, to throw out vicious phraſes and words, to correct others, and perhaps retrieve ſome others now grown obſolete, and to adjuſt the orthography, pointing, &c.

Without ſome ſuch means, he complains that the fame any writer can expect will be ſo ſhort and ſcanty, as by no means to be a ſufficient motive to call forth, and engage a man to exert his genius. Our language is chiefly confined to theſe two iſlands; and it is hard our authors' fame ſhould be limited in time as well as place. Were it not for the Bible and Common-Prayer, we ſhould hardly have been able to underſtand any thing written about two centuries ago.

It is a melancholy reflection, that Petrarch ſtill ſpeaks good Italian; whereas Chaucer, who lived an hundred years later, is not to be underſtood by an Engliſh reader without a Saxon and French gloſſary. And what ſecurity has Dryden himſelf, while things continue on their preſent footing, that he ſhall not, in a like ſpace of time, become as obſolete as Chaucer is?

Grammars and dictionaries, with whatever care and judgment they are compoſed, will prove but a feeble ſtay to a fleeting language, unleſs they have ſome extraordinary ſanction and authority. And, what is to be lamented, ſuch writings have contributed to the corruption almoſt as much as the perfection of our tongue.

Dr. Gill, Ben Johnſon, and Hexham, it is certain, by forcing the Engliſh tongue to the Latin method, have clogged and perplexed it with abundance of uſeleſs precepts concerning caſes, genders, and declenſion of nouns, tenſes, moods, and conjugations of verbs, and other things which our language has nothing to do with. Nor have even Dr. Wallis, Greenwood, &c. though ſenſible of the fault in thoſe others, been able wholly to keep clear of it themſelves. See STYLE.

ENGLISH *Town*, in *Geography*, a ſmall village in the north-weſtern part of Monmouth county, in New Jerſey, on the road from Princeton to Shrewſbury; 21 miles from the former, and ſix W. of Monmouth court-houſe.

ENGLISH *Turn.* See DETOUR *Des Anglois.*

ENGLSTAIN, a town of Germany, in the archduchy of Auſtria; ſix miles N.W. of Zwetl.

ENGONASIS, Εγγονασις, in *Aſtronomy*, Hercules; one of the northern conſtellations. See HERCULES.

ENGOUTED, in *Falconry*, is ſaid of a hawk's feathers, when they have black ſpots in them.

ENGRAFTING. See GRAFTING.

ENGRAILED, or INGRAILED, in *Heraldry*, (from the French *grêle*, hail) is when a thing is repreſented with its edges ragged, or notched, ſemi-circularly, as if broken by ſomething falling on it. See INDENTED and INVECTED.

Spelman expreſſes it in Latin by *imbricatus;* others by *ingrediatus;* and others by *ſtriatus.*

ENGRAPPLE. This is a device in uſe principally in *Naval Warfare*, where it is intended to retain an enemy's veſſel in ſome particular poſition, eſpecially for the purpoſe of boarding. When an opportunity may offer of grappling acroſs a ſhip's bows, or ſtern, ſo as to allow raking her fore and aft, the battle is uſually but of ſhort duration; it being almoſt impoſſible for a crew to ſtand to their guns while ſubject to ſo deſtructive a fire. Generally we find, that when a commander is intent on boarding his opponent, he has his yard-arms ſupplied with ſmall grapnails, which being lowered down at pleaſure, among the enemy's rigging, hook therein, and thus prevent her from retiring to avoid the boarders. Sometimes poles, having long barbs at their ends, are uſed for the ſame purpoſe; theſe are chiefly managed by the forecaſtle-men, and have their butts laſhed to the *davit*, or to the *cat-head.* Whatever contrivance may be in uſe for engrappling, it is expedient that the implement be every where ſufficiently ſolid or firm to retain its hold, and

and to refift the hatchet, otherwife the enemy would fpeedily cut them away: thus, all grap-nails fhould be fufpended by means of chains, paffed through blocks at the yard-arms; nor fhould the tackle, by which they are acted upon, be hauled tight until the points of the grap-nails may be firmly hooked among the fhrowd-hawfers, or fome fuch fubftantial part of the enemy's rigging, which he could not, with fafety to his mafts or yards, cut away. Where it is practicable, a very ftrong chain fhould be paffed round the whole of the fhrowd-hawfers of that maft, refpectively, oppofite which the veffel is engrappled; or, if that be too hazardous, the chain-plates may be fecured in a fimilar manner. It is evident, that were the former to be all included, the enemy muft cut away every fupport on that fide his maft, before he could extricate himfelf: in the latter inftance, as the chain-plates are of iron, and very fubftantial, nothing but the chain, whereby they are embraced, giving way, could afford the means of feparation.

Sometimes fhips become fortuitoufly engrappled, by the flukes of their anchors hooking among the rigging of the veffels oppofed to them: this, however, is feldom permanent; for as the engrappling arifes from accident, fo does a lift, or heave of the fea, ordinarily fet the parties at liberty, either by tearing away whatever hitches upon the fluke, or by caufing the latter to unhook itfelf. Where the fea runs high, this is often the cafe; expofing both veffels to the moft imminent danger, and always caufing confiderable damage. Hence, it fhould ever be confidered by a commander, how far the fafety of his fhip may become queftionable in the attempt to approach his opponent, when there is much fwell. The practice of engrappling is, indeed, but rarely reforted to in fhips of the line, or even by frigates; but is extremely common among privateers abounding in men, and intent upon bringing an engagement to a very fpeedy iffue, fo as to fave their hulls and rigging from fuch damages as might compel them to feek a port wherein to re-fit.

ENGRAVER, one who practifes the art of engraving. See ENGRAVING.

ENGRAVER'S *Act*, the act for fecuring the copy-right of engraved prints. That engravers might enjoy the fair advantages arifing from the exercife of their own talents, and that the public at large might in due time fucceed to fuch advantages, an act of parliament was paffed in the 8th year of Geo. II., "for the encouragement of the arts of defigning, engraving, and etching hiftorical and other prints, by vefting the properties thereof in the inventors and engravers, during a time therein mentioned."

After thus vefting the property for the term of *fourteen* years, to commence from *the day* of publication, it enacts that the name of the proprietor fhall be engraved on each plate; "and any printfeller, or other perfon, who fhall engrave, etch, or in any other manner copy, and fell, or caufe to be engraved, etched, or copied and fold, in the whole or in part by varying, adding to or diminifhing from the main defign, or fhall print, reprint, or import for fale any fuch print or prints, "without the confent of the proprietor firft had and obtained in writing," figned by him in the prefence of two credible witneffes, or knowing the fame to be fo printed, &c. without confent of the proprietor, fhall publifh, fell, or expofe to fale, then fuch offender "fhall forfeit the plate or plates" on which fuch print or prints are or fhall be copied, and all and every fheet or fheets (being part of or whereon fuch print or prints are or fhall be fo copied or printed) "to the proprietor or proprietors of fuch original print or prints," who fhall forthwith deftroy the fame. And further, that every fuch offender fhall forfeit five fhillings for every print which fhall be found in his cuftody, either printed and publifhed, or expofed to fale; one moiety to the king and the other to the informer.—*Note*, Thefe penalties do not extend to purchafers of plates from the original proprietors (f. 2.): and actions for offending againft this act muft be brought within three months (f. 3.)

The act of 7 Geo. III. c. 38. after reciting that the preceding act had been found ineffectual, enacts, that the original inventors, defigners, or engravers of any print, "map, chart, or plan, or any other print whatfoever," taken from any picture, drawing, or fculpture, are entitled to the benefit and protection of the recited and prefent acts; and by (fect. 7,) *extends* the rights intended to be fecured by this and the former act to the term of *twenty-eight* years.

A fubfequent act (paffed in the 17th of Geo. III.) ftates, that the former acts have not anfwered the purpofes for which they were intended, and that it is neceffary for the encouragement of artifts, that further provifions fhall be made. It therefore enacts, that if any engraver, etcher, printfeller, or other perfon, fhall, within the time limited by the aforefaid acts, engrave or etch, or caufe, or procure to be engraved or etched, or worked, in "mezzotinto, or chiaro-fcuro, or otherwife," copy; or who fhall print, re-print, or import for fale, any copy of any hiftorical print, or any portrait, converfation, landfcape, or architecture, map, chart, or plan, or any other print whatfoever, which hath, or have been, or fhall be engraved, etched, drawn, or defigned "in any part of Great Britain," without the exprefs confent of the proprietors firft had and obtained in writing, then every fuch proprietor fhall and may in a fpecial action on the cafe to be brought againft the offending party, recover *fuch* damages *as a jury* on the trial of fuch action, upon the execution of a writ of enquiry thereon, "fhall give or affefs," together with "double cofts of fuit."

The following are the moft important cafes which have fubfequently occurred, and which are introduced to fhew the legal conftruction which has been put upon the aforefaid act of parliament, by magiftrates of high authority.

In the fittings after Hilary term, 25 Geo. III. before lord chief juftice Mansfield, Sayer brought an action againft Moore for pirating fea charts. The charts which had been copied were four in number, which Moore had made into one large map. It appeared in evidence that the defendant had taken the body of his publication from that of the plaintiff; and that the plaintiff had originally been at great expence in procuring materials for thefe maps; but it was alfo proved that the defendant had made many material alterations and improvements thereupon. Lord Mansfield's addrefs to the jury upon this occafion is remarkable and important. "The rule of decifion in this cafe, he obferved, is a matter of great confequence to the country: in deciding it we muft take care to guard againft two extremes equally prejudicial; the one, that men of ability who have employed their time for the fervice of the community, may not be deprived of their juft merits, and the reward of their ingenuity and labour; the other, that the world may not be deprived of improvement, nor the progrefs of the arts be retarded: the act that fecures copy-right to authors, guards againft the piracy of the words and fentiments; but it does not prohibit writing upon the fame fubject, as in the cafes of hiftories and dictionaries: in the firft a man may give a relation of the fame fact, and in the fame order of time; in the latter an interpretation is given of the identical words: in all thefe cafes, the queftion of fact to come before a jury, is whether the alteration be colourable or not; there muft be fuch a fimilitude as to make it probable and reafonable to fuppofe that one is a tranfcript of the other; fo in the cafe of of prints, no doubt different men may take different engravings from the fame picture. The fame prineiple holds with regard to charts: whoever has it in his intention to publifh a ehart, may take advantage of all prior publieations; there is no monopoly of the fubject here, any more than in the other inftanees, but upon any queftion of this nature the jury will decide whether it be a fervile imitation or not. If an erroneous ehart be made, God forbid it fhould not be eorrected, finee it thereby becomes more fervieeable and ufeful for the purpofes to which it is applied: but here you are told that there are various and very material alterations: the defendant therefore has been correcting errors, and not fervilely copying. If you think fo, you will find for the defendant; if you think it a mere fervile imitation, and pirated from the other, you will find for the plaintiff." [Verdict for defendant.] No action therefore lies in future for publifhing fea eharts on an improved and more ufeful prineiple, even though many of the lines fhould be eopied from older charts.

In Eafter term, 10 Geo. III. Wil. 60. Sayer loft his action againft Diecy for eopying and felling a print, beeaufe though the *year* of our Lord, wherein the original plate was publifhed was engraved thereon, the *day of the month* was not.

In Miehaelmas term, 33 Geo. III. 5 T. R. 41. an action was brought againft Symonds and others, for pirating a portrait of the eountefs of Huntingdon. Bowyer was the original proprietor, and had affigned his right through Fittler to Thompfon, by whom the action was maintained. On becoming poffeffed of the plate, Thompfon had inferted his own name in the infeription inftead of Bowyer's, "preferving the original date" of 26th day of Auguft, 1790; but the objection ftarted on this ground was over-ruled by the court, and the plaintiff obtained a verdict and 10*l.* damages.

ENGRAVING, English, *Origin and Progrefs of.* In England, the *art* of engraving has gradually arifen from its rude mechanieal practice by our Britifh aneeftors. It may be faid to be indigenous to our foil. Roman and Saxon improvements have from time to time been engrafted; and more reeently, fhoots from the engraving of Germany, Italy, and France, have alfo been engrafted by the enterprize of individuals, not by the wifdom or authority of the ftate, on the original ftoek. It will probably exeite the furprife of pofterity, that *this* art has hitherto been cultivated, (if fueh might be called cultivation,) in Great Britain in no other way, though Great Britain be the chofen feat of modern commerce; and engraving, being in its nature the moft eommercial of thofe arts which adminifter to calm and elegant enjoyment, affords the moft effieient means of diffufing through the world a juft and general tafte in the fine arts, and, eonfequently, in thofe numerous branches of manufacture whieh are derived from, and fuftained by, thofe arts.

That it was rudely practifed in this ifland from a very early period, may be feen by the remains of inftruments of war, and other antiquities which have been found in the Celtic and Saxon tumuli; thefe, as is obferved by that intelligent artift and antiquary, the late Mr. Strutt, frequently bear marks of the graver, or of fome tool whieh cannot have been very diffimilar; and the numerous eoins of Cunobelin muft fatisfy every inquirer of the early Britifh exiftenee of this fpecies of engraving, an art whieh was probably introduced from Rome during the reign of that prince.

The art of die-engraving could not have exifted alone; it implies the exiftence of other modes of ingenuity; and, with the ufe of money, muft have fpread the ameliorating influenee of art. But all rifing ingenuity, and even this mode of engraving, appears to have funk under the Roman and Danifh ravages, whieh foon fucceeded. Excepting thefe coins, thofe of Caraufius, and a few others of lefs certain date, and the war implements mentioned above, faint indeed are the traees of Britifh engraving, until the time of Alfred the Great.

"Under the protection of that excellent monarch," fays Strutt, "the arts begun to manifeft themfelves in a fuperior degree. He not only eneouraged fuch artifts as were in England at the time, but invited others from abroad; and the works of the Anglo-Saxon goldfmiths, who were the prineipal engravers of that day, were held in the higheft efteem upon the continent as well as in their native eountry. The eafkets which they made for the prefervation of the relics of faints, and other pious purpofes, were ornamented with precious ftones and engravings in fo excellent a ftyle, as to excite the admiration of *all who faw* them." Wonder is the eoncomitant of ignoranee. There is, however, yet preferved in the Mufeum at Oxford a very valuable jewel of gold, adorned with enamelling, and a kind of fillagree work, in the midft of which is feen the half figure of a man, whieh is fuppofed by Hickes and Wooton to reprefent Jefus Chrift, and eonjectured by Strutt to be rather intended for St. Cuthbert. The back of this curious remnant of antiquity is ornamented with engraved foliage and flowers. From the unqueftionable teftimony of its own legend, this jewel is known to have been made at the eommand of Alfred the Great, and was one of the very few artieles he could have carried with him when he retreated to the ifle of Athelney; where it has fince been found.

Archbifhop Dunftan is faid to have worked in the precious metals, frequently adorning his works with images and letters whieh he engraved thereon. Ofbern (his biographer) calls him the firft of engravers; but it has been emphatieally obferved, that he who eould add the title of *Saint* to the name of Dunftan, would not hefitate to call him a Raphael in painting, or an Audran in engraving; and the fpeeimen of his drawing, whieh is ftill preferved in the Bodleian library, leaves us little to regret in the entire lofs of his engravings.

The engraving of Dunftan and his contemporary *workmen*, was doubtlefs the degenerate iffue of the art whieh the patronage of Alfred had called forth. In the tempeft of war, and the night of ignorance and fuperftition that fueceeded, feareely a glimmering of its light was feen. The mingled work of the engraver, chafer, enameller, and goldfmith, which is feen in Alfred's jewel, entirely difappeared, but die-engraving, as it afforded the means of iffuing money, became to the Anglo-Saxon prinees an art of neeeffity, becaufe infeparable from the exifting fyftem of government and polity; and henee, while other arts pined and perifhed, it was enabled to furvive the inclemeney of thofe barbarous ages, and to preferve and tranfmit to better times the art of the engraver.

Laws of Athelftan and Canute, appointing the number of minters who fhall refide in their prineipal towns, and for the punifhment of thofe who fhall dare to adulterate the coinage of the realm, are ftill extant, and may be read in Thwaite's obfervations on Anglo-Saxon and Anglo-Danifh Coins.

It may be prefumed, that the art of die-engraving, and the weak tenures by which landed property was previoufly held, gave rife to the engraving and the ufe of feals. Before their introduction, Ingulphus exprefsly fays, that lands were fometimes difpofed of by word of mouth; fometimes by laying a turf of the land granted with religious folemnity on the holy altar; and in other inftances the lord gave to the tenant a fword, bow, helmet, arrow, or drinking-horn to to certify the transfer; a drinking-horn is mentioned by Lewis as being in the poſſeſſion of a Mr. Pyſſey of Berkſhire, on which was engraven, "I king Knoute (Canute) have given thee this horn to hold thy land by."

In corroboration of the idea that the numiſmatic proceſs ſuggeſted both the manner of engraving and of *uſing* ſeals, we may mention that the matrices of ancient Engliſh ſeals, of which ſome few are yet remaining, are formed with the ſame kind of cutting and punching implements which were uſed by the die-engraver; they were of braſs, as were probably the dies of that period, and from that time to the preſent, metal ſeals have continued to be executed with the ſame implements uſed in the ſame manner, or with no other variations than have been produced by the gradual improvement of ſociety operating on the peculiarities of individual talent: alſo (ſee Seal-engraving,) that they were at firſt impreſſed as money is coined, namely, by a forcible blow, and that *lead* received the impreſſion; and from the teſtimony of Ingulphus it further appears, that ſeals were by no means common in England before his time; he ſays that, "the Normans, diſliking the Engliſh manner of ratifying their chirographs (or charters), ordered them to be confirmed by impreſſions on *wax* from the ſpecial ſeals of the parties concerned. The only ſeal in England that is known to have been impreſſed on wax before this period, is that of Edward the Confeſſor; but as this prince is known to have received his education in Normandy, the ſingularity is accounted for.

From this time the uſe and ſacredneſs of ſeals went on increaſing in the public eſtimation, ſo that before the lapſe of a century, their devices, forms, and ſizes, appropriated to the different ranks in ſociety, were gradually ſettled. Even the etiquette of ſealing on different coloured waxes, was aſcertained with ſufficient ſcrupuloſity.

An impreſſion from the ſeal of Anſelm, the primate, has been copied, and is introduced (ſee *Pl. of Britiſh Engravings, fig.* 2.) from which ſome idea may be formed of the Anglo-Norman ſtyle of deſign and engraving, as compared with what had preceded it. The archbiſhop has loſt his head, and has probably been decapitated in effigy, on account of his cropped hair, and by ſome of thoſe reſentful partizans of the long and curled locks, which were faſhionable at the court of William Rufus. Againſt long hair, Anſelm had preached with ſome apparent ſucceſs, and with a vehemence which is highly extolled by Eadmer, his companion and ſecretary; but it has been obſerved, that though the clergy at that time could overturn thrones, and had authority ſufficient to ſend above a million of men on *their* errand, to the deſarts of Aſia, they could not prevail againſt certain faſhions.

It appears that ſome argillaceous ſubſtance, apparently pipe clay, has in this inſtance been mixed with the wax of the ſeal; which has afterwards been painted either with a view to its better preſervation, or to give the true tint of the rank of a Norman archbiſhop. The ſmall folded parchment to which it is appendant, or rather which depends from it (ſee the engraving) is a grant of church land. The prolixity of modern legal forms might bluſh before its brevity.

About, or ſoon after, the time now under our obſervation, a new ſpecies of engraving, more ſimple in its nature than thoſe which had preceded it, was either introduced into or invented in England; of which there is ſcarcely an old country church of any conſequence, but affords ſome curious ſpecimens, and England more than any other nation in Europe. The braſs plates on our old ſepulchral monuments are executed entirely with the graver; the ſhadows, where ſhadowing is attempted, being expreſſed by lines (or ſtrokes,) ſtrengthened in proportion to the required depth of ſhade, and occaſionally croſſed with other lines a ſecond, and in ſome inſtances a third time, preciſely in the ſame manner as a copper plate is engraven that is intended for printing. On other occaſions a mere outline only has been cut.

Theſe engraved effigies are often found cemented on thoſe horizontal tomb-ſtones, which form part of the pavement within the churches, where the feet of the congregation, which kept the lights bright by friction, filled the inciſions with duſt, and thus darkened the ſhades; very neat or exquiſite workmanſhip was not therefore aimed at, and is not to be expected; yet ſome of theſe engravings bear no ſmall evidence of the abilities of thoſe by whom they were performed, and conſidering the dark period during which they were executed, are entitled to more praiſe than many engravings which have been ſubſequently produced. The engraver's ſtyle of drawing the human figure differs little from that of the contemporary illuminators of miſſals, and though the hands, feet, and other nudities are rarely tolerable, the ſtiffneſs of the draperies does in many inſtances bear conſiderable reſemblance to the tiſſued and embroidered veſtments of the entombed abbots, and other dignitaries of the early Catholic church; while the faces occaſionally diſplay attempts not altogether ſucceſsleſs, as it ſhould ſeem, at individual portraiture.

That which has been ſelected as a ſpecimen of this mode of engraving, is from the tomb of William de Fulbourn, in Fulbourn church, Cambridgeſhire, and is copied, with the permiſſion of the Meſſrs. Lyſons, from their Magna Britannia. William de Fulbourn was appointed a baron of the exchequer in the year 1328, and is here repreſented (ſee the *Plate* of *Engliſh Engravings, fig.* 3.) "with the effigies of an eccleſiaſtic in a richly ornamented cope, under an elegant canopy, engraved on braſs," &c. &c. See Lyſons's Cambridgeſhire, p. 64. Part of the canopy and finale have been omitted on account of the ſmaller dimenſions of our plate. The pattern of the embroidery, as may be ſeen, is far from being inelegant, and the recurring initials, (W. F.) roſes, and other ornaments, are engraved with no inconſiderable care and neatneſs.

Philoſophers have remarked how frequently man has ſtumbled or ſtopt ſhort at the very threſhold of improvement. From the time of the Cruſades, Great Britain has been in poſſeſſion of an art of engraving from which ink might have been delivered, and conſequently impreſſions multiplied, either on the ſame vellum on which books were formerly written, or, ſince the middle of the 12th century, on paper itſelf: yet until about the year 1460, no man appears to have thought of delivering ink from the inciſions of the graver.

Whether accident or deſign, and whether Italy or Germany had the honour of giving birth to an invention, of which three centuries and a half have not ſerved fully to develope the important conſequences to ſociety, has been much diſputed among the curious. Mr. Strutt is among the number of thoſe who have purſued theſe inquiries with conſiderable diligence. After diſcuſſing the German and Italian pretenſions, he at length brings forward an impreſſion from an engraved braſs plate in his own poſſeſſion, which he conceives to be Engliſh, and which he thinks *may* claim the palm of early date. Its ſtyle of art is truly that of the early German ſchool, and alſo that of the engravers of the Engliſh ſepulchral braſſes of the fifteenth century; yet from another circumſtance, which ſhall be mentioned anon, the writer of this article is led to think that Mr. Strutt's

Strutt's plate, and the tenor of his reafoning thereupon, are more curious, than his conclufion is well founded.

Mr. Strutt fays, "no one feems to have fuppofed that we could lay even the moft diftant claim to a rivalfhip (much lefs to a priority) with refpect to the early practice of engraving, with any of the continental nations famous for the arts. But when we confider how many engravers we had in England, about the time in which the difcovery of taking impreffions from copper-plates was made, as the many monumental engravings remaining in our churches to this day fufficiently teftify, (and a little examination of thefe early fpecimens of the art will prove how well they were adapted to the purpofe of printing,) we fhall readily conceive that if they did not themfelves difcover this mode of multiplying their works, they would at leaft have inftantly adopted it, as foon as the knowledge of fuch an invention had reached them."

There can be little doubt of the antiquity of the engraving here produced; and that it was made for the purpofe of printing, the letters being reverfed upon the plate fufficiently prove. So that if it fhould be urged, though we fee no kind of reafon for fuch a fuppofition, (this is furely more than ftrict criticifm will concede to Mr. Strutt,) that the plate itfelf was executed abroad, at the command of fome Englifh devotee, it muft at leaft be granted that the mode of taking impreffions from it was underftood in England, or the plate could not have been of any ufe to the owner of it; and that the engraving was the work of fome Englifh artift, *or* executed at the defign of fome Englifh perfonage; no one, I conceive, will doubt on examining the contents of the infcriptions. They confift of particular invocations to faints, comprehended in feven compartments, the initial letters of each invocation or prayer being ornamented with the reprefentation of the perfonages to whom it is addreffed." Here follows a particular defcription of the feveral compartments.

"The addrefs to the Englifh faints in the fifth petition, plainly, we think, determines the country to which it belonged. The ftyle of the drawing, and the manner in which the little figures are compofed, being placed in the initial letters, bear an exact refemblance to the illuminated delineations which we meet with in manufcripts of the fifteenth century, efpecially towards the commencement of it; and the writing alfo has every appearance of equal antiquity."

If we fhould proceed thus far with Mr. Strutt, and admit his reafoning, it will fcarcely be practicable to travel with him further, though he be in general, as to matters of fact, an excellent guide. The invocations, which cover the far greater part of the plate, are not in the Englifh, but the Latin language, and Mr. Strutt informs his readers, that they are "evidently ftamped upon the plate with fmall punches, and re-touched afterwards with the graver." Now, no man would cut an alphabet of punches, (or puncheons, as they are fometimes technically termed,) for the fake of engraving, or ftamping, fuch a plate as Mr. Strutt has brought forward, nor would probably any caufe of lefs magnitude than the formation of matrices for an alphabet of moveable types, induce an artificer to beftow the time and pains, neceffary to the production of fuch an alphabet of puncheons. From this fingle circumftance, the prefent writer is inclined to refer the engraving in queftion, in whatever country it may have been executed, to a period fubfequent to the invention of moveable types; confequently if it was executed in England, it muft have been after the year 1471, when, according to Dr. Middleton, Caxton had returned from abroad, and began to print books in Weftminfter Abbey.

Another reafon, which does not feem to have prefented itfelf to Mr. Strutt, why the invention of printing with the rolling prefs from plates of metal cannot, in fairnefs, be affigned to England, is that to fuppofe this art to have been known here before the experiments of Finiguerra, we muft alfo fuppofe that almoft a century elapfed between the firft and fecond examples of Englifh copper-plate printing, which is a thing not to be fuppofed for a moment.

Of the engravings that accompanied an edition of Vefalius's anatomy, which was printed in England in the year 1545, Mr. Ames fays, "thefe plates are fome of the firft rolling prefs printing in England." Of thefe plates, Thomas Geminus, or Gemini, was the engraver: they were not the very firft that were *publifhed* here. "The birth of Mankind, otherwyfe called the Woman's book," made its appearance in 1540, and contains fome fmall anonymous copper-plate cuts, yet Geminus might poffibly have begun his engravings more than four years before the date of their publication: at leaft he is the firft engraver in England of whofe name we are in poffeffion, and whofe works were printed on paper.

The firft edition of Geminus's Vefalius was dedicated to king Henry VIII. He publifhed a tranflation by Nicholas Udal, of the fame work, in 1552, and dedicated it to Edward VI. The tranflator in his preface fays, "Accepte therefore jentell reader, this treatife of anatomie, thankfully interpreting the labours of Thomas Gemini, the workman. He that with his great charge, watch and travayle, hath fet out thefe figures in pourtrature, will moft willingly be amended, or better perfected of his own workmanfhip, if admonifhed."

Thofe who have feen the mafterly wood engravings to the original Vefalius, publifhed at Padua, in 1542, engravings that were done under the eye, and, as fome have faid, touched by the hand, of Titian, will perceive that Gemini has left abundant room for admonition: yet the confideration that his work was a firft attempt, at once to tranfplant a new art to England, and to extend the knowledge of anatomy, will probably be received as no unfatisfactory apology for the defects of thefe engravings.

Gemini lived in Black-Friars: he printed and publifhed other books, among which are a fmall tract on midwifery, with copper-plate engravings, (which is, perhaps, the fame that is mentioned above, under the title of "the Birth of Mankind, &c.") a prognoftication relating to the weather, the phenomena of the heavens, &c. decorated with a number of cuts, and another edition of his Vefalius, printed in 1559, and dedicated to queen Elizabeth

Lord Orford has obferved that, "fo congenial an art as engraving, when once difcovered, could not fail to fpread in an age of literature. That accomplifhed prelate, archbifhop Parker, who thought that whatever tended to enlighten and cultivate the human mind, was within his province, feems to have been the moft confpicuous patron of the art, in the reign of Elizabeth. He employed, in his palace at Lambeth, a painter and two or three engravers. Of thefe engravers, the chief was Remigius Hogenbergh, who twice engraved the archbifhop's head, which, if Vertue be right, was the firft portrait printed in England, from an engraving on copper; Remigius had a brother whofe name was Francis, by whofe hand is extant a print of queen Mary I. dated in the year 1555. Under it is written "Veritas Temporis Filia." In the fet of Saxton's maps, thofe of Gaul and Belgium are by this artift, and he has alfo engraved *views* both in Bruin's Civitates Orbis Terrarum, printed in 1572 at Cologn, and in Abraham Ortelius's Theatrum Orbis Terrarum, printed in 1570 at Antwerp. On the foreground of one of the views contained in the latter work, are two figures dreffed in the coftume of the times, one of which is the portrait of Ortelius himfelf, (as the infcription beneath informs us); and the other that of Hoefnagle the engraver, who, though a native of Antwerp, was among the firft of thofe who practifed the art in England. The map of England in this work was by Humphrey Lhuyd of Denbighfhire, and that of Spain by Thomas Geminus, whom we have already mentioned. Lord Orford thinks it creditable to England, that we had at this time, "profeffors worthy of being employed to adorn Flemifh editions; Flanders being at that time a capital theatre of arts and learning;" and Ortelius himfelf commends the Englifh engravers, fpecifying befides thofe whom we named, Antony Jenkenfon, and Robert Leeth.

Chriftopher Saxton deferves mention here, for at once extending the knowledge of our national geography, enlarging the field of engraving, and raifing himfelf to eminence from the condition of a fervant. He was a native of Yorkfhire, and lived at Tingley, near Leeds, in the fervice of Thomas Sekeford, efq. mafter of the Requefts, and of the court of Wards. Encouraged by this gentleman, who kindly affifted him with money, Saxton undertook to make a complete fet of maps of the counties of England and Wales. Many of the plates he engraved himfelf, and in others was affifted by Francis Hogenbergh, Nicholas Reynold, and Auguftin Ryther. Six years were employed in the work, which commenced in the year 1573. Thefe were *the firft* county maps that ever appeared in England, and Thorefby fays of that of Yorkfhire, which is three feet wide, that it is "the beft that ever was made of that county." Ryther had the chief hand in engraving it, and at the corners are views of the city of York, and the port of Hull. Thefe maps are alfo adorned with the royal arms, and thofe of the patron "Mafter Sekeford," and are dedicated to the queen.

In lord Orford's catalogue is a worthlefs portrait of George Hoefnagle, who engraved about this time a map of Briftol, and a view of the palace of Nonfuch, which, though once fo magnificent, is now only known from defcription and the print of Hoefnagle. He worked entirely with the graver, and, as has already been mentioned, was one of thofe employed by Ortelius, in his great work, which may truly be called fo, when we confider the time when, and the circumftances under which, it was produced.

We have paffed over Cole, Bettes, the de Brees, and others: and even the names of many of thofe who ferved to mark no era in the art of which we are here tracing the progrefs in England; who neither invented nor introduced a new ftyle, nor diftinguifhed themfelves in thofe which were previoufly known and practifed; we fhall pafs over them with a general reference to Strutt, Grainger, and lord Orford's catalogue, where their names and the dates of their works may be found, with fuch lifts of their performances as thofe authors, with the affiftance of George Vertue, were able to form or collect.

Notwithftanding the praife of Ortelius, Englifh copperplate engraving retained, for more than an hundred years, much of its original coarfenefs and vulgarity. The ftyle of Reginald Elftracke, who lived at the clofe of the fixteenth and beginning of the feventeeth centuries, is occafionally fomewhat neater than that of his predeceffors, but ftill deftitute of tafte. His inftrument was the graver, but faint indeed are the mental rays that attended its progrefs.

Elftracke worked chiefly for the bookfellers; and his beft works are portraits, which are for the moft part, if not entirely, after his own drawings. They are in number at leaft thirty; and among the beft of them are thofe of fir Philip Sydney, engraved foon after his death, and "ΒΑΖΙΛΙΩΛΟΓΙΑ, or the true and lively Effigies of all our Englifh Kings from the Conqueft to the prefent time" (1618.) His portrait of queen Mary of Scotland is probably, on the whole, his beft performance.

Francis Delaram was contemporary with Elftracke. His workmanfhip, for it can fcarcely yet be called art, and certainly not fine art, was fomewhat neater than that of Elftracke, but equally taftelefs. The fquarenefs or rectangularity of his croffings gives a peculiar drynefs to his ftyle of engraving; he drew but indifferently, his outlines are hard, and his draperies heavy. Unlefs we may except the following plates, which are after his own defigns, his portraits are the beft of his works. The frontifpiece for "Wyther's Preparation to the Pfalter," ornamented with emblematical figures, and dated 1619. The frontifpiece to "The Seven golden Candlefticks," 1624. "Nero Cæfar, or Monarchie Depraved," 1627; this alfo is a frontifpiece. And the beft of his portraits are thofe of "James the Firft," an upright whole fheet print, as large as life. "Queen Mary and Queen Elizabeth," fmall uprights. "Henry Percy, Earl of Northumberland," dated 1619. "Frances, Duchefs of Richmond and Lenox," and "Sir Thomas Grefham."

But the family of the Paffes, or *de* Paffes, of whom the elder came hither from Utrecht, early in the feventeenth century, introduced a better tafte, and a neater and more elaborate ftyle of engraving than had hitherto been practifed in England.

Crifpin de Paffe was a man of letters, ftudious, and of a liberal mind. Holland's Heroologia was embellifhed and publifhed at his expence; and in the preface to a drawing-book, publifhed by him at Amfterdam, in the year 1643, (after his departure from England,) he difcovers fome knowledge in geometry and perfpective; gives directions for the proportions of the human body; for drawing in the academy by lamp light, and for the ufe of the lay-figure in ftudying draperies; and details the proportions of horfes, lions, and other quadrupeds, and of birds and fifhes. In the fame preface he fays of himfelf that he applied early to the ftudy of the arts, and mentions Rubens, Bloemart, and other diftinguifhed contemporary artifts, as his friends and encouragers: but he appears alfo to have looked with advantage at the neater productions of the German fchool of engraving. The following is a tolerably juft eftimate of his powers as an artift, and is from the pen of the late Mr. Strutt.

"Paffe worked entirely with the graver, in a neat, clear ftyle, which has much originality; and, excepting fome little ftiffnefs which frequently appears, and the want of harmony with refpect to the diftribution of the light and fhadow, (a fault which prevailed at the time in which he lived,) his beft works poffefs a very confiderable fhare of merit, efpecially his portraits, many of which he drew from the life; and the far greater part of his hiftorical and emblematical fubjects are engraved from his own compofitions. He drew the human figure very correctly," (but the proportions and ftyle of his figures are thofe of the fchool of Rubens,) "and marked the extremities with a degree of exactnefs, not ufually found in the works of thofe mafters who employed themfelves upon fmall fubjects."

Mr. Strutt ſhould have recollected here, that exquiſite examples of delicate marking and elaborate workmanſhip might then have been ſeen, and, probably, were ſeen by Criſpin Paſſe, in the works of the Behams, Penz, and thoſe other German artiſts who are emphatically termed the *little* maſters; particularly in the engravings of Bartholomew Beham, who had ſtudied under Marc Antonio.

The ſons of this artiſt, who were Criſpin junior, William, and Simon, and his daughter Magdalen de Paſſe, followed the inſtructions and the ſtyle, and in ſome inſtances ſurpaſſed the merits, of their father; though the works of Magdalen, the firſt female engraver we read of who practiſed the art in England, are not equal to the beſt of thoſe of her brethren. In three plates from Ovid's Metamorphoſes, which ſhe has engraved after pictures by Elſheimer, ſhe has judiciouſly imitated the ſtyle of count Goudt, but has not produced the ſame forcible effect, nor attained the ſame exquiſite degree of finiſh. Liſts of the numerous portraits and other engravings by this family, may be ſeen in lord Orford's Catalogue, and Mr. Strutt's Dictionary of Engravers; and in the Royal library at Paris, before the revolution, was a collection of their works in large volumes, of which there were either two or three.

From Simon Paſſe the art deſcended to his pupil John Payne. Other engravers were practiſing in England at the time, but of inferior merit. Payne had caught the mantle of the Paſſes. Strutt ſays of him that "he was a man of genius, and though his works are not very numerous, they neverthelefs manifeſt his ſuperior abilities. He was recommended to Charles I., and had a fair proſpect of making his fortune; but careleſs of that as he was of his fame, he neglected his buſineſs and died in indigence, A.D. 1647 or 48, before he had reached his 40th year. His chief engravings conſiſt of frontiſpieces and other book-plates, and portraits. But he alſo engraved a variety of other ſubjects, ſuch as landſcapes, flowers, &c. His portraits, however, are, in my opinion, by far his beſt works. Thoſe he executed entirely with the graver in a free open ſtyle, ſo managed as to produce a very pleaſing effect. Mr. Evelyn, ſpeaking of this artiſt, commends him alſo for a ſhip which he engraved. This ſhip, as Vertue informs us, was the Royal Sovereign, built by Phineas Pett. The print was of a prodigious ſize, and engraved on two plates, being, when joined, three feet long, by two feet two inches high." His beſt portraits are from Cornelius Janſen.

Having proceeded thus far with the progreſs in England of the art of engraving on *copper*, it behoves us to attend to the introduction and early progreſs of that of engraving on *wood.*

The art of engraving, and printing from, blocks of wood, was introduced into England about the ſame time with the mode of printing with the rolling preſs from engravings on copper: if, indeed, *wood* were really the material uſed for thoſe engravings which are called, and generally ſuppoſed to be, wood engravings, and which are common from the time of the firſt promulgation of the art through the fifteenth and the two following centuries, and where the printing ink is evidently delivered from "lines croſſing each other," and with the letter-preſs.

The earlieſt Engliſh engravings of this kind which the preſent writer has examined, unleſs thoſe which are publiſhed with the mark of Holbein are really by his hand, and were any of them performed after his arrival in this country, are thoſe of Chriſtopher Switzer, who lived at the cloſe of the ſixteenth and beginning of the ſeventeenth centuries. He was probably a German by birth, though he reſided in England. Vertue ſays, he cut a ſet of the broad ſeals of England, which may be ſeen in the Harleian library, but impreſſions from the blocks of coins and ſeals which he cut for Speed's hiſtory are not uncommon; and here the remarkable dark croſſings occur, and may be particularly obſerved in the four blocks which are entitled "portraitures of the ancient and of the more civil Britons." Speed calls this artiſt "the moſt exquiſite and curious hand of that age," and he probably was ſo, if we confine the remark to wood-engraving, and to England. Evelyn ſays of Switzer's ſon, who ſucceeded him in his profeſſion, and was alſo named Chriſtopher, "we have likewiſe a Switzer for cutting in wood, the ſon of a father, who diſcovered his dexterity in the herbals ſet forth by Mr. Parkinſon, Lobel, and divers other works with due commendation;" which ſhews that the elder Switzer engraved the blocks of botanical ſubjects for Lobel's obſervations, and Parkinſon's "Paradiſus Terreſtris," which was publiſhed in 1629.

It may have been perceived that of the fact of dark lines croſſing each other, being printed from the ſurfaces of engraved blocks and with the letter-preſs, the preſent writer entertains conſiderable doubt. His doubt is founded on the extreme difficulty, amounting to impracticability, though not to abſolute impoſſibility, of cutting away the minute lozenges of wood, or interſtices between the croſſed lines, ſo as to leave ſuch a ſurface of dark croſſings as muſt have preſented itſelf to the letter preſs printers of this period.

To print dark croſſings from the inciſions of the graver, and with the rolling-preſs, may be conceived to be comparatively eaſy: but as printing from the *ſurface*, and with the letter preſs, was preferred on account of its ſuperior facility, we are reduced in reaſoning upon theſe engravings, if we ſuppoſe them to have been performed on *wood*, to the monſtrous abſurdity of ſuppoſing, that a difficult and tedious, was preferred to a ſimple and eaſy proceſs, and that on account of its ſuperior facility!

Theſe conſiderations have led to the ſuppoſition that the prints in queſtion were not taken immediately from the engravings, but from caſts of ſome kind, for which the engravings, on whatever ſubſtances they were performed, did but ſerve as matrices or moulds. Yet wood cannot be caſt in moulds: and in the library of Mr. Anthony Carliſle, profeſſor of anatomy to the Royal Academy (whoſe name is, undeſignedly on the part of the author, omitted in a note to the volume of lectures on engraving delivered at the Royal Inſtitution, p. 205.) are two books illuſtrated with letter preſs engravings, which appear to contradict the above hypotheſis. It may not be impertinent here to tranſcribe a paſſage from the *manuſcript* of the lecturer.

"I have to regret that this part of the lecture is ſo little better than a ſtatement of doubts. Since this volume has been in the preſs, I have ſeen, in the library of Mr. Carliſle the anatomiſt, a copy of Johnſon's tranſlation of Ambroſe Parey's anatomy, printed in 1691, which is illuſtrated with letter preſs engravings where dark croſſings frequently occur, and in the preface to which the author ſays, 'the figures in this work are not the ſame uſed by my author; but according to thoſe of Bauhine, which were uſed in the work of Dr. Crook.' Upon referring to the latter work, which I found in the ſame library, and which was printed in 1631, it was evident that the prints were not copies, but impreſſed from the very ſame engravings: but there was this remarkable difference which *ordinary* incredulity could ſcarcely ſtand againſt, that in Johnſon's work the prints were obviouſly impreſſed from ſome ſubſtance which had been *worm-eaten* in the courſe of the ſixty years it had lain by, and which could not therefore have been *metal.*" The remainder of this note would be ſuperfluous: the inference is obvious,

obvious. But, the public muſt not be led aſtray, nor muſt the author of that note let paſs this opportunity of controverting himſelf.

It has ſince come to his knowledge, and is an undoubted fact, that old lead is not unfrequently found perforated by worms, or by ſome ſmall animalculæ, which leave behind circular holes of exactly the ſame kind and ſize, which we ſo frequently ſee in old wooden furniture, books, &c. He reſumes therefore his opinion, and indeed a further and more particular inſpection of the productions of this kind, of the German ſchool, has confirmed his belief, that the numerous prints produced at this early period in Germany and the Low Countries, which are ſuppoſed to be impreſſed from engravings on wood, are really printed from metal caſts.

As Dr. Crook's anatomical work was publiſhed but two years after Parkinſon's Paradiſus Terreſtris, it is probable that one of the Switzers engraved the anonymous anatomical figures which are the ſubjects of the above comments. The art of engraving, on whatever ſubſtance was then employed to enable the printer to produce dark croſſings from the ſurface of the work, was an exotic tranſplanted from Germany or the Low Countries, and appears never to have taken root in our ſoil. It died away with or ſoon after the Switzers, and has never revived ſince: for the art of engraving on wood, as practiſed by the Bewicks of Newcaſtle and their diſciples, and imitators, is to be conſidered as quite a diſtinct art. But, for further information on this ſubject, ſee Letter Press Engraving, and Wood Engraving.

Contemporary with the younger Switzer and with Hollar, of whom we ſhall preſently treat, were Robert VanderVoerſt and Lucas Vorſterman, who were rival competitors for public fame, and rivals alſo in the favour of king Charles I. Charles was the firſt Engliſh monarch who was ſufficiently ſenſible of the beauty of engraving, and of the popular and important purpoſes to which it might be applied, to appoint an engraver royal. The king took care to ſee that the title was not worthleſsly thrown away, in mere kindneſs to a courtier, and Voerſt was the firſt artiſt on whom that honour was conferred. He was a native of Holland, and in what year he came hither is uncertain. He was an able draftſman, and hatched his drawings with pen and ink, as was the general cuſtom of the artiſts, particularly the engravers, of that period. A drawing of this kind performed on vellum, and of which the ſubject was the Madonna with the infant Jeſus and St. John, he had the honour of preſenting to the king, for whom he afterwards engraved a portrait of his majeſty's ſiſter, and a plate from a picture which Vandyke painted to ſupply the place of that one of Titian's Cæſars which by ſome accident had been loſt or deſtroyed: ſo that Voerſt's title was not merely nominal. He engraved alſo from Vandyke, the portraits of Charles I. and his queen; (from the ſame celebrated picture which has been ſubſequently engraved by Vertue) that of the queen alone; ſir Kenelm Digby, Inigo Jones, and ſeveral others, of which a liſt may be ſeen in lord Orford's catalogue. He handled his graver in a bold, free, and commanding ſtyle.

The ſtyle of Vorſterman exhibits more careful finiſhing and painter-like feeling, and muſt on the whole be allowed to be ſuperior to that of his rival. He was to Rubens and Vandyke in England, and the Low Countries, what Marc Antonio was to Raphael in Italy. He may be ſaid at once to have ſucceſsfully tranſlated and ſtereotyped the great originals of thoſe very diſtinguiſhed painters.

Mr. Strutt ſays of him with great truth that no one ever engraved more ſucceſsfully from the pictures of Rubens: than whom, no painter that ever lived had the pleaſure of ſeeing ſo great a number of his pictures finely engraved. Vorſterman drew the human figure with correctneſs and taſte. He was maſter of the graver, and could handle it with the utmoſt facility; but he paid much greater attention to the general effect of his prints, than to the regularity of the ſtrokes; and like Gerard Audran, wiſhed to enter into the thoughts of the maſter, and tranſcribe on copper the very life and ſpirit of his pictures, rather than ſhew his own dexterity in the mere mechanical part of the workmanſhip. The heads of his figures are finely drawn, and the extremities marked in a very maſterly manner. Vertue mentions with approbation two drawings by Vorſterman, namely, a portrait of prince Henry, and a woman's head, after Leonardo da Vinci.

This celebrated engraver was a native of Antwerp, but from whom, or whether from any maſter, he learned the principles of painting and engraving, does not appear. He came over into England about the year 1623, and was occaſionally employed both by king Charles I. and the earl of Arundel. His engravings are numerous, and chiefly from Rubens, Vandyke, and Holbein. Among thoſe which may be mentioned with diſtinction are; from the former maſter, "The fall of the Damned," (a large upright); "The battle of the Amazons," a large and grand plate, printed on ſix ſheets; "Lot leaving Sodom;" "The temptation of Job;" "Suſanna and the Elders," and ſeveral others, particularly the "Return from Egypt," which he has treated in a manner differing from his uſual ſtyle, and more bold and open. From Vandyke he has engraved a dead Chriſt, ſupported on the lap of the Virgin, and a conſiderable number of admirable portraits, among which are thoſe of Charles I. and Vandyke himſelf; and from Holbein, he has engraved "Thomas duke of Norfolk," with the ſtaves of lord treaſurer, and earl Marſhal, "Eraſmus, ſir Thomas More," and the painter himſelf. Sir Thomas has here a flatter face and ſmaller bonnet than in other pictures of him; and from the circumſtance of Holbein's pencil being placed in his left hand, may be inferred, not that this print was a copy from another without being reverſed on the copper (as lord Orford has ſurmiſed) but that Holbein painted with his left hand: a truth which the painter here meant to ſay of himſelf, and which the engraver has faithfully reported.

Nor muſt the illuſtrious name of ſir Anthony Vandyke be omitted, in enumerating thoſe of the artiſts who contributed to accelerate the progreſs of Britiſh engraving. The portraits which he etched of Snyders, Vorſterman, Paul Pontius, and other diſtinguiſhed artiſts who were his contemporaries and friends, excited the juſt ſurpriſe and emulation of the painters and engravers of that age, and the beſt of them have continued to the preſent to be examples of excellence. Among the beſt may be reckoned that head of himſelf, looking over his ſhoulder, where he has introduced the golden chain which he had the honour of receiving, together with his majeſty's picture in miniature, at the hands of Charles I. a circumſtance which ſerves to ſhew that he etched this plate at leaſt, and preſumptively others, after his arrival in England. In ſome of thoſe which he had previouſly executed, we ſee him contending, as it were, againſt the difficulties of his own imperfect knowledge of the newly acquired art, and that his plates are accordingly blurred with accidental ſcratches, and blotted and ſtained with foul biting, which all the ſkill of Bolſwert, Neeffs, and Vorſterman, who ſeverally employed the graver in finiſhing moſt of his draperies and ſome of his faces, has not been ſufficient to obliterate or conceal. His ſtyle of etching is original, vigorous, free, and expreſſive, and in ſome inſtances he has finiſhed his heads with conſiderable care. The tranſcendental taſte

taſte and judgment which he has ſo amply diſplayed in his pictures, guided and determined his hand in etching, and though nearly two centuries, which have boaſted of their refinements, have elapſed ſince the period of their production, his "Ecce Homo" and his portraits, ſtill preſerve their ſtations in the collections of the taſteful, and are ſtill eſteemed among the moſt highly valued ſtudies both of the portrait painter and engraver. By liberating Britiſh portrait engraving from the ſtiff regularity of the graving tool, which had before been too much regarded as a teſt of merit, Vandyke extended the views of the taſteful, while he taught the true value of outline, and light and ſhade.

It would not now be eaſy to aſcertain the preciſe time when that important branch of engraving, which is technically termed *etching*, (for an explanation of its proceſs, ſee the article ETCHING,) was introduced into England. Ortelius's and Bruin's publications contain ſome prints where etching appears to be mingled with the work of the graver, but if they are by Engliſh artiſts, thoſe artiſts probably acquired their knowledge of etching in Flanders, where they practiſed it; and on the whole it ſeems highly probable, that no etching was performed in England till the period of Vandyke's and Hollar's reſidence in London, and that the honour of having introduced it belongs to one or the other of theſe diſtinguiſhed characters. Vandyke was here and in high favour at the court of Charles I. when Hollar arrived, but whether he had then performed any of his admirable etchings is no where recorded; and as they are without dates, cannot now be eaſily aſcertained. As neither of theſe diſtinguiſhed men was the diſcoverer of an art, though each was the inventor of a ſtyle, it may be enough to believe it highly probable, that Vandyke was the firſt perſon who etched portraits in England, and Hollar the firſt who etched landſcape and natural hiſtory.

It is not certain, that William James Delft, or *Van* Delft, (for he was ſo named from the place of his nativity,) was ever in England. Yet from his ſtyling himſelf the king of England's engraver, and engraving portraits of Charles I., his queen Henriette Maria, and the duke of Buckingham, it ſhould ſeem to be not improbable that he ſucceeded Voerſt. Strutt ſays of him, that "he drew and painted portraits with great taſte, and in a ſtyle that acquired him conſiderable reputation; but as an engraver of portraits he is more generally known, and in that light only I ſhall conſider him. He worked entirely with the graver, and handled that inſtrument with the greateſt facility. He drew correctly, and his beſt prints are very finely finiſhed. Conſidering the great number of plates which were completed by the graver of this artiſt, it is not reaſonable to ſuppoſe they ſhould be all alike or equal in merit. Accordingly I ſhall diſtinguiſh two manners in which he engraved, and produced many excellent plates in both: firſt, a bold, powerful open ſtyle, productive of a fine effect; and as a ſpecimen of it I would refer the reader to the portrait of Hugo Grotius, dated 1652: ſecondly, a neat and much more finiſhed manner, as we find in the admirable portrait of Michael Miravelt (a near relation to the engraver,) from a picture of Vandyke." From the pictures of Michael and John Miravelt, he engraved a conſiderable number of portraits.

Wenceſlaus Hollar, who has been already named, if not the firſt perſon who practiſed the art of etching in England, was the firſt who particularly diſtinguiſhed himſelf in etching landſcape, ſhipping, antiquities, and natural hiſtory.

This diſtinguiſhed artiſt, a gentleman by birth, was a native of Prague in Bohemia, and intended by his parents to have been educated to the ſtudy of the law; but the civil commotions which happened in his youth, and which led to the memorable battle of Prague, obliging them to abandon this intention, and his genius for art diſcovering itſelf about the ſame time, he was placed under Marian, an able deſigner and engraver of views, and by the time he had attained the age of nineteen, Hollar produced two plates, of which the ſubjects were an Ecce Homo and a Madonna, and child, (the latter from Albert Durer,) which drew forth the notice of the public, and confirmed the hopes of his friends. In the courſe of the next year (1636,) he engraved another of Albert Durer's Madonnas, and a plate which the ſuperſtitious might regard as ominous of his future fate, of "Fortune ſurmounting a Globe," which was alſo from Albert Durer.

He ſoon afterwards excelled in drawing geometrical and perſpective views and plans of buildings; ancient and modern churches and abbies, cities and towns; landſcapes; and various kinds of natural and artificial curioſities, ſome of which he executed with a pen in a very maſterly and peculiar ſtyle. To this art of drawing with a pen, he ſubſequently added the uſe of water-colours, which he occaſionally, in the treatment of ſuch ſubjects, as butterflies, beetles, &c. heightened and enriched with gilding in a very beautiful manner, as the volume of his drawings now in the poſſeſſion of John Townley, eſq. F. R. S. and F. A. S. of Park-ſtreet, Weſtminſter, abundantly teſtifies.

After paſſing ſome years in travelling through Germany, during which he drew and engraved views of Frankfort, Wurtſburg, Cologn, and other of its principal cities; but where he met with little encouragement: the earl of Arundel, then on an embaſſy to the Imperial court, met with him at Cologn, and being ſtruck with his uncommon abilities, and particularly delighted with a large drawing of Prague, which Vertue ſays, "was curiouſly and exactly done with the pen and pencil," took him under his protection, and Hollar travelled in the ambaſſador's ſuite, from Cologn to Mentz, Prague, Nuremberg, Augſburg, Wurtſburg, Frankfort, Regenſburg, Vienna, and finally to England, where it is ſaid the noble earl recommended him to the favour of king Charles I.

There is ſome reaſon to fear that lord Arundel's patronage of Hollar was more nominal than real; and that the vanity of the patron was more gratified, than the fortune of the artiſt was promoted, by their connection. That Hollar was left deſtitute by the death of this nobleman, notwithſtanding that political, were then added to his profeſſional, merits, (for he was a zealous adherent to the cauſe of royalty and lord Arundel,) is freely excuſed on the ground of his lordſhip's own reverſe of fortune, but it appears to imply more neglect than the liberal would elſe be diſpoſed to impute to this nobleman, that during the firſt year of Hollar's arrival in England he was under the neceſſity of drawing and etching his view of Greenwich, which is more than two feet in length, for the paltry ſum of thirty ſhillings! Yet the reader muſt wiſh in vain for a more honourable contraſt between the parſimony of Stent, who purchaſed a *commodity* of Greenwich, with no other view than to enrich himſelf by the profits it might produce; and the liberality of the exalted peer, who deſerved his exaltation as the patron and protector of talent, alive to the charms of art, and kindling with the flame of contemporary genius.

But it muſt be candidly allowed that the art of Hollar had little affinity with that of Vandyke, and, ſo dependent is the judgment in fine art of ſome men, upon the opinions of others, that the merit which lord Arundel thought he had diſcovered at Cologne or at Prague, might have faded in his own eſtimation when he approached the light of the court of London. Notwithſtanding his own partiality and

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native feeling for the merits of Hollar, Vertue is obliged to confefs of him that " it is certain he could not fo well enter into that mafter's (Vandyke's) true manner of drawing in his grace and touches, as other engravers, fome in England and others abroad, who had ftudied his way or manner of drawing and painting; for which reafon " he could not obtain Vandyke's recommendation, nor that of his admirers." Portrait painting was then the reigning fafhion in England, and as the national tafte for art was bafking in the meridian fplendour of the powers of Vandyke, it is not furprifing that the lefs fortunate and more humble claims of Hollar were little feen, and met with fmall comparative encouragement.

Though the warmth of lord Arundel's patronage might perhaps be damped by thefe caufes, he continued in fome degree to befriend our artift. On his arrival in London, Hollar fat down with his habitual induftry to engraving, and after producing his large plate of Greenwich, which fhewed what he could do in this department of engraving, put afide for a time his talents for landfcape and natural hiftory, in order to accommodate himfelf to the public occafions and the prevailing tafte, and foon completed an equeftrian portrait of his patron, with two plates of king Richard II. kneeling before his patron faints, from an ancient altar folding table, and fome other works from the Arundelian collection, including the curious cup which was defigned by Andrea Mantegna.

In the year 1641, which was the year of Vandyke's deceafe, he engraved fome portraits, including thofe of the king and queen, from the pictures of that celebrated painter. He had now been introduced to teach drawing to fome branch of the royal family. Vertue thinks it was to teach prince Charles, having " feen a book mounting the arms or badge of the prince of Wales, (the crown and feathers,) wherein were drawings of parts of faces, &c. to begin to learn from, with fome of Hollar's hand-writing :" but in an infcription under his portrait, publifhed at Antwerp in 1648, and which infcription is fuppofed to have been fupplied by himfelf, he fays, he " had been domeftic fervant to the duke of York."

However this may have been, the civil wars which broke out foon after this mafterfhip or fervitude, toffed Hollar about with the royal party, ruined his better hopes, and obliged lord Arundel to return into Flanders. The engraver being left behind, refolved to try the fortune of war, and entering the army under the command of the marquis of Winchefter, was made prifoner at Bafing-houfe, in Hampfhire, from which having, with fome difficulty, effected his efcape, he went over to Antwerp, in the year 1645, and once more fought the patronage or confolation of the earl of Arundel. He remained in that city for fome years, endeavouring, through means of his art, to retrieve his fhattered circumftances; but his patron going to Italy for the benefit of his health, and dying at Padua in 1646, Hollar was left to the accidents of precarious encouragement and the avarice of trade. He fell again into diftrefs, and was obliged to work for the book and printfellers at very low prices.

Under fuch circumftances were produced his book of heads, after da Vinci; his thirty-eight plates of fhells, with many other fubjects from the Arundelian collection; a confiderable number of landfcapes after Breughel, Elfheimer, Teniers, and other mafters, and a ftill greater number of portraits, among which were thofe of Charles I., Charles II. when a youth, after Vandyke, the duke of York, after Teniers, which is now become very fcarce, and his own portrait, after Meyfens. At the period of the reftoration Hollar returned to England, where, though he found fufficient employment to occupy his time, the prices he received for his engravings were fo very inadequate to the labour which they neceffarily required, that he could but barely fubfift; and the plague putting for fome time an effectual ftop to bufinefs, and being foon after fucceeded by the fire of London, the pecuniary embarraffments of our artift were greater than ever, of which Leake, Jennings, Mark, and thofe other dealers, for whom, in the courfe of the years 1666 and 67, he engraved various views and plans of London, before and after the great fire, did not fail to take advantage.

" Born to misfortune as the fparks fly upwards," it was foon the fate of Hollar to turn his hopes once more toward the court, for that protection and encouragement which commerce blindly refufed him; and in the years 1668 and 69 he was employed by government under the orders of lord Howard, to make drawings of the town and forts of Tangiers, which he afterwards engraved. In this perilous fervice, he narrowly efcaped being killed or made prifoner by the Turks. The fhip, on board which he had embarked for England, the Mary Rofe, Capt. Kempthorn, fought feven Algerine Corfairs off Cadiz, and had eleven men killed and feventeen wounded; but Hollar efcaped unhurt, and had afterwards the honour of engraving a plate of the battle.

On his return to England, he received no more for the difficulties and dangers which he had encountered, the drawings he had made, and the year he had fpent in this arduous fervice, than one hundred pounds; and this, according to Vertue, was not obtained till after long attendance at the public offices, and experiencing many of thofe rebuffs " which patient merit from the unworthy takes."

From this time till the year 1677, when death put a final period to his exertions, he fpent much of his time in travelling through the northern counties of England, and delineating and engraving their topography, and produced thofe plates which are now objects of fo great curiofity, and will be yet more highly valued by pofterity, as fhewing what England was (and what Hollar was) during the reign of Charles II. The plates for Thoroton's Nottinghamfhire and Sandford's Genealogical Hiftory, were engraved in the courfe of the three laft years of his life.

He ufed to work for the mercenary book and printfellers at the rate of fourpence an hour, always having an hourglafs before him; and was fo fcrupuloufly exact, that when obliged to attend the calls of nature, or whilft talking, (though with the perfons for whom he was working, and about their own bufinefs,) he conftantly laid the glafs on its fide, to prevent the fand from running. Yet notwithftanding his exemplary induftry, and this rigid adherence to principle; notwithftanding his extraordinary merit as an artift; notwithftanding his loyalty and the paft favour of lord Arundel and Charles I., Hollar died poor and miferable, after a life of viciffitude, and for the moft part of fuffering.

During the diffolute reign of the fecond Charles, who was to liften to the claims of modeft and retired merit? The delighted purchafers of his " Seleucus," after Julio Romano; his " Fountain of Pleafures;" or his " Queen Sheba vifiting Solomon," (as will be the cafe under any reign where *patrons* are content to be acquainted with contemporary art only through the medium of parafites and dealers,) were either heedlefs of what befel their author, or were deceived into the belief that he was at leaft comfortably provided for; and while Stent, Overton, Green, and the reft of the dealers of that day, enjoyed their fire-fides in comfort, or rioted in the lap of luxury, on the profits of his works, the engraver of more than two thoufand plates, which are fince fought for through Europe, and moft of which

which are after his own deſigns, expired in the very act of intreating the bailiffs, who had entered his wretched apartment, for a little forbearance.

Hollar's plates are for the moſt part etchings, touched here and there, where ſuperior clearneſs was wanted, or the aqua-fortis had not accompliſhed its purpoſe, with the graver. His ſmall plates are ſuperior to his larger; his ſtyle of handling his etching-needle is pleaſing, and was original; and, in the accuracy, freedom, lightneſs, ſpirit, and finiſh of his cities, abbies, cathedrals, and ſome other of his landſcapes, and his plates of natural hiſtory and ſtill life, he much excelled his contemporaries; even thoſe on the continent: but in drawing the human figure he was not equally well informed, and his hands and feet are therefore often defective.

In conformity with the falſe preference which faſhion had conferred on works performed ſolely with the graving-tool, he attempted to execute ſome plates with the graver only, but has here failed of the ſucceſs that attended him in etching.

Hollar appears to have been a meek-tempered man, and to have wanted the neceſſary confidence in his own powers or the public taſte, to venture on publiſhing any of his own engravings; though Vertue aſcribes this effect to a different cauſe, which, no doubt, was at leaſt a concomitant, he ſays, "I don't find that at any time he worked for himſelf, to ſell or publiſh, as has been cuſtomary with profeſſors of that art (engraving) when they had ſubſtance of their own, or friends and intereſt ſufficient." Alas! what is ſociety if it befriend not the ingenious.

The innate love of engraving muſt be ſtrong in ſome minds, or the neceſſity of practiſing that art muſt be imperious, for Hollar to have left ſucceſſors. The truth, however, is, that in the department of his art, in which Hollar's merit chiefly reſided, he had no ſucceſſor, for Barlow, of whom we ſhall preſently ſpeak, was an Engliſh painter, who merely learned of him the proceſs of laying etching-grounds and uſing aqua-fortis; and William Carter, Daniel King, and Thomas Dudley, who were all natives of England, and pupils of Hollar, rather followed him to the grave, than ſucceeded him in art. The former was uſed occaſionally to aſſiſt his maſter; imitated feebly his ſtyle of etching; and is the engraver of the vignette head-pieces to Ogilby's Homer, and probably of many other of thoſe anonymous book-plates that ſome collectors aſcribe to Hollar. King is ſomewhat more conſpicuous. He publiſhed "The Vale Royal of Cheſhire" from his own drawings; and engraved for Dugdale's Monaſticon, and ſome other plates of topographical ſubjects. Dudley has occaſionally ſubſcribed himſelf "quondam condiſcipulus W. Hollar," and Mr. Strutt's account of him is as follows. "He was a native of England, and one of the pupils of the famous Hollar, whoſe manner of engraving he imitated. But though he never equalled his maſter in the lightneſs of his point or freedom of execution, his etchings are not without merit. His moſt conſiderable work was a ſet of cuts for the life of Æſop, prefixed to the laſt edition of his Fables, publiſhed by Barlow. He alſo etched the portrait of biſhop Ruſſel, which is ſubſcribed Thomas Dudley Anglus fecit 1679."

R. Gaywood has alſo been mentioned as a diſciple of Hollar, but he etched no views, or other landſcapes, and in engraving portraits employed leſs of etching; and, in ſhort, did not confine himſelf to the ſtyle of that maſter, but blended with it what he acquired from ſtudying Vorſt, Vorſterman, and the other engravers of the Vandyke ſchool.

Gaywood engraved a conſiderable number of portraits, among which are thoſe of queen Mary of Scotland, with a croſs; the counteſs of Portland, Holbein, Vandyke, and Dr. Fauſtus. The only hiſtorical engraving of any conſequence from his hand is the couchant Venus of Titian, which was once in king Charles's collection, and ſince in that of the earl of Cholmondeley.

Of Francis Barlow much more may with the greateſt truth be aſſerted. This artiſt was a native of Lincolnſhire, but in what year he was born was not known. He received his firſt inſtructions in art from a portrait painter of ſmall note of the name of Shepherd, and if he learned the uſe of the engraver's inſtruments from Hollar, he formed a ſtyle for himſelf.

The inventive powers of Barlow were extremely fertile. His great merit lay in deſigning and etching quadrupeds, birds, fiſhes, inſects; in ſhort, the whole volume of animated nature appears to have been open to his view, and in this reſpect, he is the fitteſt of all men to be the companion of that great moral philoſopher Æſop, whoſe fables he has ſo admirably embelliſhed. His human figures, which with conſiderable judgment he occaſionally introduced, exhibit the dreſſes and manners of his age; he had obſerved the natural inſtincts and cuſtoms of animals, and has delineated them with a fidelity which is ſurpriſing; and his landſcape back grounds often aſſume a grandeur which could only reſult from elevated ideas of art.

His compoſitions ſhew that he had ſtudied the animal and landſcape painters who preceded him, as well as nature herſelf, with advantage. In forming his ſtyle of etching, he has evidently looked at the animals of Hollar, yet is original, vigorous, free, and ſo happily varied, as to expreſs the feathery and hairy ſurfaces of birds and quadrupeds with a degree of ſucceſs which none of his predeceſſors, and only Hollar among his contemporaries, will bear to be compared with.

The frontiſpiece to his Æſop's fables, where Æſop himſelf appears ſurrounded by animals; the angler and entreating fiſh, with its landſcape accompaniments; the proſtrate camel; the battle of the frogs and mice; and the oak, and reed bending before the ſtorm, may be mentioned with diſtinguiſhed praiſe. His foxes, camels, aſſes, and wolves, are in general moſt excellent, and all his birds are ſo, without exception: but his lions, wherever they occur, are either ideal lions, and not well conceived, or ſhew that he had once ſeen and drawn from a bad model, and repeated it wherever he had occaſion for a lion.

Part of "Monk's funeral" is Barlow's engraving: and ſeveral of the plates for Edward Benlowe's "Theophila," publiſhed in folio, A. D. 1652; and ſome of thoſe for Ogilby's Virgil, are alſo deſigned and etched by Barlow.

That at ſome period of his life he had travelled northward, may be ſeen in the print which F. Place has engraved after his drawing of "the Baſs Iſland," wherein he has introduced ſoland geeſe, curlews, gulls, and all the varieties of Northern ſea fowl; and if he failed thither from any port of Scotland, it was probably during this journey that he ſaw in the latter country an eagle ſoaring with a cat in its talons, of which he afterward engraved a ſpirited plate. This anecdote is recorded both by lord Orford and Mr. Strutt, who agree in ſtating that Barlow witneſſed this contention in the air whilſt he was drawing a view in Scotland, and that the cat's reſiſtance had the effect of bringing both animals to the ground.

At one period of his life, probably towards its cloſe, he reſided near the ſign of the Drum in Drury-lane. That he was induſtrious is atteſted in the great number of his productions: yet notwithſtanding this circumſtance, and the praiſe of ſuperior excellence to which he is ſo juſtly entitled: and notwithſtanding the aſſiſtance of (Mr. Strutt ſays) "a conſiderable ſum of money," (he does not ſay how much) which was

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left him by a friend, he died in indigent circumftances in the year 1702.

Francis Place has fometimes been fpoken of as if he had learned etching of Hollar, but in a letter to Mr. Vertue he denies this; and indeed the ftyle which he adopted and the number of plates which he has engraved after the drawings and pictures of Barlow, teaches us rather to think he muft have ftudied under that mafter, if under any mafter at all. Lord Orford fays " his prints are very fcarce," but in a book which contains " fixty-feven excellent and ufeful prints of birds and beafts" after Barlow, to which modern ftudents and even academicians are not a little indebted, and worn impreffions of which book may now be purchafed of Carington Bowles for half a guinea the fet, are twenty plates of a moderate fize, which bear the name of Place, befide others which on a critical infpection may be feen to be from the fame hand. The birds in thefe prints are etched with fo much of the fpirit and feeling of Barlow himfelf, that they might well be fufpected to be his own performance, but for the name of Francis Place, which is annexed; nor are his graffy foregrounds, and the foliage and ramifications of his trees lefs excellent.

" This ingenious artift was the fon of Mr. Rowland Place, of Dinfdale, in the county of Durham." When young he was articled as clerk to an attorney in London, where he continued till the year 1665, when certain officers coming to fhut up the houfe where he refided, on account of the plague, he took the opportunity of quitting a profeffion that did not accord with his inclination, " and of following (fays lord Orford) the roving life he loved, and the arts for which he had talents."

In the courfe of his various rambles, he drew, painted, and engraved, as inclination prompted or opportunity occurred, befides difcovering fome occafional difpofition to mineralogical refearch, and fkill in the manufacture of pottery.

He drew and engraved views of Tinmouth caftle and light houfe, the cathedral of York; Scarborough caftle, feveral plates for Thorefby's Topography of Leeds, befide various other views in England, Wales, Scotland, and Ireland, and the figures for Godartius's book of infects.

His former biographers agree in affirming that during the reign of Charles II. he was offered a penfion of 500*l. per annum*, to draw the royal navy, but declined accepting it, having a competence without, and from his natural love of independence and diflike of confinement. He died in the manor houfe of York in the year 1728.

Befide the etchings which are here enumerated, and feveral others, Place engraved the portaits of bifhop Crewe, general Lambert, and Richard Thompfon, in mezzotinto: to treat of the difcovery and introduction of which art, we muft return back a few years.

Mr. Evelyn has been juftly ridiculed by lord Orford, for the myfterious and paradoxical manner in which he announces prince Rupert's difcovery of mezzotinto. It is, perhaps, one of the moft honeft, moft candid, and moft happily expreffed, of the numerous pages which his lordfhip has written on the fubject of fine art. " Ancient fages, fays he, ufed to wrap up their doctrines, difcoveries or nonfenfe, in fuch unintelligible jargon: (as Mr. Evelyn's) and the baby world, who preferred being impofed upon to being taught, thought themfelves extremely obliged for being told any fecret which they could not comprehend. They would be reckoned mountebanks in this age, who fhould pretend to inftruct without informing; and one cannot help wondering that fo beneficent a nature as Mr. Evelyn's fhould juggle with mankind, when the inventor himfelf had confented that the new art fhould be made public.

" It is a trite obfervation that gunpowder was difcovered by a monk, and printing by a foldier. It is an additional honour to the latter profeffion to have invented mezzotinto. Few royal names appear at the head of difcoveries; nor is it furprifing. One cannot expect that many of the leaft common rank fhould be bleffed with uncommon abilities. Quicknefs to feize and fagacity to apply are requifite to fortuitous difcoveries. Gunpowder, or printing, might have fallen in many a prince's way, and the world have been ftill happy or unhappy enough not to poffefs thofe arts. Born with the tafte of an uncle whom his fword was not fortunate in defending, prince Rupert was fond of thofe fciences which foften and adorn a hero's private hours, and knew how to mix them with his minutes of amufement without dedicating his life to thefe purfuits; (like us, who, wanting capacity for momentous views, make ferious ftudy of what is only the tranfitory occupation of a genius.) Had the court of the firft Charles been peaceful, how agreeably had the prince's congenial propenfity flattered and confirmed the inclination of his uncle! How the mufe of art would have repaid the patronage of the monarch, when for his firft artift fhe would have prefented him with his nephew! How different a figure did the fame prince make in a reign of diffimilar complexion! The philofophic warrior, who could relax himfelf into the ornament of a refined court, was thought a favage mechanic, when courtiers were only voluptuous wits. Yet if the prince was defective in the tranfient varnifh of a court, he at leaft was adorned by the arts with that polifh which alone can make a court attract the attention of fubfequent ages.

" Going out early one morning during his retirement at Bruffells, he obferved the centinel at fome diftance from his poft, very bufy doing fomething to his piece. The prince afked the foldier what he was about? he replied, the dew had fallen in the night, had made his fufil rufty, and that he was fcraping and cleaning it. The prince looking at it, was ftruck with fomething like a figure eaten into the barrel, with innumerable little holes clofed together like friezed work on gold or filver, part of which the fellow had fcraped away.

" The *genie fecond en experiences*, from fo trifling an accident conceived mezzotinto. The prince concluded that fome contrivance might be found to cover a brafs plate with fuch a grained ground of fine preffed holes, which would undoubtedly give an impreffion all black; and that by fcraping away proper parts, the fmooth fuperficies would leave the reft of the paper white."

Communicating his idea to Wallerant Vaillant, a reputable painter then in the neighbourhood of Bruffells, they made feveral experiments, and at laft invented a fteel roller with projecting points or teeth like a file, which effectually produced the black ground, and which being fcraped away, or diminifhed at pleafure, left the gradations of light.

Such was the invention of mezzotinto according to lord Orford, Mr. Evelyn, and Mr. Vertue; but the baron Heinnekin affirms that " it was not prince Rupert who invented the art of engraving in mezzotinto, as Vertue and feveral other authors pretend to fay; but it was the lieutenant colonel de Siegen, an officer in the fervice of the landgrave of Heffe, who firft engraved in this manner; and the print which he produced was a portrait of the princefs Amelia Elizabeth of Heffe, engraved as early as the year 1643. Prince Rupert, he adds, learned the fecret from this gentleman, and brought it into England when he came over the fecond time with Charles II."

The prefent writer has not feen the print thus fpoken of of by the baron: and the precife date of prince Rupert's difcovery is no where mentioned. But if a mezzotinto engraving dated feventeen years before the reftoration can be produced, and the date be genuine, it certainly goes far toward proving Heinnekin's affertion. Vertue acknowledges to have feen an oval head of Leopold William, archduke of Auftria, in mezzotinto, that was dated in 1656, which he efteems the earlieft. It is infcribed "Theodorus Cafparus á Furftenburgh canonicus ad vivum pinxit et fecit;" but this argues little againft prince Rupert's difcovery, fince it is quite within probability that Cafparus might have learned the art from the prince or Vaillant during their refidence in the Low Countries.

The earlieft of Rupert's engravings in mezzotinto, that is now extant, is dated in 1658. It is an half length figure from Spagnoletto: the fubject, an executioner holding a fword in one hand and in the other a head, which is probably intended for that of John the Baptift, and upon the fword are the initials R. P. F. furmounted with a coronet. It is further diftinguifhed by the following infcription on a tablet beneath "SP in RVP. P. fecit. Francofurti. anno 1658 M. A. P. M."

Return we now to the hiftorical progrefs of Englifh *engraving*, properly fo called; referring to the word Mezzotinto, for the improved modern procefs of that branch of the art.

Lord Orford fpeaks of William Faithorne the elder with diftinguifhed praife, and has given a tolerably correct lift of his engravings, which he has feparated into five claffes, and to which the reader, who may wifh to arrange the works of Faithorne, is referred. He lived at the fame period with Hollar, and about the year 1654 in the very fame houfe; but the year of his birth has not been afcertained. He was the difciple of Peak, the painter and print-feller, who was afterwards knighted, for whom he worked three or four years. With Peak he efpoufed the royal caufe, when the civil wars broke out between king Charles and his parliament; and with him, and probably with Hollar alfo, was taken prifoner at Bafing-houfe; from whence he was fent to London, and confined for fome time in the prifon of Alderfgate. In this uncomfortable fituation he exercifed his fkill as an engraver; and here he produced a fmall head of the firft Villiers duke of Buckingham, which is in the circular ftyle of Mellan.

At the folicitation of his friends, he was releafed from confinement, and permitted to retire to France: though Graham fays, he was banifhed for refufing to take the oaths of allegiance to Cromwell, and that he ftudied feveral years under Champagne.

Vertue, who received his accounts of Faithorne from Mr. W. Hill Clark, and Mr. Bagford, lord Orford's librarian, feems to difcredit thefe facts; but all agree that he found protection and encouragement in France from the abbe de Marolles, and obtained improvement under the juftly celebrated Nanteuil.

The latter indeed is fufficiently obvious in his engravings. At his return to England, which lord Orford thinks was before the time of the protectorate, he married a fifter of captain Cround, by whom he had two fons, and opened a print-fhop oppofite the Palfgrave-head tavern, without Temple-bar, affuming the fign of the Ship. Here he not only followed his art, but fold Italian, French, and Dutch prints, and alfo the engravings of other Englifh artifts; fome of which are ftill to be feen with the fubfcription "fold by William Faithorne." And here he appears to have remained about 30 years.

"Some time after the year 1680," fays lord Orford, "Faithorne quitted his fhop, and retired to a more private life in Printing-houfe yard, Blackfriars; ftill engraving, but chiefly painting from the life in crayons, in which art he had formerly received inftructions at Paris from Nanteuil." He alfo painted miniatures, and drew portraits in black and white. Faithorne was a robuft and vigorous man; but the mifconduct and confequent misfortunes of his fon William, broke down his frame and fpirits, and he died in the year 1691, and was interred in the church of St. Anne, Blackfriars.

The principal part of his engravings appears to have been executed during his refidence near Temple-bar, where he alfo wrote and publifhed a "Treatife on Engraving," A.D. 1662, which he dedicated to his former mafter, fir Robert Peake. The contents of this book, as difplayed in the title page, are as follows: "The Art of Graving and Etching, wherein is expreffed the true way of graving on Copper; alfo, the Manner and Method of that famous Callot and Mr. Bofs, in their feveral ways of Etching."

Portraits conftitute by far the moft numerous part of this artift's works. He worked almoft entirely with the graver, in a free and clear ftyle, paying more attention to the beauty of his lines than moft of his Britifh predeceffors. In the early part of his life, he feems to have followed the Dutch and Flemifh manner of engraving; but on his return from France, his improvement was evidently confiderable. His portraits are his beft works; and the beft of his portraits are juftly admired for their delicacy, freedom, and force of chiaro-fcuro.

Mr. Strutt has diftinguifhed the following among the more valuable of Faithorne's hiftorical engravings: "a holy Family," from S. Vouet, a middling fized plate, in the ftyle of Couvy; "a dead Chrift," from Vandyke; "the laft Supper," without any painter's name, in folio; "Chrift praying in the Garden," the fame; "the Marriage of Cana in Galilee," an etching, the fame; "the Scourging of Chrift," from Deepenbeck. Under this latter print is written "Faithorne Sculp. Antwerp, 1657," which date feems to have efcaped the notice of Vertue, and to falfify the opinion that lord Orford, on his authority, had formed, that "Faithorne returned to England before the protectorate."

His portraits, as has been already intimated, are too numerous to be detailed in this place.

William Faithorne the younger was far inferior to his father as an artift. His principal works are portraits, fcraped in mezzotinto, of which Vertue has particularized about thirty, with three prints of fancy fubjects, and a head of St. Mary Magdalen.

John Fillian was alfo a difciple of the elder Faithorne, whofe ftyle and fome of whofe portraits he copied. He was living in 1656, but died at an early age. His principal works are, "a Head of his Mafter," looking over his fhoulder, which is copied from a print by Faithorne himfelf; the portraits of "Thomas Cromwell," and "Paracelfus," and the "Frontifpiece" to Heylin's Cofmography, in folio.

Of Peter Lombart, Vertue has been able to trace little, but that he came from Paris, and returned thither after remaining for fome years in England; to which Strutt adds, that he was a native of France, and came into England before the revolution.

He worked in a neat, laboured ftyle, and difcovers but little tafte. His drawing is frequently incorrect; his outlines hard; his fhadows deficient in force and boldnefs; his lights of too low a tone, and even his engravings after Vandyke are deficient in *force*, though he has difcovered a tolerable

tolerable eye for the *harmony*, of chiaro-fcuro. Yet he worked after the pictures of the greateft mafters: after Raphael, Guido, Pouffin, Annibal Carracci, and Vandyke. Among the beft of his engravings are, "the laft Supper," a large upright, from Nicholas Pouffin; "the Angel appearing to Jofeph," after Ph. Champagne; "the Crucifixion," from the fame mafter; the "Frontifpiece," and feveral other plates for Ogilby's Virgil. Among his portraits from Vandyke is that of "Charles I." on horfeback, a large half-fheet print. From this plate he afterwards erafed the face, and fubftituted that of "Cromwell;" and at a fubfequent period, "with the vicar of Bray's graver," as lord Orford wittily fays, reftored the king's.

Vertue has enumerated twenty other of his portraits, which are chiefly after the fame mafter; and to them may be added a fet of twelve half-lengths of rather a large fize, of which ten are portraits of celebrated ladies of the court of king Charles.

Notwithftanding his referve in communicating prince Rupert's difcovery of mezzotinto, John Evelyn, efq. of Wooton, in Surrey, is entitled to honourable mention in this place. He was the firft Englifh gentleman who wrote upon the fubject of engraving; and though his "Sculptura" be deficient in artiftical knowledge and feeling, it is a work of confiderable erudition, and has contributed not a little to the advancement of the art; while it clearly evinces his love for engraving, the excellence of the example which he wifhed to fet, and the general goodnefs of his heart. Lord Orford handfomely fays of him: "If Mr. Evelyn had not been an artift himfelf, as I think I can prove [that he was], I fhould yet have found it difficult to deny myfelf the pleafure of allotting him a place among the arts he loved, promoted, patronized; and it will be but juftice to infcribe his name with due panegyric iu thefe records, as I have once or twice taken upon me to criticife him: but they are trifling blemifhes, when compared with his amiable virtues and beneficence; and it may be remarked, that the worft I have faid of him is, that he knew more than he always communicated."

The duration of the life of this great contributor to learning and the arts was protracted to 86 years, and he died in 1705.

It appears now to be agreed among the connoiffeurs, that the five fmall prints of Mr. Evelyn's "Journey from Naples to Rome," which his biographer thought were etched by Mr. Hoare, are Evelyn's own performances; and to thefe Mr. Strutt has added a "Portrait of Dobfon" the painter, from a picture by himfelf.

David Loggan was a native of Dantzick; he was born about the year 1635, and died in 1693. From Simon Pafs, in Denmark, he is faid to have received his earlieft inftructions in engraving; he afterwards refided in Holland, where he ftudied under Hondius; and a fhort time before the reftoration he came to England.

His drawings of All-Soul's college being taken great notice of at Oxford, he was requefted to undertake plates of the public buildings in that univerfity. By thefe engravings he firft diftinguifhed himfelf; and at Oxford he remained a confiderable time, and married Mrs. Jordan of a good family, near Witney. In the latter part of his life he refided in Leicefter fields, London; where he died.

In fatirifing the vanity of a certain dramatic poet, Dryden fays,

> "And in the front of all his fenfelefs plays,
> Makes David Loggan crown his head with bays."

Yet as Loggan's merits as an engraver were not fuch as to crown his own with lafting reputation: his *name* will probably live much longer than his works will be cared for. He etched very little, and his ftyle of engraving, though it has a certain degree of neatnefs, is ftiff and taftelefs. His portraits, of which he executed a confiderable number, are chiefly after his own drawings in black lead, which he handled with more ability, at leaft with a better tafte, than his graver.

Vertue has enumerated 76 portraits from the hand of Loggan, of which the principal are, three plates of "Charles II.;" "Mother Loufe of Loufe-hall," which it feems added much to his contemporary reputation; and "George duke of Albemarle," a half-fheet print, and probably his beft portrait from the life. He alfo engraved two views of "Cambridge;" a whole fheet view of "King's "College Chapel" in that univerfity; feveral views of public Buildings at Oxford; and eleven plates of the "Habits of the Academics" at that univerfity, which are entitled, "Habitus Academicorum Oxoniæ à Doctore ad Servientem;" and had (what feems an odd thing) a licence for fifteen years for vending his "Oxonia Illuftrata."

With David Loggan came over from Holland Abraham Blooteling and Gerard Valck, men of fuperior talents, though probably of inferior addrefs. Vertue informs us, that whilft in England, Blooteling received thirty guineas (a large price in thofe days) for an etching of the duke of Norfolk. His powers were various: he etched, engraved, and fcraped in mezzotinto. His etchings are fpirited and free; and his mezzotintos of a clear grain, and tolerably well drawn. About eighteen of his portraits are enumerated by Vertue, of which the principal are, "Anthony earl of Shaftefbury," one of the fcarceft of Blooteling's works; and "Prince Rupert," after fir P. Lely. The portrait of "Admiral Kortenaer," a large upright, from Bartholomew Vander Helft, is not among thofe mentioned by Vertue.

After remaining fome few years in England, Blooteling returned to Amfterdam; and in the year 1685, publifhed there the "Gems of Leonardo Auguftino," from plates etched by himfelf.

Gerard Valck was originally Blooteling's fervant, (perhaps apprentice,) but afterwards married his fifter. Some of the beft engravings, or beft parts of thofe engravings, which were publifhed in the name of Loggan, are probably the performances of Valck, who alfo affifted Peter Schenck in his large Dutch Atlas, publifhed in 1683. Lord Orford fays, that he "engraved one of the fineft prints we have: it is the famous "Duchefs of Mazarine," fitting in very loofe attire, with one hand on an urn;" but this praife is more than the engraving deferves. His other works are, a "Bathfheba bathing," from B. Graat; and the portraits of "Robert Lord Brooke," and "John Duke of Lauderdale." Vertue knew of no other plates that were entirely engraved by Valck.

Notwithftanding the "Sculptura" of Evelyn, and the merits of Hollar, Barlow, Faithorne, and the engravers of the Vandyke fchool, the tafteleffnefs and diffolute manners of the court of Charles II. had now reduced the art of engraving to a very low ebb. Its records are fcarcely more than thofe of the commoneft trade.

Edward le Davis was of Welfh extraction, and, having fome inclination for the arts, was articled as an apprentice to David Loggan. Being maltreated by his miftrefs, who obliged him to wear a livery, and follow her as a fervant, he abfented himfelf, went over to France, and became a dealer in pictures. On his return he drew and engraved feveral portraits, and fome other fubjects; but their merits are inconfiderable. Vertue mentions the names of nine of thefe portraits,

portraits, of which the moſt remarkable are, "King Charles II." ſeated, whoſe face was afterwards eraſed from the copper, and that of William III. ſubſtituted in its ſtead; "Queen Catherine of England," a large whole length; and "James Duke of York," a large head in an oval, ſurrounded by flowers. Le Davis alſo engraved an "Ecce Homo," after Caracci, which is become ſcarce; and "a Merry Andrew," after Frank Hals.

About the ſame time with Blooteling, Michael Burghers was alſo driven hither by the troubles in the United Netherlands, and ſettled at Oxford. His works are executed entirely with the graver, in a ſtiff, laboured ſtyle: and his drawing of the human figure very defective. The moſt valuable of his engravings are the antiquities, conſiſting of ancient pavements, ruined monaſteries, &c. which he executed for that indefatigable antiquary, Thomas Hearne. Mr. Strutt, ſpeaking of them, ſays, "though we cannot admire the taſte with which they are executed, yet they become eſtimable, becauſe they ſtill continue to us an idea of thoſe monuments of antiquity, which time had otherwiſe obliterated for ever."

Excepting theſe, his beſt prints are probably a few which he copied from Mellan, wherein he imitated the ſpiral ſtyle of that ſingular maſter, and among which are, a large "Face of our Saviour," executed in a ſingle ſpiral line; and "a Frontiſpiece" to Creech's tranſlation of the Satires of Horace, a much ſmaller plate. He alſo engraved ſome few of the "Oxford Almanacks," beginning (though the plate appears without his name) in the year 1676, and did ſeveral other plates, among which are the old chapel of Queen's college, before it was pulled down, for that learned univerſity; ſometimes adding to his name, when he inſcribed it beneath his engravings, "Academiæ Oxon. Calcographus."

Peter Vanderbank was an engraver of more merit. He was born at Paris, though probably of Dutch anceſtors, and ſtudied under De Poilly. He arrived in England about the year 1674, and here he married the ſiſter of Mr. Foreſter of Bradfield, in Hertfordſhire. Lord Orford ſays, he "was ſoon admired for the ſoftneſs of his prints, and ſtill more for the ſize of them; ſome of his heads being the largeſt that had yet appeared in England." But ſoftneſs and admiration are comparative terms; and the reader muſt not ſuppoſe that his portraits are in that reſpect comparable with thoſe of Nanteuil or Houbraken. Yet the merit of paying more attention than had hitherto been paid in England to the manual part of engraving is certainly his; and this circumſtance, added to the large dimenſions of many of his plates, occaſioned them to occupy ſo much time, that he was by no means adequately compenſated for his labour. After ſtruggling for a time with poverty, print-dealers, and the low taſte of the times, he retired without compromiſing his merits, and found an aſylum under the friendly roof of his brother-in-law at Bradfield, where he died in the year 1697.

"After his death, his widow diſpoſed of his plates to Brown, the print-ſeller, who made great advantage of them, and left an eaſy fortune."

Vanderbank engraved ſome plates after Verrio's pictures at Windſor, but by far the greater part of his works are portraits, of which Vertue has enumerated no fewer than fifty! which, conſidering the large ſize of ſome of them, is no trifling evidence of his profeſſional diligence. Thoſe of moſt importance are, "King Charles II." in his greater robes, after Gaſcar, (done the year after Vanderbank's arrival;) another portrait of Charles, two feet four inches high, by two feet wide! "King James II." after ſir Godfrey Kneller, large; "Mary his Queen," ditto; ſeparate plates of "King William" and "Queen Mary;" "Thomas Lamplugh, archbiſhop of York," which is one of the fineſt of his works; and two heads of Waller the poet, at the ages of twenty-three and ſeventy-ſix.

Arthur Soly, William Elder, John Drapentier, Robert Jackſon, Francis Bragge, Paul Vanſomer, Nicholas Yates, John Collins, Simon Gribelin, William and John Clarke, and R. Tompſon, who all lived and engraved about the time now under our obſervation, are unworthy of particular notice. "The art of engraving," ſays Vertue, "had ſunk ſo low about the cloſe of the century, that Verrio, Cooke, and Laguerre, could find no better artiſts to engrave their deſigns than Gribelin and Vanſomer." "He might in juſtice have added," obſerves lord Orford, "that the engravers were good enough for the painters."

Of Robert White, who was born in London in the year 1645, and died in 1704, little more can be ſaid, except on the ſcore of his drawings in black-lead, and his profeſſional induſtry, which, judging from the number of his engravings, may well excite our ſurpriſe. Vertue praiſes his portraits more than they will be found to deſerve as engravings. Yet all his biographers agree that the merit of producing a ſtrong likeneſs was certainly his, and in portrait engraving this is the firſt of merits.

The preſident of the Royal Academy (Mr. Weſt) is in poſſeſſion of ſome of his pencil drawings on vellum, which are ſuperior to his prints; and ſir Godfrey Kneller thought ſo well of them, that he painted White's portrait in return for drawings of his own and his brother's, from the hand of the engraver. The reader will find White's portrait of ſir Godfrey in Sandrart's lives of the painters.

From David Loggan he learned the rudiments of engraving, and in the year 1674, which is two years before Burghers was employed on the "Oxford Almanack," White produced the firſt of that ſeries.

For the generality of his portraits for books, which are disfigured by the broad borders that were then the faſhion, he received at the rate of four pounds each, with the occaſional addition of ten ſhillings; thirty pounds, which was paid him by Mr. Sowters of Exeter for a portrait of the king of Sweden, (which the preſent writer has not ſeen, but which was probably of much larger dimenſions,) has been ſpoken of as an extraordinary price. So great, however, is the number of his engravings, that in the courſe of forty years he ſaved from four to five thouſand pounds; and yet, ſay his biographers, (with little reflection copying each other,) by ſome misfortune or ſudden extravagance, he died in indigent circumſtances at his houſe in Bloomſbury. The reader, probably, will not readily believe, that the habits acquired by the patient profeſſional induſtry of forty years, could plunge into ſudden extravagance.

Of his own works he made no regular collection, but when he had done a plate, rolled up two or three proofs, and flung them into a cloſet, where they were found in heaps. Many of theſe proofs may now be found in the collections of thoſe curious perſons who take Grainger for their guide.

The plates which he had by him were, after his deceaſe, ſold to a printſeller in the Poultry, who in a few years, according to lord Orford and Mr. Strutt, enriched himſelf by the purchaſe. Vertue expreſſes his honeſt diſpleaſure that ſo large a portion of the produce of our engraver's induſtry ſhould devolve to the dealer; but ſo it has ever been: and if he complains for White, how loudly ſhould he complain for Milton!

The number of his portraits of which Vertue has collected the names, are two hundred and ſeventy-five, of which,

which, two are ſcraped in mezzotinto, and all the reſt engraved in lines. Some few of Robert White's plates are finiſhed by his ſon George, who chiefly practiſed in mezzotinto, but engraved a few plates in lines, of which the principal one is a large portrait of "James Gardiner," biſhop of Lincoln.

John Sturt, the pupil of White, who was born in London in the year 1658, and lived to the age of ſeventy-two, was a man of ignorant ingenuity. His principal work is the "Book of Common Prayer," which he engraved on ſilver plates. The top of every page is ornamented with a ſmall hiſtorical vignette. Prefixed is the buſt of George I. in a circle, and facing it the prince and princeſs of Wales. The peculiarity of this work is, that the lines of the king's face are expreſſed by writing, ſo ſmall that few perſons can read it without a magniſying glaſs, and that this writing conſiſts of the Lord's prayer, the Ten Commandments, prayers for the royal family, and the 21ſt Pſalm. So that here are prayers which cannot be read, and a head which might have been better produced with a hundredth part of the labour. This *uncommon* Common Prayer Book was publiſhed by ſubſcription in London in the year 1717. It was in large octavo, and was followed by a "Companion to the Altar" of the ſame ſize, and executed in the ſame manner. Sturt was alſo the firſt man who poſed the wondering multitude of "microſcopic wights," by engraving the Lord's Prayer within the area of a circle of the dimenſions of a ſilver penny.

To this wonder-niggling ſtate was engraving reduced, when, at the commencement of the new century, ſir Nicholas Dorigny ſhone forth on the darkened arts of England. He was born in France, and was a younger ſon of Michael Dorigny, by a daughter of Vouet the painter. His father dying whilſt he was young, he was brought up to the ſtudy of the law, which he purſued till he was about thirty years of age: being then examined, in order to his admiſſion into the corps of advocates, the judge found him very difficult of hearing, and accordingly adviſed him to relinquiſh a profeſſion for which he was in this reſpect ſo ill qualified by nature. He took the advice, and immediately applied himſelf to drawing with great aſſiduity. After a year's experience in this art he repaired to Rome, where his brother at that time reſided, and here he followed painting for ſome years; when, having acquired great freedom of hand, and being uncommonly docile and flexible in his diſpoſition, he followed the recommendation of certain friends, who adviſed him to ſtudy etching. In this art he produced ſeveral works of merit, but the engravings of Audran, which were now the topic of general and juſt encomium, convinced him that the ſtyle he had adopted was ſuſceptible of great improvement; and he employed *ten years* in emulating the vigour and grandeur of that diſtinguiſhed artiſt. He had now etched many plates, and among them the ſeries from the fable of "Cupid and Pſyche," after Raffaelle, when, feeling that he had not acquired that command of the graver which was neceſſary to the harmonious perfection which he contemplated, he abandoned engraving for a ſhort time and returned to his pencils. "A word from a friend," ſays lord Orford, "would have thrown him back to the law:" this, however, it is not eaſy to believe.

After two months re-application to painting, he reſolved to acquire that power over the graver, of which he had ſo ſtrongly felt or fancied the neceſſity. All theſe feelings and reſolutions are thoſe of an artiſt of genius. With a little inſtruction, he rapidly acquired the knowledge and power of which he was in queſt, and begun to engrave the ſet of "Seven Planets," after Raffaelle; in which he ſucceeded ſo well, that he was now emboldened to undertake Raffaelle's "Transfiguration," the accompliſhment of which raiſed his reputation to an extraordinary height.

Being known to ſeveral Engliſh noblemen and gentlemen of rank, who at that time reſided in Italy, he was perſuaded to come to England, and undertake to engrave the Cartoons. He arrived in June 1711, but experienced ſome diſappointment, and was not enabled to begin his drawings till the year following, the intervening time being ſpent in raiſing a fund to enable him to proſecute his intended work.

At firſt it was propoſed that the plates ſhould be engraved at queen Anne's expence, and that the impreſſions ſhould be given as preſents to the nobility, foreign princes, miniſters, &c.; but this was too liberal even for what has been emphatically called the Auguſtan age of England, which had now commenced. Dorigny eſtimated the expences at four or five thouſand pounds, but though the lord treaſurer Orford exerted himſelf greatly in the cauſe of the artiſt, he could not obtain the ſum, and this plan was conſequently rendered abortive.

The engraver had, however, an apartment aſſigned him in Hampton Court palace, and the work was at laſt undertaken by a public ſubſcription, at four guineas the ſet.

The labour of ſeven plates of the large dimenſions that were reſolved on, appearing too great for the hand of a ſingle individual, who was not young, Dorigny was induced to ſend to Paris for aſſiſtance; and for the firſt two or three years obtained that of Dupuis and Duboſc, who both quitted him before the engravings from the Cartoons were half completed.

In ſomewhat leſs than ſeven years, however, from the date of his arrival, (namely, on the 1ſt day of April, 1719,) Dorigny had the honour of preſenting two complete ſets of theſe celebrated engravings (with an engraved dedication) to king George I., one ſet to the prince, and another to the princeſs, when he received from his majeſty a purſe of a hundred guineas, and a medal from the prince; and the duke of Devonſhire, of whom he had borrowed four hundred pounds, freely remitted the intereſt for four years. His reputation from this time continued to increaſe through Europe, and in the year following he received the further honour of knighthood from the hand of his majeſty.

In a few years after the completion of the Cartoons, the eyes of our engraver began to grow dim, and either this circumſtance, or the natural inclination of man to return to the place of his nativity, occaſioned his return to Paris, where, in the year 1725, he was made a member of the Royal Academy of Arts, and where he died at the advanced age of eighty-nine.

His drawings from the old maſters, chiefly after Raffaelle, Dominichino, Guercino, and Daniel de Volterra, have been much admired, and have ſold for conſiderable ſums; and beſides the plates mentioned above, he engraved "St. Peter curing the lame Man," a large upright from Civoli, which is one of his early works, and in the dark manner of his father; "The Deſcent from the Croſs," after Daniel de Volterra, a very fine engraving; the "Martyrdom of St. Sebaſtian," after Dominichino, an upright, and equally meritorious; "The Holy Trinity," from Guido; and a few other plates from A. Carracci, Lanfranc, and Louis Dorigny, his brother.

When the late period of life at which Dorigny began to uſe the graver is conſidered, the power which he acquired over that inſtrument muſt be regarded as extraordinary: the art with which he mingled the lines of the graver with thoſe of the etching-needle is alſo much to be admired; and though it muſt be allowed that in copying Raffaelle's forms he has often loft much of their exquifite grace and chaftenefs, and has rendered the characters of his heads but coarfely, yet on the whole he rides his graphic Pegafus with mafculine grace. There is a manly energy and freedom in his ftyle, bridled by fimplicity; his fhadows are full-toned, clear, and rich; and though his flefh be deficient in characteriftic texture, the lines are often conducted over his draperies with unprecedented freedom and elegance, of which the figure of "St. Paul preaching at Athens," and that of the fame apoftle in the Cartoon of "Elymas the forcerer, ftruck blind," may be fufficient examples. Indeed, a critical eye may trace in the arrangement of Dorigny's lines, the rudimental principle of that fimple fyftem of drapery-engraving, which Mr. Heath and his fchool have fince polifhed and rendered more perfect.

Charles Dupuis, who has been mentioned as the affiftant of Dorigny, engraved fome plates from the hiftory of the misfortunes of Charles I., but the climate of England not agreeing with his conftitution, he returned to Paris, and died there in the year 1743. A younger brother of his alfo came over, but returned in difappointment, finding Britifh encouragement lefs than he had expected.

Claude Dubofc quitted Dorigny's fervice at the fame time with Dupuis, but fettled here, and, with more boldnefs than ability, undertook to engrave the Cartoons on a fmaller fcale than Dorigny's for the printfellers, who prefumptively, were *cunning* enough to think, not of tranfcending, but of *underfelling* the engravings of that diftinguifhed artift. He next engaged himfelf to engrave a fet of the duke of Marlborough's battles, for which he received at the rate of four-fcore pounds *per* plate. At firft he had no affiftance but what he received from du Guernier, but afterwards fent to Paris for Beauvais and Baron, who affifted him in the completion of thefe engravings. He now commenced printfeller, and publifhed in numbers a tranflation of Picart's "Religious Ceremonies," in engraving which, he was affifted by Gravelot and Scotin, who came over to England for that purpofe.

Dubofc's ftyle of engraving is heavy, and his drawing of the naked very indifferent, which renders it not improbable that the worft parts of Dorigny's Cartoons are by his hand. Among his works, which are not very numerous, the "Continence of Scipio," from that picture of Nicholas Pouffin, which was in the Houghton Collection, is probably the beft.

Of the Winftanleys, as engravers, little can be faid. Henry (the elder) etched feveral views of "The Palace at Audley-end;" and Hamlet (fon of the former) etched twenty plates from the earl of Derby's Collection, and a fet of prints from fir James Thornhill's "Cupola of St. Paul's Cathedral."

The father was projector and builder of the Eddyftone light-houfe, and when it was thrown down by a dreadful tempeft, was buried in its ruins. To his etchings of Audley-end, which were dedicated to king James II., he added an infcription in honour of fir Chriftopher Wren, and the plates being "referved by the defcendants of the earl of Suffolk," (according to lord Orford,) the impreffions are now become fcarce.

The fon ftudied under the Knellers, and afterwards in Italy, yet he made no great figure as an artift. The nobleman quoted above, fpeaks of his houfe at Littlebury, where "were feveral mechanic tricks to furprife the populace, which were known by the name of "Winftanley's Wonders." Thefe childifh contrivances, I fuppofe, he learned in Italy, where they do not let their religion monopolize *all* kinds of legerdemain. In the noble palace of the villa Borghefe," adds his lordfhip, "was the noble ftatue of Seneca dying in the bath, and a devil that ftarted out of a clock-cafe as you entered the room." Hamlet painted a few portraits with moderate ability.

The affiftance which du Guernier rendered to Dubofc in his "Battles of the Duke of Marlborough," has been already mentioned. He ftudied under Chatillon, at Paris, and came to England in 1708. The London Academy, as it was called, was then eftablifhing under the aufpices of fir Godfrey Kneller, and du Guernier was chofen director of it, and continued fo to the time of his death, which was occafioned by the fmall-pox, and happened Sept. 19, 1716, when he was but thirty-nine years of age. Befides his fhare of the Marlborough's battles, he engraved a few frontispieces, chiefly for plays, and, at the inftance of lord Halifax, a large print of "Lot and his Daughter," from Caravaggio, and the portraits (large) of the "Duke and Duchefs of Queenfbury."

Bickham, Coignard, Johnfon, George King, Nichols, and Simpfon, who were all contemporary, are paffed over for reafons which have formerly been given. John Kip engraved a confiderable number of the palaces and feats of the nobility and gentry from Knyff, but they were indifferent, and were far from advancing the art.

It has been already mentioned, that Girard Scotin, the younger, came over from Paris to affift Dubofc. He ftudied under his father, who was an engraver and a difciple of De Poilly, but was a man of more induftry than talent. His principal works are, "Belifarius," a large plate, after Vandyke, or Murillo, for it does not appear to be afcertained to which of thefe mafters this celebrated picture fhould be afcribed; and "Alfred receiving the Account of the defeat of the Danes," from Blakeney. He alfo affifted Hogarth in fome of his feries, and engraved a few portraits.

Henry Gravelot, who came hither at the fame time, was an artift of much more tafte. His opportunities of obferving nature had been more various and extenfive than fell to the lot of many of his contemporary profeffors of the fine arts. He was a native of France, but had been in America as fecretary to the governor of Canada: the climate difagreeing with him, he returned to Paris, whence he was invited to England by Dubofc.

He was for fome time employed in Gloucefterfhire, drawing churches and antiquities, and, according to lord Orford, he drew the monuments of kings for Vertue. For the bookfellers he made a very great number of defigns, both hiftorical and ornamental, wherein his tafte and the fertility of his inventive powers are eminently confpicuous. From many of thefe he made etchings, as alfo many after the defigns of Hayman, and the fame tafte and facility attended his etching-needle, which is confpicuous in the productions of his pencil.

In fir Thomas Hanmer's and Theobald's editions of Shakefpeare, a great number of his engravings, and feveral of his defigns, may be found. His principal work on copper is a large print of "Kirkftall Abbey," which Strutt fpeaks of as a fine fpecimen of his abilities, but which the prefent writer has not feen. He lived to the age of feventy-four, and died at Paris in the year 1773.

Bernard Baron was alfo tranfplanted hither from the continent by Dubofc, who appears to have been a great fpeculator in this fpecies of culture. They differed, and went to law, on the fubject of a fet of engravings after Dr. Mead's pictures from the hiftory of Ulyffes, by Rubens, but were afterwards reconciled, and went to Paris together in the year 1729. After engraving fome plates for Monf. Crozat,

Crozat, from the royal collection, he returned to England, and here he executed a conſiderable number, and had the ſatisfaction of working after ſome of the fineſt pictures in the kingdom.

His ſtyle is chiefly ſtudied from that of ſir Nicholas Dorigny, generally coarſe, but occaſionally ſomewhat ſoftened and incorporated with the prevailing taſte of the French ſchool. His principal engravings are as follow, and are all large plates. "Vandyke's equeſtrian figure of Charles I." from the royal gallery at Kenſington; the "Cornaro family," from the celebrated Titian at Northumberland houſe; the "Pembroke family," from the ſame maſter, at Wilton houſe; the "Naſſau family," from the ſame, in the collection of earl Cowper; the "Jupiter and Antiope," alſo after Titian, executed in Paris; "Henry VIII. granting the charter of incorporation to the company of Surgeons" from Holbein. Baron died in Panton ſquare, Piccadilly, in the year 1762.

Chereau, the younger, was alſo imported from Paris by Duboſc, and engraved a profile likeneſs of George I. which poſſeſſes ſome merit, but finding or fancying, that his talents were undervalued in England, he ſoon returned.

Michael Vandergucht, originally of Antwerp, ſtudied under Boutats, but was the maſter of Vertue. The year of his arrival in England is not known: here, however, he met with ſome encouragement, and reſided in London. His chief employment was to engrave anatomical figures, but he ſometimes undertook ſubjects of a different kind. His maſter-piece, according to Vertue, was a portrait of Mr. Savage. He alſo engraved a very large plate of the royal navy from Baſton.

John Vandergucht, ſon of the preceding, was born in 1697, and acquired from his father the manual practice of engraving, but ſtudied drawing under Lewis Cheron, and afterwards at the London Academy. He was employed by Cheſelden to draw and engrave the ſubjects for his Oſteology, a work by which he obtained much credit; and he had a conſiderable ſum for engraving "Sir James Thornhill's cupola of St. Paul's cathedral." The ſix academy figures which he engraved from the drawings of his maſter Cheron, ſhew that he underſtood drawing better than he could manage the graver. He alſo engraved Pouſſin's "Tancred and Erminia."

He produced a great number of book-plates, of which the merits were not great, and ſome were alſo engraved by his brother Gerard Vandergucht, who was a great dealer in pictures, lived to the age of eighty years, and died in 1778 at his houſe in Brook-ſtreet, the ſame that is now inhabited by Treſham the academician.

George Vertue was born in the year 1684, in the pariſh of St. Martin in the Fields, London, and was put apprentice at the age of thirteen to a maſter who engraved heraldry on plate. This perſon being obliged to leave the kingdom by the time Vertue had been three or four years under him, our artiſt returned to his parents. He then gave himſelf entirely to the ſtudy of drawing for two years, when he became the pupil of Michael Vandergucht; with whom he engaged to remain three years, but protracted his ſtay to ſeven, when he quitted his maſter on handſome terms, and begun to engrave book-plates for himſelf.

"The art was then, ſays lord Orford, at the loweſt ebb in England. The beſt performers were worn out; the war with France ſhut the door againſt recruits; and the animoſity of faction diverted public attention from the common arts of amuſement." At this period our young engraver was recommended to the notice of ſir Godfrey Kneller, whoſe reputation ſuſtained the remaining dignity of art: Kneller befriended him, and he was ſoon after employed by lord Somers, who, according to Strutt, "rewarded him generouſly," and by his talents and induſtry he was now enabled to ſupport his widowed mother, with her family of ſeveral children.

In the year 1711 he begun to ſtudy at the academy which ſir Godfrey had recently inſtituted; where he continued to draw for ſome years with great aſſiduity. He had now produced his famous head of archbiſhop Tillotſon, which lord Orford emphatically calls "the ground-work of his reputation," and ſoon after the acceſſion of the preſent royal family, he publiſhed a large portrait of king George I. from a picture by Kneller. "As it was the firſt portrait of that monarch, many thouſands were ſold, though by no means a laborious or valuable performance. However it was ſhewn at court, and was followed by his undertaking to engrave portraits of the prince and princeſs."

Vertue had now commenced thoſe biographical and antiquarian reſearches, in which he has been ſo eminently ſucceſsful. In theſe purſuits he made many journeys to different parts of our iſland, and his time was induſtriouſly employed in making drawings, catalogues, and various memoranda.

"His thirſt after Britiſh antiquities ſoon led him to a congenial Mæcenas. That munificent collector, Robert Harley, ſecond earl of Oxford, diſtinguiſhed the merit and application of Vertue;" and the invariable gratitude of the latter, expreſſed on all occaſions, atteſts at once the bounty of his patron and his own humility.

Another of his patrons was Heneage Finch, earl of Winchelſea, whoſe portrait he painted and engraved, and who, being preſident of the Society of Antiquaries on its revival, in 1717, appointed Vertue, who was a member, engraver to that learned body.

Henry Hare, the laſt lord Coleraine, was alſo one of his antiquarian benefactors, and the univerſity of Oxford employed him for many years to engrave the head pieces for their almanacks.

With lord Orford, lord Coleraine, and Mr. Stephens the hiſtoriographer, he made ſeveral tours to various parts of England. For the former he engraved portraits of "Matthew Prior," "ſir Hugh Middleton," and other diſtinguiſhed men: for the duke of Montague he engraved, "ſir Ralph Windwood;" for ſir Paul Methuen, the portraits of "Cortez," and "Archbiſhop Warham" from Holbein's original at Lambeth; and for lord Burlington, Zucchero's "Queen Mary of Scotland," a plate which evinces more felicity, and a better taſte of execution, than moſt other of his works.

In the year 1727 he travelled with lord Orford to Burleigh, Lincoln, Welbeck, Chatſworth, and York, at which latter place he obtained from Francis Place, whom we have mentioned, many of thoſe anecdotes of Hollar which are inſerted in his biography.

In the next year, the duke of Dorſet invited him to Knowle. From the gallery there, he copied the portraits of ſeveral of the poets. Here he was on fairy ground, and Arcadia was on the confines; but he was diſappointed on an excurſion to Penſhurſt, at not finding there any portrait of ſir Philip Sydney.

In 1730 appeared his twelve heads of diſtinguiſhed poets, one of his capital works, which he meant to have followed with the portraits of other eminent men, arranged in claſſes, but this ſcheme was taken out of his hands by the Meſſrs. Knapton; and there is reaſon to think that Vertue's rigid regard for veracity, which made him juſtly ſcrupulous of authenticating the likeneſſes of deceaſed characters without the cleareſt proofs, and not the ſuperior taſte or diſcernment of the Knapton's, made them engage the fuperior talents of Houbraken and Gravelot, to finifh a work which our artift had begun, and had himfelf projected.

His next confiderable production was, the portraits of king Charles I. and the loyal fufferers in his caufe, with their characters fubjoined from Clarendon. But this was fcarcely finifhed, before Rapin's hiftory of England appeared, "a work, (fays he,) which had a prodigious run, infomuch that it became all the converfation of the town and country, and the noife being heightened by oppofition and party, it was propofed to publifh it in folio by numbers, of which thoufands were fold every week." The Meffrs. Knapton engaged Vertue to accompany it with effigies of the kings and other fuitable embellifhments, an undertaking which occupied three years of his life. He prefented a copy of this work, when finifhed, richly bound, to the prince of Wales, at Kenfington.

He now renewed his topographical journies, accompanied fometimes by the earl of Leicefter, fometimes by lord Oxford, and fometimes by Roger Gale the antiquary; and between the years 1734-38, vifited St. Albans, Northampton, Oxford, Penfhurft, Warwick, Coventry, Stratford, and travelled through the counties of Kent, Suffex, and Hampfhire, where he made various fketches, drawings, and notes, always prefenting a duplicate of his obfervations to his patron lord Oxford.

In 1739, he travelled eaftward with lord Coleraine, through the counties of Effex, Suffolk, and Norfolk, ftopping as ufual to make drawings and obfervations at every memorable church, feat, or other fpot congenial to his purfuits. In 1741 he loft his noble friend and patron the earl of Oxford, who died on the 16th of June. But his merit and modefty ftill raifed him benefactors. The countefs dowager of Oxford, even, alleviated his lofs, and the duchefs of Portland (their daughter), the duke of Richmond, and lord Burlington, did not forget him among the artifts whom they patronized.

In the year 1749, he found a yet more exalted protector in the prince of Wales, whom he often had the honour of attending, and to whom he fold many prints, miniature pictures, &c.

"He had now reafon to flatter himfelf with permanent fortune. He faw his fate linked with the revival of the arts he loved; he was ufeful to a prince who trod in the fteps of the accomplifhed Charles, and no Hugh Peters (adds lord Orford) feemed to threaten havoc to the growing collection." But the death of this prince fuddenly blafted the hopes of Vertue, and affected him with confiderable dejection of fpirits, from which, according to his lordfhip, he never perfectly recovered. He died in the year 1756, and was buried in the cloifters of Weftminfter abbey.

By the majority of connoiffeurs, Vertue's talents as an engraver have been over-rated. He rarely rifes above mediocrity, and fometimes finks below it, yet the prefent writer muft freely declare his furprife when he firft faw a good impreffion of Vertue's print of "Mary Queen of Scotland," after Zucchero, at the fuperior merits which it difplayed.

A much more copious biography of this artift will be found in the printed works of lord Orford, and alfo a catalogue of his engravings (amounting to near five hundred!) claffed under the heads of "Royal Portraits," "Noblemen," "Bifhops," "Poets," "Antiquaries," "Tombs," "Hiftoric Prints," "Coins," "Medals," "Frontifpieces," &c. &c. &c.

To all the diftinguifhed notice and patronage with which Vertue was honoured, and to the repeated praife of lord Orford, who was one of his friends, he was entitled lefs by his talents as an artift, or native independence of mind, than by his patience and accuracy of refearch as an antiquary, and as his noble biographer cannot boaft of his genius, it might, perhaps, have been thought that he did right to dwell with fo much feeming approbation on his diligence and humility; if he had not himfelf left pofterity fuch abundant room to wifh that he had refpected genius more, and been lefs completely fatisfied with the blandifhments, which plodding mediocrity may with little difficulty acquire.

We now approach the lefs patronized and more highly refpectable name of William Hogarth, upon whofe valuable works as painter and engraver, fo many volumes might be profitably written. The able pen to which the biography of the former defcription of artifts is confided, will doubtlefs claim Hogarth as a painter, yet, as he was both by education and long practice an engraver alfo, he muft not here be paffed in filence.

In the narrative which he left behind of his own life and opinions, where his philofophy is not lefs confpicuous than his manly franknefs, and where his forefight with refpect to the well-being of Britifh art has fhewn itfelf prophetic, he informs us, that he was born in London in the year 1697; that during his infancy he derived uncommon pleafure from fhews and mimickry; that an early accefs to a neighbouring painter drew his attention from play; and that when at fchool his exercifes were remarkable for the ornaments with which they were adorned.

He was fcarcely more attracted by art, than driven from literature, which was the profeffion of his father. "Befides the natural turn I had for drawing," proceeds he, "I had before my eyes the precarious fituation of men of claffical education. I faw the difficulties under which my father laboured, and the many inconveniences he endured from his dependance being chiefly on his pen, and the cruel treatment he met with from bookfellers and printers. It was, therefore, very conformable to my own wifhes that I was taken from fchool, and ferved a long apprenticefhip to a filver-plate engraver.

"I foon found this bufinefs in every refpect too limited. The paintings of St. Paul's cathedral and Greenwich hofpital, which were at that time going on, ran in my head, and I determined that filver-plate engraving fhould be followed no longer than neceffity obliged me to it.

"Engraving on copper was, at twenty years of age, my utmoft ambition. To attain this it was neceffary that I fhould learn to draw objects fomething like nature, inftead of the monfters of heraldry, and the common methods of ftudy being much too tedious for one who loved his pleafure, I was led to confider whether a fhorter road than that ufually travelled was not to be found. I had learned by practice to copy with tolerable exactnefs in the ufual way; but it occurred to me that there were many difadvantages attending this method of ftudy, as having faulty originals," &c. Drawing in an academy, (Hogarth means a fchool,) though it fhould be after the life, will not make the ftudent an artift, for as the eye is often taken from the original to draw a bit at a time, it is poffible he may know no more of what he has been copying when his work is finifhed, than he did before it was begun.

"More reafons, not neceffary to enumerate, ftruck me as ftrong objections to this practice, and led me to wifh that I could find the fhorter path, fix forms and characters in my mind, and inftead of copying the lines, try to read the language, and if poffible find the grammar of the art, by bringing into one focus the various obſervations I had made, and then trying, by my power on the canvas and copper, how far my plan enabled me to combine and apply them to practice.

"For this purpoſe, I conſidered what various ways, and to what different purpoſes the memory might be applied; and fell upon that which I found moſt ſuitable to my ſituation and idle diſpoſition.

"Laying it down firſt as an axiom, that he who could by any means acquire and retain in his memory perfect ideas of the ſubjects he meant to draw, would have as clear a knowledge of the figure as a man who can write freely hath of the twenty-four letters of the alphabet and their infinite combinations (each of them being compoſed of lines), and would conſequently be an accurate deſigner.

"This I thought my only chance for eminence, as I found that the beauty and delicacy of the ſtroke in engraving was not to be learnt without much practice, and demanded a larger portion of patience than I felt myſelf diſpoſed to exerciſe. Added to this, I ſaw little probability of acquiring the full command of the graver in a ſufficient degree to diſtinguiſh myſelf in that walk, nor was I at twenty years of age much diſpoſed to enter on ſo barren and unprofitable a ſtudy as that of merely making fine lines.

"I therefore endeavoured to habituate myſelf to the exerciſe of a ſort of technical memory, and by repeating in my own mind the parts of which objects were compoſed, I could by degrees combine and put them together. Thus, with all the drawbacks which reſulted from the circumſtances I have mentioned, I had one material advantage over my competitors, *viz.* the early habit I thus acquired of retaining in my mind's eye whatever I intended to imitate. Sometimes, but too ſeldom, I took the life for correcting the parts I had not perfectly enough remembered, and then I transferred them to my compoſitions."

Such parts only of Hogarth's valuable narrative as are to the preſent purpoſe, are here extracted. Thoſe who would read the whole are referred to "A ſupplement to Hogarth illuſtrated, compiled from his original manuſcript by John Ireland," 1798, publiſhed for the author by Nicol, and the Meſſrs. Boydell. Our artiſt proceeds:

"Inſtead of burthening the memory with muſty rules, or tiring the eyes with copying dry and damaged pictures, I have ever found ſtudying from nature the ſhorteſt and ſafeſt way of attaining knowledge in art."—"Had I not ſeduloufly practiſed what I thus acquired, I ſhould very ſoon have loſt the power of performing it."

In a ſubſequent chapter he ſays, "in purſuing my ſtudies, I made all poſſible uſe of the technical memory which I have before deſcribed, by obſerving and endeavouring to retain in my mind lineally, ſuch objects as beſt ſuited my purpoſe, ſo that be where I would my eyes were open, I was at my ſtudies, and acquiring ſomething uſeful in my profeſſion, and thus the more ſtriking objects, whether of beauty or deformity, were by habit the moſt eaſily impreſſed and retained in my imagination. A redundancy of matter being by this means acquired, it is natural to ſuppoſe I introduced it into my works on every occaſion that I could.

"By this idle way of proceeding, I grew ſo profane as to admire nature beyond the firſt productions of art, and acknowledge I ſaw, or fancied, delicacies in the life, far ſurpaſſing the utmoſt efforts of imitation.

"To return, the inſtant I became maſter of my own time, I determined to qualify myſelf for engraving on copper. In this I readily got employment; and frontiſpieces to books, prints to Hudibras, &c. ſoon brought me into the way. But the tribe of bookſellers remained as my father had left them when he died, (about five years before,) which was of an illneſs occaſioned partly by the treatment he met with from this ſet of people, and partly by diſappointment from great men's promiſes; ſo that I doubly felt this uſage, which put me upon publiſhing on my own account. But here again I had to encounter a monopoly of printſellers, equally mean and deſtructive to the ingenious; for the firſt plate I publiſhed, called "The Taſte of the Town," had no ſooner begun to take a run, than I found copies of it in the print-ſhops vending at half price, while the original prints were returned to me again, and I was thus obliged to ſell the plate for whatever theſe pirates pleaſed to give me, as there was no place of ſale but at their ſhops. Owing to this and other circumſtances, by engraving until I was near thirty, I could do little more than maintain myſelf."

At the age of two and thirty, he married the daughter of ſir James Thornhill, and commenced painter of ſmall converſation pieces, which, having novelty, ſucceeded for a few years, but were afterwards not ſufficiently profitable to pay the expences of his family. "I therefore," ſays he, "turned my thoughts to a ſtill more novel mode, *viz.* painting and engraving modern moral ſubjects, a field not broken up in any country or any age.

"I thought that both writers and artiſts had overlooked that intermediate ſpecies of ſubject, which may be placed between the ſublime and the groteſque; I therefore wiſhed to compoſe pictures on canvas, ſimilar to repreſentations on the ſtage.

"Ocular demonſtration will carry more conviction to the mind of a ſenſible man than all he would find in a thouſand volumes; and this has been attempted in the prints which I have compoſed.

"After having had my plates pirated in almoſt all ſizes, I, in 1735, applied to parliament for redreſs, and obtained it in ſo liberal a manner, as hath not only anſwered my own purpoſe, but made prints a conſiderable article in the commerce of this country; there being now more buſineſs of this kind done here, than in Paris or any where elſe.

"The dealers in pictures and prints found their craft in danger, by what they called a new-fangled innovation. Their trade of living and getting fortunes by the ingenuity of the induſtrious has, I know, ſuffered much by my interference; and if the detection of this band of public cheats and oppreſſors of the riſing artiſts be a crime, I confeſs myſelf moſt guilty."

The obtainment of this act, which ſecures the copy-right of engravings, was certainly a great benefit, not only to artiſts, but to the public, and even to the print dealers themſelves, who now were ſecured in the poſſeſſion of any engraved property which they might purchaſe. The remainder of Hogarth's narrative chiefly reſpects his profeſſion as a painter, and the incidents of his private life. His reputation was now extending far and wide: he had publiſhed his "Harlot's Progreſs" in ſix plates, beſide many other prints of leſs importance, which Mr. Ireland has enumerated, and now brought forth his "Rake's Progreſs" in eight, which are replete with moral leſſon and the moſt pointed ſatire. Swift about this time wrote

"How I want thee, hum'rous Hogarth!
Thou, I hear, a pleaſant rogue art,
Were but you and I acquainted
Ev'ry monſter ſhould be painted:
You ſhould try your graving tools
On this odious group of fools, (the Legion Club.)
Draw the beaſts as I deſcribe 'em,
Form their features, while I gibe 'em."

In the courſe of the next year he engraved "The Sleeping Congregation;" "The Diſtreſſed Poet," which in its original ſtate repreſents Pope thraſhing the bookſeller Curl, and "The Arms of the Undertaker's Company." He alſo publiſhed a whole length portrait of lady Byron, from a picture of his own, engraved in mezzotinto by Faber.

In the year 1737, he produced only "The Lecture." In 1738, he publiſhed "Morning," "Noon," "Evening," and "Night." The third plate was engraved by Baron, except the figure of the girl with a fan, which was an afterthought of Hogarth's, and is from his own graver. The "Saliſbury" flying coach in the engraving of Night, is thought to be a ſatire on a certain peer who delighted to drive his own horſes. He alſo produced this year "Strolling Actreſſes in a Barn;" the original picture of which he ſold to Francis Beckford, eſq. for 27*l.* 6*s.* who returned it, though charged at ſo low a price, and it was afterwards ſold to Mr. Wood of Littleton for the ſame ſum.

Until the year 1741, he publiſhed nothing more, when "The enraged Muſician" made its appearance, in which the principal figure has been ſpoken of as being the portrait of Cervetto, but on better authority, is now ſuppoſed to be that of Feſtin.

In 1742, he engraved and publiſhed the portrait of "Martin Foulkes, eſq." "The Charmers of the Age," (a ſketch,) and "Taſte in High Life," which latter is replete with the moſt pointed ſatire on the reigning follies and faſhions which then prevailed in the higher circles. A more ſophiſticated aſſemblage of objects cannot be imagined, and the elderly lady of the Cheſterfield ſchool, who holds the ſmall Dreſden tea-cup with ſo much exquiſite delicacy of fingering, and a countenance ſo truly expreſſive of the affectation of intenſe enjoyment of its beauties, has never been ſurpaſſed.

From this time, till the year 1745, he was employed on his "Marriage A-la-Mode," and only publiſhed three portraits, engraved by other artiſts, from his own pictures. The ſeries of ſix plates of the Marriage A-la-mode were chiefly engraved by Scotin and Baron, who have been already mentioned, and S. Ravenet. Hogarth engraved on the plates from time to time, which has occaſioned thoſe variations which certain adorers of rarity look for with more eagerneſs, than they appear to poſſeſs feeling or judgment in eſtimating the general deſign. This ſeries comprehends indeed maſter-pieces of art in their kind, and places Hogarth's fame on the broadeſt and moſt durable baſis.

In the following year, he etched and publiſhed his characteriſtic portrait of "Lord Lovat," which, by thoſe who have ſeen him, has been atteſted to be "in air, character, and features, a moſt faithful reſemblance of the original." He is repreſented ſeated in his old faſhioned chair with the lofty back, and in the act of enumerating by his fingers the rebel forces. It is etched with uncommon ſpirit, and what was of more pecuniary importance, (adds Mr. Ireland,) was ſo well timed, that Mrs. Lewis told me, they for many weeks received more than ten pounds a day from the ſale. It was publiſhed the 25th Auguſt, 1746, and the peer was beheaded the 9th April 1747, in the eightieth year of his age. The portrait of Garrick, in the character of Richard III. engraved by Hogarth, and C. Grignion, was alſo publiſhed this year, of which Mr. Grignion, (who has done ſo much for an art which has done ſo little for him, and is ſtill living,) ſays, that Hogarth etched the head and the hands, but eraſed the head twice before he could ſatisfy himſelf. In the courſe of the preſent year Hogarth alſo iſſued the ſubſcription ticket to "The March to Finchley."

The ſeries of "The Idle and Induſtrious Apprentices," in twelve plates, deſigned and engraved by William Hogarth, were publiſhed in 1747. Of this ſeries, ſo replete with moral leſſon, and heightened with ſuch admirable ſtrokes of humour, Hogarth himſelf has written as follows. "The effects of idleneſs and induſtry exemplified in the conduct of two fellow-'prentices. Theſe twelve prints were intended for the inſtruction of young people, and, conſidering the perſons they were intended to ſerve, I have endeavoured to render them intelligible and cheap as poſſible:" (the twelve were originally publiſhed at the low price of twelve ſhillings.) "Fine engraving is not neceſſary for ſuch ſubjects, if what is infinitely more material, *viz.* character and expreſſion, be properly preſerved." "The Stage Coach or Country Inn Yard," and two portraits of Gibbs the architect, engraved by Baron and Mc. Ardell, he alſo publiſhed in the courſe of this year.

In 1748, he etched a view of Mr. Ranby's houſe at Chiſwick, but nothing elſe of any conſequence. In 1749, was produced "The Gate of Calais," or, "Roaſt Beef of Old England." It appears that ſoon after the peace of Aix-la-Chapelle, Hogarth went over to France, and as he was ſauntering about at Calais, and contemplating the difference between England and France, he obſerved over the gate of the town ſome appearance of the arms of England; he was prompted to make a ſketch, and being obſerved, was taken into cuſtody: his own account of this affair is as follows: "Not attempting to cancel any of my ſketches or memorandums, which were found to be merely thoſe of a painter for his private uſe, without any relation to fortification, it was not thought neceſſary to ſend me back to Paris." (This word contradicts the aſſertion of thoſe who ſay he never went further into France than Calais.) "I was only cloſely confined to my own chamber till the wind changed for England; where I no ſooner arrived, than I ſet about the picture (of roaſt beef) and made the gate my back ground; and in one corner introduced my own portrait, which has generally been thought a correct likeneſs, with the ſoldier's hand upon my ſhoulder. By the fat friar, who ſtops the lean cook that is ſinking under the weight of a vaſt ſurloin, and two of the military who are bearing off a great kettle of ſoup maigre, I meant to diſplay to my own countrymen the ſtriking difference between the food, prieſts, ſoldiers, &c. of two nations ſo contiguous, that in a clear day one coaſt may be ſeen from the other. The melancholy and miſerable highlander, browzing on his ſcanty fare, conſiſting of a bit of bread and an onion, is intended for one of the many that fled from this country after the rebellion in 1744." In the courſe of this year, he alſo engraved and publiſhed his own portrait in a cap, with his favourite pug dog and palette, on which is drawn that myſterious "line of beauty and grace," which excited, and was meant to excite, the attention of the public in no ſlight degree.

Fourteen years afterwards, Hogarth eraſed his own head from the plate, and in its place engraved a caricature of Churchill as a bear, and inſcribed it, "The Bruiſer C. Churchill (once the Reverend!) in the character of a Ruffian Hercules," &c. &c.

In the year 1750, appeared his "March to Finchley," which was engraved by Luke Sullivan, and dedicated to the king of Pruſſia. The original picture he preſented to the Foundling hoſpital. "Gin-lane" and "Beer-ſtreet" appeared in the following year, of which prints Hogarth himſelf gives the following account. "When theſe two prints were deſigned and engraved, the dreadful conſequences of gin drinking appeared in every ſtreet. In Gin-lane, every circumſtance of its horrid effects is brought to view *in ter-*

rorem. Idlenefs, poverty, mifery, and diftrefs, which drive even to madnefs and death, are the only objects that are to be feen; and not a houfe in tolerable condition, but the pawn-brokers and gin fhop."

"Beer-ftreet," its companion, was given as a contraft, where that invigorating liquor is recommended in order to drive the other out of vogue. Here all is joyous and thriving, &c. &c."

He alfo now publifhed his "Four Stages of Cruelty," of which he has thus ufefully, honeftly, and proudly written. "The leading points in thefe, as well as the two preceding prints, were made as obvious as poffible, in the hope that their tendency might be feen by men of the loweft rank. Neither minute accuracy of defign, nor fine engraving, were deemed neceffary, as the latter would have rendered them too expenfive to the perfons to whom they were intended to be ufeful: and the fact is, that the paffions may be more forcibly expreffed by a ftrong bold ftroke, than by the moft delicate engraving." (The artift probably meant this obfervation to be applied to the violent, and not to the tender paffions.) "To expreffing them as I felt them, I have paid the utmoft attention, and as they were addreffed to hard hearts, have rather preferred leaving them hard, and giving the effect by a quick touch, to rendering them languid and feeble by fine ftrokes and foft engraving, which require more care than can often be attained, except by a man of a very quiet turn of mind. Maffon, who gave two ftrokes to every particular hair that he engraved, merited great admiration, but at fuch admiration I never afpired, neither was I capable of attaining it if I had.

"The prints were engraved with the hope of, in fome degree, correcting that barbarous treatment of animals, the very fight of which renders the ftreets of our metropolis fo diftreffing to every feeling mind. If they have had this effect and checked the progrefs of cruelty, I am more proud of having been the author, than I fhould be of having painted Raphael's cartoons."

The humorous "Paul before Felix" was alfo the produce of this year, which in the earlieft impreffions is fubfcribed, "defigned and fcratched in the true Dutch tafte by William Hogarth," and in the fubfequent impreffions (where he has introduced a little fiend fawing off the leg of the Apoftle's ftool,) "defigned and etched in the ridiculous manner of Rembrandt by Wm. Hogarth." This whimfical little print was originally given with the receipts to the fubfcription for the ferious "Paul before Felix," and "Pharoah's Daughter," both of which he produced in the courfe of the enfuing year.

The former of thefe he engraved from his original picture in Lincoln's-inn Hall; another plate of which fubject, with fome variations, was publifhed by Hogarth at the fame time, (which is remarkable, both being dated Feb. 5,) engraved by Luke Sullivan.

"Mofes brought to Pharaoh's Daughter" is engraved by William Hogarth and Luke Sullivan from the original painting in the Foundling hofpital, and was alfo publifhed on the fame day.

His "Columbus breaking the Egg" was given in the November of this year, with the receipt for "the firft payment of a fhort tract in quarto, called the Analyfis of Beauty; wherein forms are confidered in a new light;" and in the next year came forth his far famed "Analyfis of Beauty, written with the view of fixing the fluctuating ideas of tafte," and embellifhed with two folded and very curious illuftrative engravings.

With fome fmall literary affiftance from Dr. Hoadly, Mr. Ralph, and Dr. Morell, he here maintained an hypothefis refpecting undulating forms as effential to grace and beauty, the merits of which have, by fubfequent writers on the fubject of tafte, been varioufly eftimated, but of late have been utterly denied by Mr. P. Knight, who (in his analytical enquiry into the principles of tafte) fays, that the qualities of eafe, grace, elegance, &c. do not "confift in any lines of beauty, or depend upon the impreffions which any fpecific forms make on the organs of fight. On the contrary, they arife wholly from mental fympathies and the affociation of ideas."

An impreffion from the firft plate of the Analyfis of Beauty, which is in the poffeffion of Mr. G. Baker, has this fingularity, that the words "et tu Brute," are engraved on the pedeftal on which ftands Quin in the character of Brutus, which were afterwards erafed.

In the year 1754 his admirable fatire on parliamentary elections, which was engraved on four plates, began to appear. Of the firft plate, which is "An Election Entertainment," it has been faid that Hogarth completed the engraving without taking from it a fingle proof by which to afcertain the progrefs of his work. It might be fo, but if this were wife it would more frequently be practifed, and Hogarth himfelf is known to have repented of his imprudence when a proof was taken.

This performance, in its original ftate, is by far the moft finifhed and carefully executed of Hogarth's engravings, and he therefore, confcious of the fuperior pains which he had beftowed on it, infcribed beneath it, "painted, and *the whole* engraved by Wm. Hogarth," but thefe two words were afterwards erafed, for the number fold was fo confiderable, that by the time the fecond plate of this feries made its appearance, the firft had been touched and retouched fo often, that all the original and delicate lines were either hidden by others, or utterly obliterated, and it has been compared, wittily enough, to fir John Cutler's ftockings, which, from frequent mending, from filk degenerated into worfted.

The fecond of the election feries, of which the fubject is "Canvaffing for Votes" is engraved by C. Grignion, and was publifhed in the year 1757. On which occafion Hogarth apologized in the public prints for the delay which had taken place, afcribing it to the difficulty of procuring able hands to engrave the plates. In the early impreffion this is an excellent engraving.

The third plate of this feries is entitled "The Polling," is engraved by Hogarth and Le Cave, and was publifhed in the following year.

The fourth plate, which completes the feries, and is entitled "Chairing the Members," was alfo publifhed in the courfe of the year 1758, and is engraved by Hogarth and Aveline.

In all thefe plates the fatire of Hogarth is moft poignant and abundant; and notwithftanding the number of portraits our engraver has introduced, his meaning is fo general, that the election-prints continue to be applicable to the prefent time.

In the year 1758 he alfo engraved and publifhed "the Bench," with explanations and illuftrations of the words, "character" and "caricature." The print exhibits the infide of the court of common pleas, over which is the king's arms, and beneath are the portraits of the following judges, *viz.* honourable William Noel, fir John Willes; the lord chief juftice; honourable Mr. juftice (afterwards lord) Bathurft, and fir Edward Clive.

His own portrait, a whole length figure, was alfo the produce of this year, in which plate the face only is engraven

graven by Hogarth. He has here reprefented himfelf in profile, fitting, with a cap on his head, and engaged, in a very appropriate manner, in painting the mufe of comedy. His analyfis of beauty lies on the floor, and underneath is his title of ferjeant painter to his majefty. It may be obferved of this likenefs, and that which he has introduced in his "Gate of Calais," that they both correfpond much better with the buft of Hogarth, which was modelled by Roubilliac, and is now in the collection of M. G. Baker, than the three-quarter face which was publifhed in 1749, and afterwards metamorphofed to that of Churchill the poet.

"The Cockpit," defigned and engraved by W. Hogarth, was produced in 1759. In this engraving is introduced a portrait of Nan Rawlins, a very ugly old woman (commonly called Deptford Nan, and fometimes the duchefs of Deptford), who is well remembered at Newmarket. She was a famous cock-feeder, and did the honours of the gentlemens' ordinary at Northampton. The figure with the hump back is that of Jackfon, a once noted jockey, and the blind prefident is lord Albemarle Bertie, who conftantly attended this refined and elegant diverfion.

In the next three years he produced nothing of his own engraving, though he made fome defigns from Triftram Shandy; one for Brook Taylor's perfpective, and a few others, which were engraved by Woollett, Ravenet, and Grignion: but in 1762, he produced his "Credulity, Superftition, and Fanaticifm," which is chiefly meant to ridicule certain methodiftical fectaries, and is preferred by lord Orford to all his other works "for deep and ufeful fatire."

"The Times" was alfo produced in the year 1762. This is a political print, which Mr. Nichols explains as follows: "Europe on fire; France, Germany, and Spain, in flames, which are extending to Great Britain. This defolation continued and affifted by Mr. Pitt under the figure of king Henry VIII. with bellows encreafing the mifchief which others are ftriving to abate. He is mounted on the ftilts of the populace. A Chefhire cheefe depends from his neck with 3,000*l*. on it. This alludes to what he had faid in parliament, that he would fooner live on Chefhire cheefe and a fhoulder of mutton, than fubmit to the enemies of Great Britain. Lord Bute, attended by Englifh foldiers, failors, and highlanders, manages an engine for extinguifhing the flames, but is impeded by the duke of Newcaftle with a wheel-barrow full of monitors and North Britons, for the purpofe of feeding the blaze. The refpectable body under Mr. Pitt are the aldermen of London worfhipping the idol they had fet up; whilft the mufical king of Pruffia, who alone is fure to gain by the war, is amufing himfelf with a violin amongft his miferable country women. The picture of the Indian alludes to the advocates for retaining our Weft Indian conquefts, which it was faid would only increafe excefs and debauchery. The breaking down of the Newcaftle arms, and the drawing up the patriotic ones, refer to the refignation of that noble duke, and the appointment of his fucceffor. The Dutchman fmoking his pipe and a fox peeping out behind him and waiting the iffue; the waggon with the treafures of the Hermione; the unneceffary marching of the militia, fignified by the Norfolk jigs; the dove with the olive branch, and the miferies of war, are all obvious, and perhaps need no explication."

In 1763, he publifhed a caricature of "John Wilkes," efquire, drawn from the life, and etched in aquafortis by William Hogarth. To which was ironically added "this is a direct contraft to the print of Simon lord Lovat."

Of this caricature, Wilkes with his ufual good humour has been heard to fay, that he was every day growing more and more like his portrait by Hogarth.

In the fame year was publifhed alfo, "the Bruifer C. Churchill," which has been already mentioned, and which neither added to his fame, nor in its confequences to his happinefs.

"The Bathos," publifhed in 1764, was his laft engraving of any confequence, if not his very laft work. In the month of October of this year being feventy-four years of age, he departed this life, and was buried in the church yard of Chifwick, where a monument, with an excellent epitaph by Garrick, is erected to his memory.

His engravings, like the tenour of his life, are characterized not by delicacy, but by ftrength of thought and expreffion. He did not aim at captivating by the beauty of his art, but at excelling by the power which he poffeffed of combining a number of particular and congenial truths into one impreffive whole: agreeably to his own declarations, we perceive in his prints, that he difcovers little dexterity in the arrangement of his lines, and ftill lefs folicitude about their beauty: yet in his pictures, and efpecially in thofe of the Marriage A-la-Mode, now in the collection of J. J. Angerftein, efquire, are fome paffages which no Dutch painter and no other painter could have more exquifitely touched. No artift whatever, and fcarcely any man more than Hogarth, deferves the praife of original and independent thinking. His engravings are in fome inftances taken from no pictures, and his pictures from no books. Without having recourfe to hiftory or poetry he *invented* his fubjects. The world of moral art "was all before him where to choofe:" he marked out and took poffeffion of an ample province for himfelf, replete with the riches of nature; a province which few have fince dared to invade, and to which none have difputed his title.

Luke Sullivan, who has been already mentioned, was Hogarth's moft valuable coadjutor in engraving. He was a native of Ireland, an eccentric character, and much addicted to women. Whilft engraving the march to Finchley (according to Mr. Ireland,) "Hogarth held out every poffible inducement to his remaining at his houfe in Leicefter fquare night and day; for if once Luke quitted it he was not vifible for a month." If Hogarth gave him but one hundred pounds for this plate, as his biographers fay, Sullivan's inducements to ftay at home were certainly ftrong.

Befide what he did after Hogarth, Sullivan engraved "the Temptation of St. Anthony," after Teniers, and feveral garden fcenes and other landfcapes, which he drew from nature with fome ability. He alfo painted miniatures with fuccefs. His own portrait may be feen in the character of an angel, in Hogarth's humorous print of "Paul before Felix." He died of a confumption in the year 1750.

About this time John Pine, whofe portrait Hogarth painted in the manner of Rembrandt, was in good repute, but the years of his birth and death are uncertain. His chief works are, "the Ceremonies ufed at the revival of the order of the Bath;" "The Deftruction of the Spanifh Armada," from the tapeftry of the houfe of lords; a fplendid edition of Horace, illuftrated with copies of antique bas reliefs, gems, coins, &c. and a print of the houfe of commons.

The paftorals and Georgics of Virgil were publifhed by his fon after his death, adorned in the fame manner as the Horace, but printed with letter-prefs types.

Now alfo flourifhed Arthur Pond, another native of England. He etched feveral portraits with freedom, tafte, and fpirit, among which are thofe of Mr. Pope (an excellent likenefs), lord Bolingbroke, Dr. Mead, and himfelf. He was

was concerned with the Meffrs. Knapton in publifhing the volume of portraits of illuftrious men which were engraven by Houbraken, Vertue, Gravelot, &c. and in promoting other meritorious works, particularly a fet of plates from the great Italian mafters in imitation of chalk and biftre drawings, which he accomplifhed with great fuccefs. He alfo etched a fet of caricatures from the chevalier Ghiffi, and a few landfcapes, chiefly after Rembrandt.

Simon Francis Ravenet was another of Hogarth's occafional coadjutors. He was a native of France, came into England about the year 1750, and fettled in London. In the latter part of his life he refided at Mother Red Cap's, near Kentifh Town, where he died in 1774. He was of an amiable difpofition and much refpected, and had the honour of inftructing both Ryland and Hall in the art of engraving.

The fhadows in his engravings are deep toned, and his ftyle both of drawing and engraving vigorous, though fomewhat mannered. Befide what he produced after Hogarth, the following are efteemed among his beft prints: "The Prodigal Son," (a large upright) from Sal. Rofa; "Lucretia deploring her Misfortune," from A. Cafali; "The Manifeftation of the Innocence of the Princefs Gunhelda," (its companion) from the fame; "The Death of Seneca," (a large plate) from Lucca Giordano; "The Arcadian Shepherds," from N. Pouffin; "The portrait of Lord Camden," from fir Jofhua Reynolds. He is alfo the author of a confiderable number of vignettes, book plates, and fmall portraits.

William Wynne Ryland was born in London in the year 1732. His genius for the fine arts manifefted itfelf at an early period of his life, and he was accordingly placed under Ravenet. At the expiration of the term of his engagement he went to Paris, at that time the chief feminary of engraving, for improvement; and remained there five years.

Under the guidance of Boucher, who at that time led the fafhion in art, he applied with great affiduity to the ftudy of drawing, but did not neglect to improve himfelf alfo in the practical part of engraving. From the defigns of this principal mifleader of the tafte of France, Ryland engraved feveral plates, of which the principal and probably the beft engraving he ever performed, is rather a large work, of which the fubject is "Jupiter and Leda."

He has here difplayed great power as an engraver in lines. The print has a fine tranfparent tone; he has tempered the flimfy touchinefs of the French tafte with a portion of Ravenet's folidity; the foft firmnefs of flefh is ably characterized in the figure of Leda, and the delicacy of the fwan, and various textures of the furrounding objects, are rendered with much feeling and judicious fubferviency to the principal parts.

In one of his amatory poems, M'Kenzie emphatically exclaims, "Alas! are there fafhions in love!"—Alas! there are alfo fafhions in fine art. Unmeaning glitter, unprecedented foftnefs, unprincipled novelty, fhall fometimes fet afide for a while the truth and fimplicity of nature, and the approbation of ages.

It was not, however, the falfe tafte of Boucher that turned afide Ryland's talents from the mark at which he was evidently and fuccefsfully aiming, when he produced his "Jupiter and Leda," but a fafhion of ftippling which he learned in France, and introduced, with his own modifications, into England. Stippling with the graver had been occafionally practifed both by Martin Schoen and Albert Durer in the very infancy of the art: the latter employed it in imitating the foft texture of beaver hats, as well as on fome other occafions. Perceiving that it was peculiarly expreffive of foftnefs, Agoftino Veneziano and Boulanger fometimes ftippled their flefh, and Julio Campagnola his back grounds alfo. Almoft a century afterward it was obferved by De Marteau, who was now living, that by etching fome of the dots of which this kind of engraving confifts, and engraving others, very fuccefsful imitations of drawings hatched with chalk, might be produced. But Ryland employed ftippling, fo as rather to imitate fuch drawings as are ftumped than fuch as are hatched with chalk, by which means he foftened down all energy of ftyle, and has left pofterity to regret the voluntary emafculation of the powers he had manifefted in the engraving, which is the fubject of the above comments.

Soon after his return to England, he, however, engraved in lines a portrait of the queen, after Coates, and that portrait of his majefty, after Allen Ramfay, which Strange, from a mifunderftanding either with the earl of Bute or Ramfay, had declined, but they poffefs neither the vigour nor tafte of his "Jupiter and Leda." From this time he was appointed engraver to the king, and received an annual falary.

His fubfequent engravings, in the chalk manner, are chiefly after Angelica Kauffman, and confift of four half-fheet circles, of which the fubjects are, "Juno obtaining the Ceftus of Venus," "A Sacrifice to Pan," "Cupid bound," and "Cupid afleep;" "Queen Eleanor fucking the poifon from the wounded Edward I.;" (an excellent engraving of the kind;) "Lady Elizabeth Grey foliciting the reftoration of her Lands;" "Maria;" from Sterne's Sentimental Journey, and "Patience," both upright ovals; alfo "King John ratifying Magna Charta." The laft plate being left, by Ryland's unfortunate death, in an unfinifhed ftate, has fince been completed by Bartolozzi. This artift alfo engraved in lines, "Antiochus and Stratonice," from Pietro de Cortona, and "The firft Interview between Edgar and Elfrida," from Angelica Kauffman, both large plates.

Ryland's engravings in the novel manner were, for the moft part, printed in red, and this manner of engraving foon obtained the name of "the red chalk manner," and was run after with avidity by the public. With fo much heedlefs anxiety was it purfued, that people never ftopt to confider whether even red-chalk or ftumped drawings themfelves, of which thefe prints were profeffed imitations, were fo good reprefentations of nature, or afforded a means fo happy and efficient of transfufing the foul of painting, as the art which previoufly exifted, of engraving in lines, and which was then exercifed in high perfection by Bartolozzi, Strange, Vivares, and Woollet: it was enough that it was new and red; Ryland and novelty led the way, and fafhion and the printfellers followed.

The print-dealers, upon miftaken notions of private advantage, are ever exhaufting the permanent hopes of the art. Like favages, who are recklefs of the future, they cut down the tree in order to obtain its fruit. The novelty of chalk engraving, by calling forth their ignorant exertions, coincided with, and encreafed, the mania of the public, and except for the landfcapes of Vivares, Rooker, and Woollett, which required and exhibited more vigour and more detail of drawing than ftippling could beftow; and that now and then an hiftorical engraving by Strange and Bartolozzi, and the feries from Weft's hiftory of England, (of which the death of general Wolfe was the firft,) attefted the exiftence and maintained the dignity of the legitimate art, the engravers of Great Britain were compelled to feel, and filently to acknowledge, that

"Since

"Since ignorance was blifs,
'Twas folly to be wife."

This mode of engraving, however, has fince been greatly improved, and this improvement has been effected chiefly by living profeffors. For an account of its procefs and fufceptibilities, fee the article Stippling.

Engraving, a mode or fpecies of fculpture performed by incifion. The radix of the word fhould rather be fought in the Hebrew, than in the Greek language, becaufe the art itfelf was practifed by the Hebrews and their Chaldean anceftors for centuries before Greece had exiftence.

There are feveral words ufed by the facred hiftorian to exprefs or denote the work of the engraver. In the 28th chapter of Exodus, verfe 9, פתח fignifies to make an opening, or incifion; and hence come both the noun and its plural, פתוחים engravings.

One of the original fenfes of the root is *to plough up*, fo that the engraver is called *the plougher*; and frequently the word אבן, *a ftone*, is added for the fake of diftinction, and both together may be properly tranflated *the plougher* or *engraver in ftone.*

Mr. Strutt with much truth obferves, that "no word can exprefs more perfectly the operation of the engraver on metals of the prefent day (when performed fimply with the graver) than the verb *to plough.*" His line is a furrow, and in cutting it he turns up the copper, or other metal, as the hufbandman turns up the earth. The metal fo turned up is termed the *burr*, which is afterwards removed with a tool termed by engravers a *fcraper.*

In the 6th chapter of the firft book of Kings, the word קלע is ufed to exprefs the hollowing out of the carved work upon the cherubim, palm trees, and open flowering in the fanctuary, which were afterwards filled up with gold; which word in the Latin Vulgate is rendered *fculpfit*; by others *cælavit*, and by others *incidit.*

Engraving has been performed in different countries and at different periods of time, on various fubftances; chiefly on metals, wood, and the oriental precious ftones, which are called gems, but with inftruments that have varied but little fince they were firft invented. For the latter arts, fee Gem *Engraving* and Wood *Engraving.*

The metals upon which engraving is chiefly employed are copper and fteel, the former for producing impreffions on paper in various ways; the latter for ftriking coins, medals, &c.

Engraving on copper, for the purpofe of producing impreffions, may be divided into five fpecies, engraving in aqua-tinta, for which fee Aqua-tinta; engraving in the chalk manner, for which fee Stippling; engraving with aqua-fortis, for which fee Etching; engraving on mezzotinto, for which fee Mezzotinto *Engraving*, and the original art of engraving *in lines.*

Engraving in lines, for the purpofe of producing impreffions on paper, may almoft be faid to be an art of modern invention, for though the ancients ornamented their pateras, armour, metal vafes, &c. by this means, they appear never to have thought of printing from the incifions, or lines cut with the graver; nor was it thought of at all until about the middle of the 15th century, for which fee our accounts of the German and Italian *Schools of Engraving.*

This art is chiefly employed in reprefenting hiftorical fubjects, landfcapes, portraits, &c. &c. after pictures, or other defigns made for the purpofe.

It is performed, as we have ftated, with the graver, dry point, or more frequently with the work of both thefe tools, mingled with lines corroded with aqua fortis. For the firft there need but little apparatus, and few inftruments. The plate you work on being well polifhed, (for the method of preparing which, fee Copper-*plates*,) is covered over with a thin fkin of virgin-wax, and on this the outline of the draught, or defign, done in black lead, red chalk, or other ungummed matter, is laid; and rubbed down for the wax to take off. The defign, thus transferred upon the wax, is traced through on the copper, with a point, or needle; then heating the plate, and taking off the wax, the ftrokes remain; to be followed, heightened, &c. according to the tenor of the defign, with the graver, which is to be very fharp, and well tempered.

The dry point, or needle, which has been of late much ufed in engraving, is a tool like an etching point, which being drawn hard on the copper, cuts a ftroke, and raifes a burr; the burr is fcraped off, and there remains a ftroke more foft and delicate than can be produced in any other way. See Dry *Point.*

In the adroit conduct of the graver and dry point the art chiefly confifts; for which there are no rules to be given; all depending on the habitude, difpofition, and genius, of the artift. However, fome general obfervations and directions may not be improper. As the principles of engraving are the fame with thofe of painting, a perfon cannot expect to attain any confiderable degree of perfection in this art who is not a good mafter of defign; and therefore he ought to be well acquainted both with perfpective and architecture: for the former, by the proper degradations of ftrong and faint tints, will enable him to throw backward, or bring forward, the figures and other objects of the picture or defign which he propofes to imitate; and the latter will teach him to preferve the due proportion of its feveral orders, which the painter often entrufts to the difcretion of the engraver. In order to preferve equality and union in his works, the engraver fhould always fketch out the principal objects of his piece before he undertakes to finifh them. Care fhould be taken that the graver be carried level upon the plate, and be preffed, as occafion requires, with greater or lefs force, carrying the hand as evenly as poffible. In engraving ftraight lines, a lefs degree of preffure ferves for thofe that are finer, and a greater is required to form the broader and deeper lines. In forming circular or curved lines, the hand and graver muft be held fteady, and the plate is to be moved upon the cufhion under the graver. In large works a cufhion is ufelefs. The engraved work may be rendered more vifible, by rubbing it over with a roll of felt, dipt in oil, and which is called an oil rubber. The ftrokes of the graver fhould never be croffed too much in the lozenge manner, particularly in the reprefentation of flefh, becaufe fharp angles produce the unpleafing effect of lattice-work, and take from the eye the repofe which is agreeable to it in all kinds of picturefque defigns: we fhould except the cafe of clouds, tempefts, waves of the fea, the fkins of hairy animals, or the leaves of trees, where this method of croffing may be admitted. But in avoiding the lozenge, it is not proper to get entirely into the fquare, which would give too much of the hardnefs of ftone. In conducting the ftrokes, the action of the figures, and of all their parts, fhould be confidered; and it fhould be obferved how they advance towards, or recede from, the eye; and the graver fhould be guided according to the rifings or cavities of the mufcles or folds, making the ftrokes wider and fainter in the light, and clofer and firmer in the fhades. Thus the figures will not appear jagged; and the hand fhould be lightened in fuch ſuch a manner, that the outlines may be formed and terminated without being cut too hard: however, though the ſtrokes break off where the muſcle begins, yet they ought always to have a certain connection with each other, ſo that the firſt ſtroke may often ſerve by its return to make the ſecond, which will ſhew the freedom of the engraver.

In engraving the fleſh, the effect may be produced in the lighter parts, and middle tints, by long pecks of the gravers, rather than by light lines; or by round dots, or by dots a little lengthened by the graver, or, beſt of all, by a judicious mixture of theſe together.

In engraving the hair and the beard, the engraver ſhould begin his work by laying the principal grounds, and ſketching the chief ſhades in a careleſs manner, or with a few ſtrokes; and he may finiſh it at leiſure with finer and thinner ſtrokes to the extremities. When architecture is to be repreſented, except it be old and ruinous buildings, the work ought not to be made very black; becauſe, as edifices are commonly conſtructed either of ſtone or white marble, the colour, being reflected on all ſides, does not produce dark ſhades, as in other ſubſtances. Where ſculpture is to be repreſented, white points muſt not be put in the pupils of the eyes of figures, as in engravings after paintings; nor muſt the hair or beard be repreſented as in nature, which makes the locks appear flowing in the air; becauſe in ſculpture there can be no ſuch appearances.

In engraving cloths of different kinds, linen ſhould be done with finer and cloſer lines than other ſorts, and be executed with ſingle ſtrokes. Woollen cloth ſhould be engraved wide, in proportion to the coarſeneſs or fineneſs of the ſtuff; and when the ſtrokes are croſſed, the ſecond ſhould be ſmaller than the firſt, and the third than the ſecond. Shining ſtuffs, which are generally of ſilk or ſatin, and which produce flat and broken folds, ſhould be engraved more hard and more ſtraight than others, with one or two ſtrokes, as their colours are bright or otherwiſe; and between the firſt courſe of lines other ſmaller muſt be occaſionally introduced, which is called interlining. Velvet and pluſh are expreſſed in the ſame manner, and ſhould always be interlined. Metals, as armour, &c. are alſo repreſented by interlining, or by clear ſingle ſtrokes. In architecture, the ſtrokes which form the rounding objects ſhould tend to the point of ſight; and when whole columns occur, it is proper to produce the effect as much as poſſible, by perpendicular ſtrokes. If a croſs ſtroke is put, it ſhould be at right angles, and wider and thinner than the firſt ſtroke. The ſtrokes ought to be frequently diſcontinued and broken, for ſharp and craggy objects. Objects that are diſtant towards the horizon ſhould be kept very tender. Waters that are calm and ſtill are beſt repreſented by ſtrokes that are ſtraight, and parallel to the horizon, interlined with thoſe that are finer; omitting ſuch places as, in conſequence of gleams of light, exhibit the ſhining appearance of water; and the forms of objects, reflected from the water at a ſmall diſtance upon it, or on the banks of the water, are expreſſed by the ſame ſtrokes, retouched more ſtrongly, or faintly, as occaſion may require, and even by ſome that are perpendicular. For agitated waters, as the waves of the ſea, the firſt ſtrokes ſhould follow the figure of the waves, and may be interlined, and the croſs ſtrokes ought to be very lozenge. In caſcades, the ſtrokes ſhould follow the fall, and be interlined. In engraving clouds, the graver ſhould ſport, where they appear thick and agitated, in turning every way according to their form, and their agitation. If the clouds are dark, ſo that two ſtrokes are neceſſary, they ſhould be croſſed more lozenge than the figures, and the ſecond ſtrokes ſhould be rather wider than the firſt. The flat clouds, that are loſt inſenſibly in the clear ſky, ſhould be made by ſtrokes parallel to the horizon, and a little waving; if ſecond ſtrokes are required, they ſhould be more or leſs lozenge; and when they are brought to the extremity, the hand ſhould be ſo lightened, that they may form no outline. The flat and clear ſky is repreſented by parallel and ſtraight ſtrokes, without the leaſt turning. In landſcapes, the trees, rocks, earth, and herbage, ſhould be etched as much as poſſible: nothing ſhould be left for the graver but perfecting, ſoftening, and ſtrengthening. The dry point produces an effect more delicate than the graver can, and may be uſed to great advantage in linen, ſkies, diſtances, ice, and often in water, eſpecially in ſmall engravings. In moſt things it is proper to etch the ſhadows, only leaving the lighter tints for the dry point, graver, &c.

The other inſtruments, beſides the graver and dry point, are, a cuſhion, or ſand-bag, to lay the plate on, to give it the neceſſary turns and motions: a burniſher, round at one end, and uſually flattiſh at the other, to rub out ſlips and failures, and to ſoften the ſtrokes, &c. A ſcraper, to pare off the ſurface, on occaſion, and remove the burr; and a rubber of black cloth, or hat, to fill up the ſtrokes, that it may ſhew how the work proceeds: but the latter ſhould be ſparingly uſed.

Engraving *on ſteel*, is chiefly employed in cutting punches, matrices, and dies, proper for ſtriking coins, medals, and counters.

The method of engraving, with the inſtruments, &c. are the ſame for coins as for medals and counters: all the difference conſiſts in their greater, or leſs relievo; the relievo of coins being much leſs conſiderable than that of medals; and that of counters ſtill leſs than that of coins. The engraver in ſteel uſually begins with punches, or punchions, which are in relievo, and ſerve for making the creux, or cavities of the matrices, and dies; though ſometimes he begins immediately with the creux; but it is only when the intended work is to be cut very ſhallow. The firſt thing is to deſign his figures; then he moulds them in white wax, of the ſize and depth required; and from this wax he graves his punch.

This punch is a piece of ſteel, or, at leaſt, of iron and ſteel mixed; on which, before they temper, or harden it, the intended figure, whether a head, or a reverſe, is cut, or carved, in relievo. The inſtruments uſed in this *graving* in relievo, which are much the ſame as thoſe wherewith the finiſhing of the work in creux is effected, are of ſteel: the principal are, gravers of divers kinds, chiſſels, flatters, &c. when the punch is finiſhed, they give it a very high temper, that it may the better bear the blows of the hammer, wherewith it is ſtruck, to give the impreſſion to the matrice.

What they call *matrice*, or *matrix*, is a piece of good ſteel, of a cubic form, called alſo the *dye*, whereon the relievo of the punch is ſtruck in creux: it is called *matrix*, becauſe in the cavities, or indentures, thereof, the coins, or medals, ſeem formed, or generated, as animals are in the matrix of their mother. To ſoften this ſteel, that it may more eaſily take the impreſſions of the punch, they make it red-hot; and, after ſtriking the punch thereon in this ſtate, they proceed to touch up, or finiſh, the ſtrokes and lines, where, becauſe of their fineneſs, or the too great relievo, they are in any reſpect defective, with ſome of the tools above-mentioned.

The figure thus finiſhed, they proceed to engrave the reſt of the medal; as the mouldings of the border, the engrailed ring, letters, &c. all which, particularly the letters, and graining, or engrailment, are performed with little fteel punches, well tempered and very fharp. Add, that as they fometimes make ufe of puncheons to engrave the creux of the matrix, fo, on fome occafions, they make ufe of the creux of the matrix to engrave the relievo of the punch.

To fee and judge of the engraving in creux, divers means have been devifed to take the impreffions therefrom, as the work proceeds; fometimes they make ufe of a compofition of common wax, turpentine, and lamp-black; which, always retaining its foftnefs, eafily takes the impreffion of the part of the graving it is applied to; but this only ferving to fhew the work piece-meal, they have had recourfe to other ways to fhew the whole figure. The firft by pouring melted lead on a piece of paper, and clapping the matrice thereon; the fecond, with melted fulphur, managed the fame way; and the third, proper only where the graving is fhallow, by laying a piece of foft paper on the graving, and over the paper a leaf of lead; when giving two or three blows with a hammer on the lead, the paper takes the impreffion of the work.

When the matrix is quite finifhed, they temper it, rub it well with a pumice-ftone, and clean out the ftone again with a hair-brufh; and, laftly, polifh it with oil and emery: in this condition it is fit for the mill, to be ufed to ftrike coins, medals, &c.

After the like manner are the matrices for cafting of printing letters engraven. See *Letter* Foundery.

Engraving *of feals, ftamps, puncheons, marking irons, gilding irons*, and other matters, for goldfmiths, pewterers, bookbinders, &c. either in relievo, or indenture, is performed after the manner laft defcribed.

Engraving *in wood*. See Cutting *in wood*, and Wood *Engraving*.

ENGRAULIS, in *Ichthyology*, a name given, by fome authors, to the anchovy, called alfo, by fome, lycoftomus, and, by others, halecula. See Encrasicolus.

ENGROSSING, the writing a deed over fair and in proper legible characters. Among lawyers it more particularly means the copying of any writing fair upon parchment, or ftamped paper. See Copy, Calligraphus, &c.

Engrossing, in *Law*, denotes the getting into one's poffeffion, or buying up large quantities of corn, or other dead victuals, with intent to fell them again. This muft of courfe be injurious to the public, by putting it in the power of one or two rich men to raife the price of provifions at their own difcretion. And fo the total engroffing of any other commodity, with intent to fell it at an unreafonable price, is an offence indictable and fineable at the common law. (Cro. Car. 232.) And the general penalty for this offence, as well as for *foreftalling* and *regrating* (which fee), by the common law, (for all the ftatutes concerning them were repealed by 12 Geo. III. c. 71.) is, as in other minute mifdemefnors, difcretionary fine and imprifonment. (1 Hawk. P. C. 235.) Among the Romans thefe offences, and other mal-practices to raife the price of provifions, were punifhed by a pecuniary mulct. "Pœna viginti aureorum ftatuitur adverfus eum, qui contra annonam fecerit, focietatemve coierit quo annona carior fiat." (Inf. 48. 22. 2.)

ENGSTLEN, in *Geography*, a remarkable fpring of Switzerland, in the canton of Berne, in the valley called Gentel. The water flows only from the beginning of May till the latter end of Auguft, and that twice a day towards eight o'clock in the morning, and towards four in the afternoon. This circumftance is confidered as miraculous: the inhabitants fancy that providence purpofely fends them this water in the feafon, and at the time when they are to water their cattle. Nothing, however, is more eafily explained than this phenomenon. Many brooks iffue from mount Engftlen, and form a fmall lake. In the fummer months, the fnow water caufes this lake to overflow; and the melting of the fnow begins with the day, and ceafes towards night. F. I. Durand's Statiftique élémentaire de la Suiffe, 1795.

ENGUELEGUINGIT, a town of Africa, in the empire of Morocco, not far from Mogador.

ENGUICHE, in *Heraldry*, is applied to the great mouth of a hunting horn, when it has a rim of a different colour from the horn itfelf.

ENGYSCOPE, from εγγυς, *near*, and σκοπεω, *I obferve*, a machine better known under the name of microfcope. See Microscope.

ENGYTHECA, from εγγυς, *near*, and θηκη, *repofitory*, in *Antiquity*, a cup-board, or place where cups and other veffels ufed to be laid.

ENGYUM, or Enguyum, in *Ancient Geography*, a town of Sicily, fituated near mount Maurus, at the fprings of Alæfus. Cicero (in Verr.) reprefents it as one of the moft confiderable cities of that ifland. It was founded by the Cretans, and famous for a temple dedicated to Ceres, in which, it was conftantly affirmed, certain goddeffes, called the "Mothers," appeared from time to time. Plutarch fays, that this temple was built by the Cretans, and dedicated to thefe goddeffes fo called, *viz.* Cybele, Juno, and Vefta. This writer adds, that in the temple were lodged javelins and brazen helmets, which had been confecrated to the goddeffes of the place by Meriones and Ulyffes. The town was fituated in the interior of the ifland, to the weft of Hubita.

ENHADDAD, a town of Judea, comprifed in a part of the tribe of Iffachar.

ENHALLOW, in *Geography*, one of the fmaller Orkney iflands, between Rowfa and Pomona.

ENHANCE, *To*, in *Law*, is to raife the price of goods or merchandize. See Engrossing and Forestalling.

ENHANCED, in *Heraldry*, a term applied to any ordinary, when removed from its ufual fituation, and placed higher in the field.

ENHARMONIC Genus, in the *Ancient Greek Mufic*. The Greeks included all mufical founds in three genera or kinds of interval: the diatonic, for tones and femi-tones; the chromatic, for femi-tones and minor thirds; the enharmonic, for quarter-tones and major thirds. The fcale of each genus was arranged in tetrachords, or fyftems of four founds, of which the firft and laft were ftantes, immobiles, or fixed; while the two middle founds were termed mobiles, or changeable: and it is by thefe changes that the genera are diftinguifhed.

Each of the three genera had fome founds in its fcale that were peculiar and characteriftic, and fome that were in common with the other two. For inftance, B C E F A Bb and d, were ufed in all the three genera, whereas D G were peculiar to the diatonic, C✻ and F✻ to the chromatic, and B× E× and A× to the enharmonic. A complete fcale of each genus in modern notes will explain this matter better than words.

This ſubject will be further purſued under the articles *Ancient Greek* Music, Genera, and Tetrachords.

As modern melody is built upon harmony, derived from the harmonics of a fundamental-baſe, we have no inſtruments with quarter-tones, or which can furniſh a baſe to an enharmonic melody, if we had the power of framing and executing it with the voice or violin. We have, therefore, only two genera in our muſic, with all our refinements in melody of nominal enharmonic ſharps, dieſes, double flats, and ſharps, &c.: which two genera, the diatonic, conſiſting of five tones and two ſemi-tones in the octave, ſuch as the key of C natural ſupplies upon keyed inſtruments; and the chromatic, conſiſting entirely of ſemi-tones, twelve in number, ſuch as moving from any given note to its octave by ſemi-tones will furniſh. See Tone, Semi-tone, and *Enharmonic* Sharps or Dieses.

Enharmonic *Dieſis*, is an interval whoſe ratio is $\frac{125}{128} = 21\Sigma + 2\,m$. See *Enharmonic* Diesis.

Enharmonic *Degree of Ariſtoxenus*, otherwiſe his dieſis quadrantalis, was a quarter of the major tone, or $26\Sigma + \frac{1}{2}f + 2\frac{1}{4}m$.

Enharmonic *Degree of Euclid*, otherwiſe his dieſis quadrantalis, was three-thirtieths of a minor fourth, or $25\frac{2}{5}\Sigma + \frac{1}{2}f + 2\frac{1}{5}m$.

Enharmonic *Ditone of Euclid*, was twenty-four thirtieths of a minor fourth, or $203\frac{1}{4}\Sigma + 4f + 17\frac{3}{4}m$.

Enharmonic *Quarter of a tone*, is the ſame with *enharmonic dieſis*, above.

ENHYDRI, in *Chemiſtry*, are ſmall nodules of chalcedony, each containing a drop of water, which are found in the porous trap of the picentine. They are often poliſhed and ſet in rings, rather as an object of curioſity than of much beauty; and after a time the water uſually diſappears by evaporation.

ENHYDRIA, in *Ancient Geography*, a town of Phœnicia, between Caranus and Marathus. Strabo.

ENHYDRIS, the ancient Greek name for the otter.

ENJEDIM, George, in *Biography*, a learned Unitarian divine, who flouriſhed in the 16th century, was a native of Hungary, whence he removed to Tranſylvania, where he became a ſuperintendant of the Unitarian churches. He died in the year 1597, and was regarded as one of the beſt writers in what is called the Socinian cauſe. His principal work was entitled "Explicatio Locorum Scripturæ Veteris et Novi Teſtamenti, ex quibus Dogma Trinitatis ſtabiliri ſolet," 4to. The firſt impreſſion of this work was burnt by the orthodox, but a new edition was afterwards publiſhed in the Netherlands. Moreri.

ENIF, in *Aſtronomy*, a fixed ſtar of the third magnitude, in Pegaſus's mouth.

ENIGMA. See Ænigma.

ENIMIE, Sainte, in *Geography*, a ſmall town of France, in the department of Lozere, 12 miles S.W. of Mende, in a country formerly known by the name of le Gévaudan.

ENINGIA, in *Ancient Geography*, a country or iſland in the north of Europe, in the Serius Codanus or Baltic ſea, according to Pliny; ſuppoſed by ſome to be Finland.

ENIPEUS, or Enipe, a river of Greece, in Triphylia, which ran W. of Heraclea. In the time of Strabo, it was called *Barnichius*.

ENIPPA, or Agonippa, a mountain of Greece, in Bœotia.

ENISEI and Eniseisk. See Yenisei and Yeniseisk.

ENISIPIA, an iſland of the Mediterranean ſea, near Egypt, called *Æneſyppa* by Ptolemy, and *Eneſipaſta* by Strabo.

ENISPA, a town of the Peloponneſus, in Arcadia, called *Eniſpæ* by Seneca the tragedian.

ENIX, in *Geography*, a town of Spain, in the province of Grenada; 8 miles W. of Almeria.

ENIXUM Sal, in *Chemiſtry*, is the ſulphat of potaſh remaining after the preparation of nitrous acid. It is pure, if only nitre and ſulphuric acid have been made uſe of: but as the manufacturers of aquafortis uſually employ green vitriol inſtead of ſulphuric acid, the reſidual ſalt is much mixed with colcothar or oxyd of iron; from which, however, it may be ſeparated by ſubſequent ſolution and cryſtallization.

ENKIANTHUS, in *Botany*, from εγκυος, *pregnant*, and ανθος, *a flower*, "becauſe," ſays Loureiro, "its flowers are pregnant with others." Loureir. Cochinch. 276. Claſs and order, *Decandria Monogynia*. Nat. Ord. ——.

Gen. Ch. *Common Cal.* of ſix roundiſh, concave, pointed, coloured leaves. *Common Cor.* of eight oblong, flat, ſpreading petals, containing five florets, on long reflexed ſtalks.

 Perianth

Perianth of five fmall, permanent, acute, coloured leaves. *Cor. proper* of one petal, bell-fhaped; tube wide; limb fhort, in five rounded fegments. *Stam.* Filaments ten, awl-fhaped, tumid at the bafe, hairy, attached to the bottom of the corolla, and fhorter than its limb; anthers ovate, incumbent. *Pift.* Germen five-fided, fuperior; ftyle thick, as long as the ftamens; ftigma fimple, coloured, fhining. *Peric.* Berry ovate-oblong, five-fided, of five cells. *Seeds* numerous, oblong, fmall. *Loureiro.*

Eff. Ch. Common Calyx to feveral flowers; proper one inferior, of five leaves. Corolla bell-fhaped, five-cleft. Berry of five cells, with many feeds.

The fpecies are two.

1. E. *quinqueflora.* "Calyx containing five flowers. Stem arboreous." Tfiau tfung hōa of the Chinefe. Cultivated at Canton. Its branches laden with red flowers, before the leaves expand, are kept for feveral days in china vafes of water among the opulent Chinefe, and are very ornamental, though deftitute of fcent. The *tree* is of a middle fize, with a fmooth *bark*, and fpreading *branches*. *Leaves* crowded, oblong, pointed, entire, fmooth. *Flower* folitary, of a beautiful red, crowned with a white fringe, and containing five florets within.

2. E. *biflora.* "Calyx containing two flowers. Stem fhrubby." Sān lièo hōa of the Chinefe. Native of Canton. A *fhrub* three feet high, with fpreading *branches*. *Leaves* lanceolate-ovate, entire, hairy, fmall, crowded, with fhort footftalks. *Flowers* fcarlet, terminal, crowded, feffile. *Common Calyx* of five coloured, ovate, concave, deciduous leaves. *Common Corolla* none. Florets two in each common calyx. *Perianth* fmall, deeply five-cleft; its fegments lanceolate, hairy, fpreading. *Cor.* bell-fhaped, fpreading; tube with five furrows or plaits; limb in five deep, ovate, large fegments. *Filaments* ten, thread-fhaped, erect, unequal, rather fhorter than the corolla, inferted into the receptacle; anthers ovate, incumbent. *Germen* ovate, very hairy; ftyle thread-fhaped, longer than the corolla; ftigma thickifh, five-cleft, gaping. *Berry?* (not feen ripe), ovate, with five cells and many very fmall roundifh feeds.

The above is Loureiro's account of the genus in queftion, concerning which we confefs ourfelves unable to form any decided opinion. His defcription of the fecond fpecies is a little at variance with the generic characters, and what he every where terms a common calyx and common corolla muft of courfe be bracteas. Some particulars indicate a plant of the *Arbutus* or *Vaccinium* tribe, but others difagree. Ornamental fcarlet flowers, fo well known at Canton, muft long ago have been introduced to the acquaintance of European botanifts. This is one of thofe botanical enigmas with which the good father Loureiro's book abounds, in confequence of his having ftudied almoft entirely without communication with other botanifts. Hence he took the *Hydrangea* for a *Primula*, and made a new genus of *Argemone mexicana*. See ECHTRUS.

ENKIOPING, or ENDKIOPING, in *Geography*, a fmall town of Sweden, fituated on a river clofe to an inlet of the lake Mæler, and confifting chiefly of wooden houfes painted red. It ftands on a ridge of ground compofed of fand and gravel, which once formed the fhore of the lake; 21 miles S.W. of Upfal.

ENKIRCH, a town of Germany, in the circle of the Upper Rhine, and county of Sponheim; 3 miles N. of Traarbach.

ENKUSEN, a town of the ifland of Borneo.

ENLARGE, in the *Manege*, is ufed for making a horfe go large, that is, making him embrace more ground than he before covered. This is done when a horfe works upon a round, or upon volts, and approaches too near the centre, fo that it is defired he fhould gain more ground, or take a greater compafs. To enlarge your horfe, you fhould prick him with both heels, or aid him with the calves of your legs, and bear your hand outwards. If your horfe narrows, he is enlarged with pricking him with the inner heel, and fuftaining him with the outer leg, in order to prefs him forwards, and make his fhoulders go. Upon fuch occafions the riding-mafters cry only large, large. See IN.

ENLARGER L'ESTATE, in *Law*. See RELEASE.

ENLARGING STATUTE. See STATUTE.

ENMANCHE', in *Heraldry*, is when a chief has two lines drawn from the middle of the upper edge, to the fides, the depth of half the chief; the two lines including an obtufe angle, whofe vertex is the centre of the top of the chief.

The heralds conceive this, as bearing fome refemblance to fleeves; whence the etymology of the word, from the French *manche*, fleeve. It differs from chappe, where the lines come from the top to the bottom of the chief.

ENNA, in *Ancient Geography*, now *Caftro Giovani*, a city of Sicily, fituated on an eminence in the middle of the ifland, whence, according to Diodorus, it was called the "navel of Sicily." It was one of the ftrongeft places in the ifland, and remarkable for its beautiful plains, fruitful foil, and the numerous lakes and fprings which watered its territory; and the waters of which were highly commended for their limpidity and falubrioufnefs. Diodorus informs us, that Ceres was born in this diftrict; and that fhe firft taught the inhabitants of Enna the art of agriculture. He adds, that the rape of Proferpine by Pluto happened near Enna, while the young goddefs was gathering flowers in a neighbouring meadow. The Enneans fhewed a large cavern, which, as they believed, opened of itfelf, to make the god a way to his infernal kingdom. Hence originated the worfhip which the Sicilians paid to thefe two divinities; the magnificent temple which Gelo erected to Ceres in this city; and the folemn feftival, which the Syracufians annually celebrated near the fountain Cyane, fuppofed to have fprung up when the earth opened under Pluto's feet. The temple of Ceres was famous and reforted to from all parts of Italy, Greece, and Afia, and was deemed one of the richeft in Italy.

ENNEACHORD, in *Ancient Mufic*, an inftrument with nine ftrings.

ENNEACRUNOS, q. d. *the nine fountains*, in *Ancient Geography*, a fountain of Greece in Attica, at the foot of mount Hymettus, the waters of which were conveyed through nine pipes or channels into the town, conftructed by order of Pififtratus.

ENNEACTIS, in *Natural Hiftory*, a name given by Linkius to a fort of ftar-fifh, of the more branched or aftrophyte kind, which has only nine rays, where they firft part from the body, but thefe divide into a vaft number of others afterwards.

ENNEADECATERIS, in *Chronology*, a cycle, or period, of nineteen folar years.

The word is formed of ἐννεα, *nine*; δεκα, *ten*; and ἐτος, *year*.

Such is the lunar cycle invented by Meton, at the end whereof the moon returns nearly to the fame point from which it departed. Whence the Jews, Athenians, and other nations, who were difpofed to accommodate the lunar months to the folar years, made ufe of the enneadecateris; allowing to feven of the years thirteen months apiece, and to the reft twelve. See CYCLE, and EMBOLISMIC.

ENNEADECATERIS, *the Jewifh*, is properly a cycle of 19 lunar years, beginning from *molad tohu*, and returning again and again; whereof every 3d, 6th, 8th, 11th, 14th, 17th, and 19th, are embolifmic, or of 383 days 21 hours apiece; the reft common, or of 354 days 8 hours apiece. See Year.—Confequently, the Jewifh enneadecateris is 6939 days 18 hours.

ENNEAGON, in *Geometry*, a figure of nine angles, and nine fides.

The word is formed of εννεα, *nine*; and γωνια, *angle*.

Enneagon, in *Fortification*, denotes a place with nine baftions. See Fortified *Place*.

ENNEAHEDRIA, derived from the Greek εννεα, *nine*, and εδρα, a *fide*, in *Natural Hiftory*, the name of a genus of fpars.

The bodies of this genus are fpars, compofed of nine planes, in a trigonal column, terminated at each end by a trigonal pyramid. Of this genus there are four known fpecies. Hill's Hift. of Foff. p. 208.

ENNEANDRIA, in *Botany*, from εννεα, *nine*, and ανηρ, *a man*, the ninth clafs of the fexual or artificial fyftem of Linnæus, confifting of plants with nine feparate or diftinct ftamens in the fame flower with the piftil or piftils. It contains three orders, *Monogynia*, of which the valuable genus *Laurus*, including the Cinnamon, Caffia, one fort of Camphor, Sweet Bay, &c. is an example, and there are fome other fine plants in this order; *Trigynia*, of which *Rheum* or Rhubarb, nearly allied to *Rumex*, is the only inftance, and *Hexagynia*, confifting of *Butumus umbellatus* alone. Hence it appears that nine is an unufual number in the parts of flowers, though not quite fo uncommon as feven.

ENNEAPYRGÆ, in *Ancient Geography*, a town of Greece, in Attica, 7 or 8 leagues from the promontory of Sunium.

ENNEATICAL Days are every ninth day of a ficknefs; which, fome imagine, naturally occafion a great alteration, either for the better or worfe.

Enneatical *Years* are every ninth year of a man's life. See Climacteric.

ENNEBACKA, in *Geography*, a town of Norway; 26 miles S.E. of Chriftiania.

ENNEEMIMERIS is one kind of the cæfura of a Latin verfe, where, after the fourth foot, there is an odd fyllable ending a word, which helps to make the next foot with the following word; as in this inftance,

"Ille latus niveum molli fultus hyacintho,"

where all the four kinds of the cæfura occur.

ENNEL-Lough, in *Geography*, a lake of the county of Weftmeath, Ireland, near Mullengar.

ENNEOPHTHALMOS, from εννεα, *nine*, and οφθαλμος, *eye*, in *Zoology*, a name given by fome to the lamprey.

ENNERIS, in the *Ancient Ship-Building*, a name given to thofe galleys, or veffels, which had nine tires of rowers. Thefe were of a very confiderable fize; though Meibom has found fo convenient a method of placing the rowers that he has taken off very much from that immenfe height others fuppofed they had above the water. We read of the teffaracontes, and other amazing veffels of this fabric; and that of Philopater having forty rows of oars, and that of Ptolemy Philadelphus, thirty; and fome others which are fpoken of, twenty. It has been difputed by many, whether fuch large veffels as thefe were ever actually built, or ufed; but Meibom gives great reafon to believe that they really were, though he, at the fame time, alleges againft Salmafius, and the more fanguine admirers of the works of the ancients, that very few veffels were built larger than thefe enneres, or nine tiered ones, and proves it from Livy and Plutarch, and from Polybius. We are apt to admire, in many cafes, what we ought alfo to imitate, but never attempt it. This is the cafe in thefe galleys; and Meibom, who has given the rules of this ancient naval architecture, is of opinion, that by imitating it at prefent, modern galleys and galleaffes might be built much more conveniently both for ftrength and celerity, and alfo at lefs expence, than they are at prefent. Meibom. de Trirem.

The modern form is indeed allowed to be better than theirs; but if in the ftructure, the proportion of the long fhips of the ancients were obferved, they might be greatly improved: in the modern way of five men fitting at one oar in the galleaffes, much ftrength is wafted to no purpofe, becaufe they fit too near to the fulcrum, or ftay, whereas a fmaller number of rowers, at a greater diftance from the ftay, would give more ftrength, and throw the veffel along much more fwiftly, and would require lefs charge. Galleys of this fort, thus managed at a fmall expence, would be found of great ufe in the large rivers, and in the fhallow feas, and therefore convenient for the Baltic, the Britannic, and the Mediterranean feas, and would be the moft ufeful of all veffels for tranfporting great numbers of forces.

ENNEZAT, in *Geography*, a fmall town of France, in the department of the Puy de Dôme, chief place of a canton in the diftrict of Riom, with a population of 2393 individuals. The canton contains 8 communes and 9168 inhabitants, on a territorial extent of 142½ kiliometres.

ENNIS, a poft-town in the county of Clare, Ireland, of which it is the capital. It is large and populous, and has the advantage of a fmall port at Clare, which is fituated a few miles lower on the river Fergus; the tide bringing up large boats thence to Ennis. There are at this town the remains of one of the fineft abbey-churches in Ireland, built in an elegant ftyle of Gothic architecture. It is a borough town, and fends one member to the united parliament. It is 112½ Irifh miles S.W. by W. from Dublin, and 17 N. by W. from Limerick. W. long. 8° 54'. N. lat. 52° 49'.

ENNISCORTHY, a poft-town of the county of Wexford, Ireland. It is fituated on the river Slaney, which is navigable for fmall floops to this town. Its fituation is agreeable and picturefque; and there are the remains of a confiderable caftle built by the firft Englifh fettlers. It is the eftate of the earl of Portfmouth. Ennifcorthy has a manufacture of coarfe woollen-cloth, and is a thriving town. Near it are lead mines, which are very productive. Vinegar-hill, near this town, was a ftrong hold of the infurgents in 1798; and the loyal inhabitants were great fufferers at that eventful period. Ennifcorthy was reprefented in parliament before the union. It is 60 miles S. from Dublin, and near 12 N. from Wexford.

ENNISKILLEN, a poft-town of the county of Fermanagh, Ireland, and the place where the affizes are held. It is built in an ifland, formed by the river which unites the two lakes, and is the fingle pafs of communication between the parts of the county which thefe waters feparate. The ftrength of its fituation pointed it out as a military poft; and when the adherents of James II. excited a juft alarm throughout the country, numbers flocked to this place, where they bravely refifted a much fuperior force, and even gained feveral important victories. Thefe valiant men were formed into a regiment, which rendered effectual fervice to king William; and to this day the 27th regiment glories in the name of the *Ennifkilliners*. There is a fchool here, founded by James I. on the plantation of Ulfter, the income of which, by the great rife in the value of lands, has become very confiderable. Ennifkillen returns one member to to the imperial parliament. Diſtance from Dublin N.W. 79 miles.

ENNISTYMOND, or Innistymond, a ſmall poſt-town of the county of Clare, Ireland; ſituated 118 miles W. by S. from Dublin, and 13 W. from Ennis.

ENNIUS, Quintus, in *Biography*, an ancient poet, was born at Rudiæ, a city of Calabria, near Tarentum, about the year of Rome 514, B. C. 237, and flouriſhed about the cloſe of the firſt Punic war. According to Silius Italicus, he ſerved as a centurion in Sardinia, when that iſland was ſubdued by T. Manlius, and diſtinguiſhed himſelf by his valour. After the war he probably remained in Sardinia; for Cornelius Nepos informs us, that Cato, the cenſor, when prætor, brought back with him from his government of Sardinia, the poet Ennius, who muſt at this time have been in his 35th year. Another of his patrons was Scipio Africanus the elder, who made him his companion in moſt of his campaigns. This fact we learn from Claudian. He was alſo intimate with Scipio Naſica. The notice taken of him by theſe eminent perſons affords favourable teſtimony to his general character and manners; although Horace (Epiſt. xix. l. 1.) repreſents him as warming his heroic vein by liberal potations. The gout, with which he was afflicted, and his depreſſed circumſtances, were probably owing to his intemperance. Theſe evils, however, he bore with great equanimity; and his life was prolonged to the age of 70. He is ſaid to have been the father of epic or heroic poetry among the Latins, though the Greek was his mother-tongue. He was diſtinguiſhed by that ruſtic vigour, which is the uſual characteriſtic of genius in an unpoliſhed age. Thus Ovid repreſents him;

"Ennius ingenio maximus, arte rudis."

Lucretius mentions his having firſt brought the muſe to Latium; and Virgil has tranſcribed into his works many whole or half lines from Ennius, thus teſtifying his eſteem of him. The events of Roman hiſtory formed the leading ſubjects of a large performance entitled "Annals," ſubſequently divided into eighteen books. On certain days he was accuſtomed to recite portions of this poem. He alſo compoſed tragedies, comedies, epigrams, and ſatires; and alſo ſome didactic works. By his life of Scipio Africanus, he engaged the affection of the Cornelian family, who manifeſted their gratitude to him even after his death, depoſiting his aſhes in the ſame tomb with thoſe of Scipio, and erecting a marble ſtatue to him near that of this great commander. The poet Nævius, who was his contemporary, after having made ſome campaigns in the firſt Punic war, wrote the hiſtory of that war in verſe, according to the taſte of thoſe times. Fragments only of the works of Ennius remain; theſe have been publiſhed ſeparately, Amſt. 4to. 1707, and alſo in Mattaire's Corpus Poetarum.

ENNODIUS, Magnus Felix, biſhop of Pavia in the ſixth century, was born of illuſtrious parents about the year 473. His education and maintenance devolved upon an aunt, by whoſe death, before he was ſixteen years of age, he was reduced to diſtreſſing circumſtances, but afterwards, by a fortunate marriage, he attained to a ſtate of affluence. Notwithſtanding this union, he had a ſtrong inclination for the eccleſiaſtical profeſſion, and obtained his wife's conſent to enter into holy orders, whilſt ſhe at the ſame time embraced a religious life. He was ordained a deacon by Epiphanius, biſhop of Pavia, with whom he lived in habits of the ſtricteſt intimacy and friendſhip. He had an early taſte for literature, which he cultivated in connection with his theological ſtudies, with ſo much ſucceſs as obtained for him the reputation of an excellent ſcholar. On the death of his friend Epiphanius, he was admitted among the deacons of the church of Rome, and for ſome ſervices done for the popes and church, he was promoted to the ſee of Pavia about the year 510, and appointed on the commiſſion for negociating a re-union between the eaſtern and the weſtern churches. The only reward for his ſervices in this reſpect, was drawing down upon his head the reſentment of the emperor Anaſtaſius, who, after much ill treatment, diſmiſſed him home in a ſhattered veſſel, with a ſtrict prohibition of never again landing at any port in Greece, by which his life was expoſed to the moſt imminent danger. He arrived ſafe in Italy, but died as he was on his journey to Pavia, in the 48th year of his age. His works are numerous, and have been frequently printed; they were publiſhed, with many uſeful explanatory notes, at Paris, in the year 1611. Moſheim Eccl. Hiſt. Moreri.

ENNUI, a French term which is ſometimes uſed to denote a kind of liſtleſſneſs or unaptneſs for mental exertion; or which may be more ſcientifically defined to mean the uneaſineſs that prevails during the abſence of mental impreſſions. The averſion from *ennui*, or the deſire of intellectual emotion, is deſcribed by Helvetius, in his work "On Mind," as a very powerful and general ſpring of conduct, and he aſcribes to this law of the mind, perhaps, a greater degree of influence than that which properly belongs to it, conformably to the avowed ſentiments of a writer, who maintains that "to judge is to feel," (juger c'eſt ſentir.")

ENO, in *Geography*, a town of European Turkey, in the province of Romania; the ſee of a Greek archbiſhop; 28 miles N.W. of Gallipoli.—Alſo, a river of America, in North Carolina, which unites with Little and Flat rivers in Orange county, and forms the Negus, about 17 miles below Hillſborough.

ENOCH, in *Biography*, the ſon of Jared and father of Methuſelah, was the ſeventh in lineal deſcent from Adam, and born in the year B. C. 3382. Eminently diſtinguiſhed by his piety and virtue in a corrupt age, he was tranſlated to heaven in the 365th year of his age, without undergoing the pains of diſſolution. An apocryphal book, entitled "The Book or Prophecies of Enoch," has been aſcribed to this celebrated antediluvian, and is cited, as ſome ſay, by Jude in his epiſtle, and more certainly by Irenæus, Clement of Alexandria, and other ancient fathers. But this book was probably forged in the ſecond century. The Mahometans mention Enoch under the appellation of Edriſs, or Idriſs, and record many fables concerning him, which it is needleſs to mention.

Enoch, in *Ancient Geography*, a city ſaid to have been built by Cain in the land of Nod, where he and his family ſettled, and called after the name of his ſon Enoch. (Gen. iv. 16, 17.) Moſes places it, according to our tranſlation, on the eaſt of Eden; and Ptolemy mentions a city called Anuchtha in Suſiana, or Chuſiſtan, a country lying eaſtward from Chaldæa, which the learned Huet ſuppoſes to have been the ſame with that built by Cain. But it ſeems very improbable, that the city of Enoch, built before the flood, ſhould either withſtand the deluge or retain its ancient name, after ſo great a change in the ſurface of the earth. Beſides, Suſiana being a very fertile and pleaſant country, it is not likely that Cain ſhould be baniſhed thither, but rather to ſome barren and deſolate land, remote from the place of his nativity, and ſeparated by mountains, or other natural impediments, from intercourſe with his relations. As there was another Enoch (ſee the preceding article) beſides the ſon of Cain, it is not improbable that the city Anuchtha mentioned by Ptolemy, might have taken its name from him, whoſe memory would be held in veneration, or or from ſome other Enoch or Anoch, who might have lived after the flood. Grotius and Junius are of opinion, that the country into which Cain retired was the deſart of Arabia; but as this country lies on the weſt, and not on the eaſt of Eden, it is ſaid, that the words which we tranſlate "on the eaſt" of Eden ſignify no more than "before" or "over-againſt" Eden, according to the tranſlation of the Septuagint. According to this opinion; the land of Nod muſt have been Arabia Deſerta, or ſome part of it, and not Suſiana. Wells's Geog. vol. i.

ENODIS, Culmus, in *Botany*, a culm or ſtraw deſtitute of any knot, joint, or prominent tranſverſe interruption. See Culmus.

ENOLA, in *Geography*, a town of Naples, in the province of Lavora; 4 miles N. of Fundi.

ENOLMIS, Ενολμις, in *Antiquity*, a deſignation given to Apollo's prieſteſs at Delphi, becauſe ſhe ſat on the tripod which was called olmos, ολμος. Hence alſo Apollo is called Enolmos, Ενολμος. Pott. Archæol. Græc. lib. ii. cap. 9. tom. i. p. 275.

ENOMTEKIR, in *Geography*, a town of Swediſh Lapland; 150 miles N. of Tornea.

ENON, in *Ancient Geography*, a place of Judea, ſituated near Jordan in the half-tribe of Manaſſeh; which was the place in which John baptized, (John iii. 23.) becauſe there was abundance of water. This place was between Shalim and Jordan, about 8 miles from Scythopolis.

ENOPA, a town of the Peloponneſus, in Meſſenia, ſituated on an eminence at a ſmall diſtance N. of Cardamyla.

ENORAINE, in the *Manege*, a wither-wrung horſe, or one that is ſpoiled in the withers. The word is obſolete.

ENORCHIS, in *Natural Hiſtory*, the name given by many authors, to that ſpecies of ætites, or eagle-ſtone, in which the callimus, or internal nucleus, is not looſe, ſo as to rattle in it when ſhaken, but remains fixed to one ſide. The Germans call this *hodenſtein*. The outer cruſt is uſually of a whitiſh colour, and the internal nucleus is yellowiſh or browniſh, and it is uſually of the ſize of a pigeon's egg, and of the ſhape of the human teſticle; whence the name.

ENORMOUS, ſomething exceſſive, or monſtrous, eſpecially in bulk. The coloſſus of Rhodes was of an enormous ſtature.

The word is formed of the privative *e*, and *norma*, *rule;* q. d. *void of, or contrary to, rule or meaſure; contra normam.* In the corrupt ages of Latinity, they uſed *innormis*, and *inormis*.

In the French juriſprudence, *læſio enormis*, *enormous damage*, is that which exceeds half the value of the thing ſold.

ENOTAEVSK, in *Geography*, a town of Ruſſia, in the government of Caucaſus, on the Volga; 72 miles N.N.E. of Aſtrachan.

ENOUREA, in *Botany*, (a barbarous name, from the Caribæan word *Enourou*.) Aublet Guian. v. 1. 587. t. 235. Juſſ. 249. The only ſpecies is E. *capreolata*, a climbing ſhrub, with ſomething of the habit of a *Paullinia*, furniſhed with circularly-turned tendrils, pinnated leaves, ſpiked flowers, and a remarkable globular capſule of three valves, containing a globular ſeed imbedded in farinaceous pulp. Juſſieu has copied its characters from Aublet, but Schreber has paſſed it by.

ENQUEST, or Inquest, in *Law*, denotes an inquiſition of a jury by hearing of witneſſes.

This is the moſt uſual manner of trial, in all cauſes, both civil and criminal, within this realm. In civil cauſes, after proof is made, on either ſide, of ſo much as each party thinks good for himſelf; if the doubt be in the effect, it is referred to the diſcretion of twelve indifferent men, impanelled by the ſheriff for that purpoſe; and as they bring in their verdict, ſo judgment paſſeth: for the judge ſaith, *the jury findeth the fact thus*. See Writ *of Enquiry*. For the enqueſt in criminal cauſes, ſee Jury.

ENRICHED Column. See Column.

ENRICHING Plants, a term uſed, by the Engliſh farmers, to expreſs ſuch plants as are found to do good to land, rather than to exhauſt it, and in conſequence of which the ſame piece of land will produce a good crop of corn, though it would, without the aſſiſtance of their having been planted on it, have yielded a very poor one. The myſtery of this difference between plants, ſome of which are found to burn up, that is, impoveriſh lands, while others enrich it, and leave it fitter for ſucceeding crops than they found it, is explained by Mr. Tull. This author having obſerved, that breaking the earth, by digging, or horſe-hoeing, between the plants, gave them great increaſe, found that it was this practice that enriched the earth: and that, while corn and ſuch plants as ſtand cloſe, and cannot be hoed between, impoveriſh the ground, and ſuffer no means of enriching it again to be uſed, there were ſome other things, the crops of which being planted thinner, gave room to the earth to be ploughed, dug, or hoed between, and that theſe were the plants which were called the enriching kind by the farmers; and the whole ſecret lay in this, that the hoeing, ploughing, or otherways breaking the earth between them, in order to kill the weeds, enriched the ground greatly more, in proportion, than theſe plants exhauſted it; and the conſequence was, that though they had thriven very well, yet the earth was left richer than before, notwithſtanding all that they had imbibed from it. Tull's Horſehoeing Huſbandry, p. 37.

On this obſervation, this excellent author ſeems to have founded the ſyſtem of what he calls horſe-hoeing huſbandry, concerning which he has written a large and uſeful treatiſe. He found that this ſtirring up of the earth enriched it ſo greatly, that, where it was uſed in a proper manner, the kind of plant need not be changed, but that the ſame earth would yield a ſucceſſive ſeries of crops of the ſame plant, and that even without dunging, or ever lying fallow, and every crop, for a long time, would be better than the former ones. The method of ſowing, to this purpoſe, is not by ſcattering the corn with the hand, but ſowing it in rows, and leaving large intervals between, the naked earth of which might be turned up by the hoe. See Alley and Hoeing.

ENROL, in *Military Matters*, ſignifies the regiſtering of ſuch perſons as, being inliſted, or appointed, are placed upon the rolls, or ſtrength, of any particular regiment, troop, company, or portion of the military eſtabliſhment. The act of enrolment ſeems to be held neceſſary in proof of a ſoldier's having become a ſervant of the ſtate; equally ſo with the circumſtance of his having received pay, or ſome money, however trifling, in advance. For it does not appear reaſonable, that a ſoldier ſhould be puniſhed for abſenting himſelf from that employ in which he has not received either pay, or ſubſiſtence. It is not, however, to be underſtood, that, after being duly inliſted in the preſence of a magiſtrate, the recruit is at liberty to quit the party by whom he has been entertained: far otherwiſe; for though we hold a decided opinion regarding the devices often practiſed, to enſnare young men from their homes and families, we conſider it indiſpenſible that the ſacred engagement ſhould remain purely inviolate, after being once legally acknowledged

knowledged by the party to be enrolled. See INLIST and ENTERTAIN.

In regiftering, that is to fay in enrolling, a recruit, it is ufual to be very exact in afcertaining the place of his nativity, his religion or fect, his age, his ftate of health, efpecially whether he be fubject to fits, or be ruptured; while, for the purpofe of apprehending him in cafe of defertion, his height, complexion, general figure, the colour of his hair, and of his eyes, together with any particular diftinguifhing marks, whether natural or accidental, are all noted; comprifing, in the aggregate, what is called "defcription roll," of which a tranfcript is fent with each foldier, whenever draughted from one company or regiment to another.

Although a recruit is bound to the fervice after being examined and deemed competent to ferve, by the infpecting furgeon, and the fupervifor of the recruiting fervice of the diftrict refpectively, and after having acknowledged his being duly inlifted in prefence of a magiftrate, by whom the oath of allegiance fhould be tendered as fpeedily as convenience might admit, he is not faid to be enrolled until he is efficiently placed upon fome lift, whether under the recruiting officers, or in any particular regiment, troop, or company. In fome inftances, efpecially in the fervice of the Eaft India Company, the whole of the recruits are lodged at a general depot, under the charge of officers fixed thereat, but without being attached to any particular regiments until their arrival in India: in the mean while they are formed into fquads, under the immediate controul of noncommiffioned officers, by whom they are trained in the rudiments of military difcipline. We cannot with ftrict propriety fay, that fuch men are enrolled; nor, indeed, do we hold the term to be applicable until they are in a certain degree fixed in fome particular company, and entered upon its mufter-roll, as well as upon the long-roll of the regiment.

ENROLLMENT. See INROLLMENT.

Clerk of the ENROLLMENT *of fines*. See CLERK *of the Inrollments*.

ENS, in Latin *Anifia*, *Anafum*, or *Enfia*, in *Geography*, a town of Auftria, in the province called Upper Auftria, or the country above the Ens, in the diftrict of Traun. It is fituated on an eminence in the river Ens, which, not far from this place, falls into the Danube, 15 miles S. E. of Lintz, and 108 miles W. of Vienna. N. lat. 48° 11′. Its origin dates from the year 900, and it is built on the fame fpot where ftood the Laureacum of the Romans, one of their colonies, which was deftroyed by the Huns about the year 450. Ens is ftrongly fortified; its citadel is called *Enfeek*, or the corner of Ens.

ENS, in Latin *Anifus*, or *Anafus*, a river of Germany, which has its fource in the mountains of the former bifhopric, now grand duchy of Saltfburg, flows through Upper Auftria, and falls into the Danube near the town of Ens.

ENS, *Entity*, *Being*, in *Metaphyfics*, is applied, in a general fenfe, to every thing which the mind any way apprehends, and whereof it affirms, denies, proves, or difproves, any thing. This other philofophers call cogitable, and intelligible; and the logicians, thema.

ENS, in a lefs general fenfe, fignifies fomething that is, or exifts, fome way farther than by being conceived, or being capable of being conceived, in the mind. This is particularly called ens pofitivum, or reale; pofitive, or real, being. In oppofition to which ftands non ens.

ENS, in its proper, or reftrained fenfe, is that to which there are real attributes belonging, or that which has a reality, not only out of the intellect, but in itfelf. This is what is properly meant by *res*, thing; and what we otherwife call ens reale, and alfo fubftance.

ENS *rationis*, is that which depends wholly on the mind, or which exifts only in the imagination: of which they diftinguifh three kinds: ens rationis affectivum, which is done or produced by the mind, as knowledge; ens rationis fubjectivum, which is received into the mind, as fcience; and ens rationis objectivum, which is reprefented by the mind, as a chimera, a golden mountain, or the like. Which laft, if it have no other manner of being, i. e. if it be prefented fo as it does not, or cannot be, is what we moft properly call ens rationis. The generality of fchool philofophers, and the Peripatetics among the reft, affert, that there are of thefe entia rationis objectiva. Others deny there are, or can be, any fuch things.

ENS, or ENS *primum*, in the *Ancient Chemiftry*, denotes the moft efficacious part of any natural mixed body, whether animal, vegetable, or foffile, wherein all the qualities or virtues of the ingredients of the mixed are comprehended in a fmall compafs.

Paracelfus pretends to have been able to feparate the ens primum from bodies, and with it to effect prodigious things towards the renovation and reftoration of youth; but his proceffes are fo obfcurely delivered, that no body has been induced to try them.

ENS *primum falium*, a name given by Paracelfus to a preparation of fea falt, which he calls alfo a perpetual oil, and *fal circulatum*, which fee.

ENS *martis*, and *Ens veneris*. If the filings of iron or of copper be mixed with fal ammoniac and ftrongly heated, a decompofition, greater or lefs in proportion to the quantity of metal employed, will take place: the ammonia will be liberated in the form of gas, while the muriatic acid will combine with the metal. The metallic muriat thus formed will fublime at nearly the fame heat as the undecompofed refidue of the falt, whence will refult an accurate mixture of the two in the form of flowers, or a cruft of a red colour: if iron filings have been ufed, and of a green colour if copper has been employed. The former of thefe is ens martis, the latter, ens veneris.

ENSATÆ, in *Botany*, from *enfis* a fword, alluding to their fword-fhaped leaves, a name very happily applied by Mr. Gawler to the natural order of *Irides* of Juffieu, it being defirable that, if poffible, every natural order fhould have an expreffive name, independent of any particular genus it may contain; or at leaft that its name fhould not be a mere unchanged repetition of that of any fuch genus. This order is illuftrated by the able botanift above-mentioned, in Sims and Konig's Annals of Botany, v. i. 219, and efpecially in Curtis's Botanical Magazine.

ENSCONCED, in the *Military Art*. See INSCONCED.

ENSEELED, in *Falconry*, a term ufed for a hawk which has a thread drawn through her upper eyelids, and made faft under her beak, to obfcure her fight.

ENSEINT, in *Law*, a term ufed to denote a pregnant woman.

ENSEMBLE, a French term, fometimes ufed in our language, literally fignifying *together*, or *one with another*; being formed from the Latin, *in*, and *fimul*.

In *Architecture*, we fay, the enfemble, or tout enfemble of a building; meaning the work or compofition, confidered together, and not in parts; and fometimes alfo the relative proportion of the parts to the whole. All thofe pieces of building make a fine enfemble.

To judge well of a ftatue, or other work of fculpture, one muft firft examine whether the enfemble be good.

The tout enfemble of a painting, is that harmony which refults from the diftribution of the feveral objects of figures whereof

whereof the whole is compofed. This picture is good, taking the parts feparately: but the tout enfemble is bad.

Ensemble, *Fr.* together. This adverb, ufed fubftantively, and received in the French mufical technica, is, according to Rouffeau, invefted with a very extenfive fignification. To regard an object in its enfemble or totality, is to confider the effect which the feveral parts produce, when united in a whole.

It is only in the execution of a piece of mufic, that this term is applicable, when the performers are fo perfectly together in time and tune, feeming to be all fo much animated by one foul, that they communicate exactly to the ear, all that the eye can fee in the fcore.

The being together does not merely depend on the accuracy with which each reads his part, but in the intelligence with which he feels its peculiar character and connection with the whole; whether in the exactitude of phrafeology, the precifion of the movements, or feizing the inftant and degree of pianos and fortes; or finally in the nice attention to fuch ornaments, which the author has thought fo neceffary as to be indifpenfible. It is in vain for muficians to have abilities, they can never be together without an intelligence of the author's defigns, and perfectly underftanding each other: for it would be impoffible to keep together a band of performers that are deaf, nor in the execution of mufic in a ftyle with which they are totally unacquainted. It belongs to the mafters, conductors, and leaders of an orcheftra, to guide, check, or accelerate individual performers, and to keep them together in the aggregate, which is always the office of a judicious firft violin: who, by a certain firmnefs and energy in his manner, ftrongly impreffes the character of the piece in every ear. The vocal part is fubordinate to the bafe and the time; the firft violin ought to watch and follow the voice; the repienos fhould liften to and be guided by the firft violin: and, finally, the harpfichord or piano-forte, at an opera where the compofer is fuppofed to fit, fhould be the principal and moft important guide of the whole. In general, the more character there is in the ftyle, periods, phrafes, melody, and harmony, the more eafy it will be to feize the enfemble; becaufe the fame idea, ftrongly impreffed on all minds, will prefide in the whole execution. On the contrary, when the mufic fays nothing, and nothing is heard but a fucceffion of notes without meaning: then as there is no whole to which each performer can refer his part, the enfemble goes ill.

This (fays M. Rouffeau) was the reafon why French performers could never be together.

ENSENE', called alfo *Infiné*, *Scheick Abadè*, and by the Arabs *Enfiné*, in *Geography*, a town of Egypt, fituated towards the middle of the Said, eaft of the Nile, and dependent on the province of Achmounain, which is on the other fide. Abulfeda reprefents it as an ancient city, furrounded by a well cultivated country, abounding in fruits and harvefts. But thefe fertile plains have difappeared with their inhabitants, and given place to fands and deferts. See Antinoe.

ENSHEMESH, i. e. *the fountain of the Sun*, a town or fountain, which lay on the frontiers of Judah and Benjamin. (Jofh. xv. 7.) The Arabians give this name to the ancient metropolis of Egypt, which the Hebrews called *On*, and the Greeks *Heliopolis*.

ENSIFORM, in *Anatomy*, a term equivalent to xiphoid, and meaning dagger-fhaped. It is applied to the cartilage placed at the lower end of the fternum. See Trunk.

Ensiform *Leaf*, in *Botany*, a vertical two-edged leaf like a fword, as in many fpecies of Iris. See Leaf.

Ensiform *Cartilage*. Dr. Hunter remarks, that, "if this cartilage be forced inwardly by a blow, it will occafion vomiting and violent pains, by preffing againft the pylorus: in this cafe, it would be proper to lay it bare and elevate it." However, the fame eminent writer admits, that as part of the diaphragm arifes from the cartilage, the latter would be likely to be drawn out of its proper fituation again by the action of fo powerful a mufcle.

ENSIGN, in *Military Affairs*, is an officer whofe duty it is to carry the colours; hence, when a youth firft obtains a commiffion in the infantry, he is faid to "receive a pair of colours." This is the firft gradation above the rank of cadet, or volunteer, but is the loweft of all the ranks in which commiffions are held, and though obtainable by purchafe, cannot be realized without fatisfactory recommendations, and the approval of the commander of that regiment to which the nomination is to be made. From this, of courfe, fome deviations are occafionally admitted; but the neceffity for afcertaining that none but proper perfons be included within the circle of commiffioned officers, occafions confiderable ftrictnefs to be obferved in this particular; notwithftanding which, inftances have occurred of men, by no means eligible to fo honourable a diftinction, having obtained commiffions even in fome of what are technically termed "crack regiments."

The duty of an enfign requires much attention, and at times fome fhare of bodily ftrength; for, on a windy day, when the colours are fully difplayed, a puny perfon might fuffer confiderable inconvenience; and, indeed, at all times, though fupported in a fling, the colours are rather oppreffive; efpecially to thofe unaccuftomed to carrying them. With regard to the ftation of the enfign when acting with his company, or when bearing the colours, we refer to the head of Evolution; where the various changes of locality to which this officer is fubject will be exhibited.

It is proper to remark, that although there are two ftands of colours to each regiment, only one of them is properly called "the enfign." The flag, confifting of the union only, is called the king's colour, and always takes poft of the other, which being in general of the fame colour as the facings of the corps, and bearing any device or motto, by which it is diftinguifhed, is appropriately called "the regimental enfign."

In cafe of defeat, the enfigns bearing the colours muft be very careful to collect as many of the fugitives as poffible for the purpofe of rallying the corps, or, at leaft, of preventing it from being further difgraced by the lofs of their facings, which formerly was an infeparable confequence annexed to the lofs of the colours. This regulation certainly muft often produce confiderable enthufiafm; and we may reafonably conclude, that the attack made by a regiment under fuch a privation, (which could only be remedied by its taking the colours of their opponents,) muft be of the moft arduous defcription. In truth, we find in every walk of life, that when an imputation is to be removed, confiderable energy is created by the exifting difgrace; and, that the moft determined refolution is formed not only to remove it, but to obtain a claim to pre-eminent confideration in future.

The pay of an enfign in the Guards is five fhillings and tenpence daily; in the line, only four fhillings and eightpence: a fum by no means adequate to the maintenance of a young gentleman in fuch ftyle as is at prefent too generally prevalent in almoft every regiment. So far is this carried, that many young men of confiderable merit are often compelled to exchange, or even to fell out; becaufe their finances are inadequate to bearing a fhare in the mefs expences,

expences. Nor is it unufual for a notice to be given by the agent, or other perfon, to the candidate for a pair of colours, that fuch a certain fum annually will be needful, beyond his pay, to enable his keeping on a par with his brother officers. We are credibly informed, that in fome regiments it is actually impoffible for an officer to affociate with his peers, unlefs he may poffefs from 500 to 1000*l.* income, over and above his allowances!

When we analyfe this, we cannot but confider it to be a national evil, and that too of no fmall extent. We are far from wifhing to fee the refpectability of our officers, in the fmalleft degree, tarnifhed; but it certainly cannot fail to ftrike, even the moft fuperficial obferver, that fuch an excefs of expence amounts nearly to a prohibition of the middling claffes, and operates in the fame manner, though not fo avowedly, as the ancient regime of France, which profcribed all but thofe of noble family, or of eftablifhed defcents through generations devoid of mercantile fpeculation, from entering within the military pale. The very drefs of fome corps muft coft fo much as to preclude the poffibility of moderate fortunes being admitted. What fhall we fay to the charges made on a young gentleman's purfe, when it is ftated, that in fome regiments of horfe, full fix hundred pounds may be required to equip him as a cornet! While an equal fum per annum, will be *in requifition* (here the term feems peculiarly appropriate) to enable him to eat, drink, and appear in the fame company with his brother officers. Nor is this all; for the commiffion may coft a large fum, fuch as added to the other items would form a capital wherewith the youth might purchafe an annuity, far exceeding the pay he would be likely to receive, for at leaft ten or twelve years. We believe the Scotch regiments are no flouches in the field, and that they bear as many good characteriftics as any in our fervice; yet their drefs is generally very plain, and their fare very far from fumptuous. They are born economifts; and from being brought up in a hardy, active routine, are capable of enduring great fatigue, and of putting up with various privations, which, to a perfon brought up with lefs ceremony, and habituated to the enjoyment of various luxuries, might be at leaft unpleafant, if not abfolutely diftreffing.

The Turkifh enfigns are horfes' tails; the number of which diftinguifhes the rank of their commanders; the fultan has feven, the grand vizier only three, &c. Thofe of the Europeans are pieces of taffety, with divers figures, colours, arms, and devices, thereon. Xenophon tells us, that the enfign borne by the Perfians was a golden eagle on a white flag; the Corinthians bore the winged horfe, or Pegafus; the Athenians, an owl; the Meffenians, the Greek letter M; the Lacedæmonians, the Λ.

The Romans had a great diverfity of enfigns; the wolf, minotaur, horfe, boar, and at length the eagle. See Signa.

A military enfign, on a medal of a Roman colony, denotes it a colony peopled with old foldiers.

Ensign, in *Naval Affairs*, is the large flag hoifted at the ftern of a fhip, whether of war or in the merchant fervice, and denotes the country to which fhe appertains, or the government under whofe protection and authority fhe is navigated. Of the feveral diftinguifhing enfigns, a more ample defcription will be found under the head Flag: we fhall briefly obferve in this place, that this, as well as moft of the colours of fhips, whether *jacks* or *pennants*, are commonly conftructed of bunting, and, that it is ufual to make them fo ample as to occupy two-thirds of the flag-ftaff in height, and to give them depth enough juft to touch the furface of the water, when in a quiefcent ftate. All enfigns are hoifted with their unions, or diftinguifhing cantons, uppermoft, next to the truck on the head of the flag-ftaff: when hoifted in the fhrowds with the union, or diftinguifhing canton, lowermoft, fo as to reverfe all the figures, decorations, or infcriptions, it is indicative of diftrefs. The liberality of fome nations has been confpicuous in forbearing from making prizes of veffels fo circumftanced, provided their commanders have engaged to return to the neareft port, without intermediately offering any violence to fuch as they might meet, there to remain in ordinary until the conclufion of the war.

The difplay of an enfign in prefence of a ftrange fail is generally confidered a mark of civility during times of peace, and in times of war ferves to diftinguifh between friends and foes. During the latter period, fuch veffels as do not hoift their enfigns may be reafonably fufpected to be privateers, or to be defirous of evading every kind of communication. So long as the enfign remains hoifted, during an engagement, the fhip is to be confidered in a ftate of defiance; but when it is lowered, fhe is faid to ftrike; that is, to give up the conteft, and to fubmit, as a prize to her opponent. It occafionally happens that a fhip's enfign ftaff, or the haulyards by which the enfign is hoifted to the mizen-peak, is fhot away; this does not indicate fubmiffion; on the contrary, the annals of warfare exhibit many inftances of extraordinary courage in individuals, who, at fuch moments, have ran aloft, or even ftood on the poop, there to fuftain a portion of the enfign as a token of the moft determined oppofition. In the Britifh fervice we have three enfigns, namely, the white, the red, and the blue; the firft is divided into equal portions, by a broad St. George's crofs of red, of which the upper canton, or quarter, is filled up with the union. The fecond and third are both plain, with the exception of the union in the fame canton. Thefe feveral enfigns indicate the rank of the admiral under which a fhip of war is commiffioned, or employed. Thus, an admiral of the white bears a white, or, as it is commonly called, a St. George's enfign, at the main top-gallant maft head; a vice admiral of the white has one at the fore top-gallant maft head; and a rear admiral one at the mizen top-gallant maft head; the fame rules of precedence obtain, with the admirals, vice-admirals, and rear-admirals of the red and blue refpectively; each bearing a flag of his proper colour at that maft head correfponding with his rank. When fleets are feparated into fquadrons or divifions, each fhip affumes for the time the enfign of that admiral who commands the fquadron, or divifion, in which it acts. The fame is obferved by all veffels acting under any particular port-admiral; all under his authority invariably bearing an enfign conformable to his defignation, whether of the white, red, or blue.

ENSIGNCY, denotes the rank of that officer who bears the enfign or colours of a regiment of foot; and correfponds with that of "cornet" in the cavalry, and of "fecond-lieutenant" in the artillery. It is, perhaps, one among the curious anomalies which pervade many parts of our fyftem, that an enfigncy fhould exift in the engineer department, there being no colours to be carried in that corps, while the colours of the artillery battalions are borne by the fecond lieutenants.

An enfigncy in a marching regiment may generally be obtained for about three hundred pounds, when ferving within the realm: but in various fituations abroad, efpecially in the Eaft Indies, where an increafe of pay is given, the price is ufually much higher. See Ensign, *military*.

ENSISHEIM, in *Geography*, a handfome town of France, in the department of the Upper Rhine, in the diftrict of Colmar, with a population of 1809 individuals. It is ſituated on the river Ill, 12 miles N. of Mulhauſen, 12 miles S.W. of Briſack, 294 miles S. by E. of Paris. N. lat. 47° 52′, and is the chief place of a canton, which has a territorial extent of 257½ kiliometres, 17 communes, and 10,122 inhabitants.

ENSTASIS, Ενστασις, of εν and ἵστημι, *ſtatuo*, in *Logic*, a manner of replying to an opponent, either by confuting his argument, or denying the juſtneſs of his concluſion. Voſſ. Rhet. lib. iii. p. 380.

Enstasis, in *Medicine*, a term uſed to expreſs the ingreſs of moleculæ into the vacuity of the pores which obſtruct them, and thereby cauſe diſeaſes. It is a word familiar with Eraſiſtratus and Aſclepiades, who was a follower of Democritus, and taught that moſt diſeaſes were cauſed by ſuch an ingreſs of matter into the pores. Thus Aſclepiades defined a phrenzy to be ſuch an enſtaſis in the membranes of the brain. Plutarch, in his precepts of Health, alſo mentions this enſtaſis: and Galen and Caſſius, who is ſuppoſed to have been of the ſect of the Rationaliſts, expreſſes the ſame ſenſe by the ſame word.

ENSTORF, in *Geography*, a town of Germany, in the circle of Bavaria and Upper Palatinate; 22 miles N. of Ratiſbon.

ENT, *Sir* George, in *Biography*, an eminent phyſician, was born at Sandwich, in the county of Kent, on the ſixth of November, 1604. After going through the uſual courſe of claſſical inſtruction, he was ſent to Sidney college, in Cambridge. He afterwards travelled to the foreign ſeats of learning, received the degree of doctor of phyſic at Padua, and on his return was incorporated in the univerſity of Oxford, on the ſeventh of November, 1638. During the uſurpation of Cromwell he ſettled in London, where he obtained conſiderable eminence in the practice of his profeſſion: he was elected a fellow, and afterwards preſident of the College of Phyſicians; and at length his merits were rewarded with the honour of knighthood by king Charles II. He enjoyed for a long period the eſteem and confidence of the public, and died at the age of eighty-five, on the 13th of October, 1689. He was buried in the church of St. Lawrence in the Jewry. He was a very intimate friend of the celebrated Dr. Harvey, and wrote a defence of his great diſcovery, entitled "Apologia pro circulatione ſanguinis contra Æmilium Pariſanum," which was publiſhed in 8vo. in the year 1641, and again in 4to. in 1685. About 1651 he prevailed with Dr. Harvey to conſent to the publication of his "Exercitationes de generatione animalium," which he ſuperintended, and preſented to the College of Phyſicians in a ſenſible and elegant dedication. He likewiſe publiſhed a treatiſe of his own in 1679, which was reprinted in 1682, entitled, "Animadverſiones in Malachiæ Thruſtoni, M. D. diatribam de reſpirationis uſu primario," in 8vo. His works were collected, and publiſhed in one volume 8vo. at Leyden in 1687, under the title of "Georgii Entii Opera omnia Medico-Phyſica, &c.:" and after his death, his "Obſervationes ponderis teſtudinis, cum in autumno terram ſubiret, cum ejuſdem ex terra verno tempore exeuntis pondere comparati, per plures annos repetitæ," were printed in the Philoſophical Tranſactions, N° 194, anno 1691. See Eloy Dict. Med. Biog. Dict.

ENTABLATURE, in *Architecture*, is that part of an order of column which is over the capital, comprehending the architrave, frize, and corniche.

The word ſeems formed of *tabulatum* or *intabulamentum*.

The entablature is alſo called the *trabeation*, and by Vitruvius and Vignola *ornament*. It is different in the different orders; indeed, it conſiſts of the three grand parts or diviſions above-mentioned, in all; but thoſe parts conſiſt of a greater or leſs number of particular members or ſubdiviſions, as the orders are more or leſs rich.

Vignola makes the entablature a quarter of the height of the whole column, in all the orders.

In the Tuſcan and Doric, the architrave, frize, and corniche, are all of the ſame height; in the Ionic, Corinthian, and Compoſite, the whole entablature being fifteen parts, five of them are allowed for the architrave, four for the frize, and ſix for the corniche. See Ionic, Corinthian, &c. and Column.

Entablature, or *Entablament*, is ſometimes alſo uſed for the laſt rows of ſtones on the top of the wall of a building, whereon the timber and covering reſt.

As this is frequently made to project beyond the naked of the wall to carry off the rain, ſome authors call it in Latin *ſtillicidium*, or *drip*. Such an entablature does not ſtand out far enough; it lets the water fall on the foot of the wall.

ENTABLER, in the *Manege*, is ſaid of a horſe whoſe croupe goes before his ſhoulders, in working upon volts; for, in the regular manege, one-half of the ſhoulders ought to go before the croupe. Thus we ſay, your horſe entables; for, in working to the right, he has an inclination to throw himſelf upon the right heel; which fault you may prevent, by taking hold of the right rein, keeping your right leg near, and removing your left leg as far as the horſe's ſhoulder. A horſe cannot commit this fault without committing that called aculer; but aculer may be without entabler.

ENTAIL, in *Law*, ſignifies fee tail, or fee entailed, that is, abridged, curtailed, or limited to certain conditions. For the docking of an entail, ſee Docking and Recovery. See Tail and Estate, &c.

ENTALIUM, the *pipe-ſhell*, in the *Materia Medica*, a ſhell of the ſame genus with the dentalia, being a ſpecies of the tubuli marini. It is frequent in the Eaſt Indies, and ſometimes is found on our own ſhores. The virtues aſcribed to it are the ſame with thoſe of the dentalium; but neither of them have any title to more than thoſe of alkaline abſorbents, like the other teſtaceous powders.

ENTE', in *Heraldry*, literally implies *engrafted*, and is uſed by foreign heralds to expreſs a method of marſhalling, little known among us; yet we have an inſtance of it in the fourth grand quarter of his majeſty's royal enſign, whoſe blazon is Brunſwick and Lunenburgh, impaled with ancient Saxony, *enté in pointe*.

ENTELECHIA, Εντελεχεια, of εντελεχης, *perfect*, a Greek term, by which Ariſtotle defines the ſoul; and which, not occurring in any other author, has given the critics and philoſophers infinite perplexity to diſcover its true meaning. See Soul.

Hermolaus Barbarus is even ſaid to have conſulted the devil about it; after which, in his paraphraſe on Themeſtius, whether from the devil or himſelf, we know not, he renders it by *perfectihabia*, which is not a whit the clearer.

Cicero, whoſe interpretation ſhould be preferable to that of any modern, defines entelechia (Tuſc. Queſt. lib. i. cap. i.) to be, "a certain, continued, and perpetual motion;" whence it ſhould ſeem, that Ariſtotle took the ſoul for the mode of the body; a continuous motion being, doubtleſs, a mode of body.

The common Peripatetics hold entelechia to ſignify act, and under it ſuppoſe the form of the compound or animal to be underſtood.

Laſtly, others, and thoſe the lateſt Peripatetics, agree, that the act, or entelechia, whereby Ariſtotle meant to explain

plain the nature of the foul, is either fome mode of the body, as motion, or it is nothing.

ENTENDEMENT, in *Law*. See INTENDMENT.

ENTER, *To, a Hawk*, among *Sportfmen*, is ufed of a hawk when fhe begins to kill.

ENTER, *To, a Hound*. See ENTRANCE *of Hounds*.

ENTERADENES, of εντερον, *inteftine*, and αδην, *gland*, in *Anatomy*, a name by which many authors have called the inteftinal glands.

ENTERENCHYTÆ, of εντερα, *the vifcera*, and εγχυω, *I infufe*, in *Medicine*, a name given by authors to the feveral inftruments contrived for throwing clyfters into the bowels; fuch as the bladder and pipe, the fyringe, and the like, for liquid clyfters; and the box with the double pipe for conveying the fmoke of tobacco. See CLYSTER, and FUMIGATOR.

ENTERFERING, in the *Manege*. See CUTTING.

ENTERITIS, in *Medicine*, from εντερον, *inteftine*, fignifies an inflammation of the inteftines. The difeafe has been varioufly denominated *ileus*, ειλεος, *iliac paffion*, *chordapfus*, &c.

The fymptoms of inflammation of the bowels generally come on fuddenly. An acute and fixed pain, with a fenfe of heat in the abdomen, more efpecially about the umbilicus or navel, often with a feeling of twifting in that part, attacks the patient; this pain is increafed by preffure. Previoufly to its occurrence, or together with it, the ufual fymptoms of fever come on, fuch as rigor or fhivering, followed by flufhes of heat, thirft, and drynefs of the tongue; the pulfe becomes frequent, hard, and commonly fmall; confiderable anxiety enfues; the bowels are obftinately coftive; the ftomach is foon deranged; and eructations, naufea, and vomiting fucceed. As the diforder advances, the pain becomes more acute, without any difpofition to evacuation; the abdomen becomes diftended with flatulence, and more tender under preffure; and the urine is often voided with difficulty and pain. If the inflammation be not alleviated, gangrene generally enfues, often within twenty-four hours from the commencement of the difeafe, and terminates the life of the patient.

The occurrence of gangrene is indicated by a fudden remiffion of the pain, while, at the fame time, the ftrength fails, the pulfe finks, the voice grows feeble, the countenance fhrinks, and affumes even a cadaverous afpect, yet the diftenfion of the belly is not diminifhed, but often increafed. This tendency to terminate fpeedily in mortification conftitutes the great danger of inflammation of the inteftines. Sometimes the difeafe terminates in fuppuration, which, though lefs rapidly fatal, moft commonly wears out the patient's ftrength and life in a lingering manner; but occafionally this condition ends in recovery. The formation of pus is indicated in this difeafe, as in other internal inflammations, by the remiffion, but not total ceffation of the pain, and by the occurrence of frequent fits of rigor, and fometimes by a purulent difcharge by ftool. But the difeafe, efpecially when the aid of medicine is early and actively obtained, frequently terminates favourably, by refolution, as it is called; *i. e.* by a gradual diminution and ceffation of the fymptoms. If the pains abate gradually, and the tendernefs and diftenfion of the abdomen leffen, while the pulfe becomes fofter and fuller, natural evacuations of fæculent matters are paffed, and a free general perfpiration breaks out, this favourable termination may be anticipated. Whereas, the continuance of the conftipation, and of the fixed pain, the increafe of the ficknefs and vomiting, the occurrence of the fymptoms juft defcribed as indicative of gangrene, efpecially if accompanied with hiccup and cold fweats, are among the unfavourable prognoftics.

The principal fource of miftake, into which the practitioner is likely to fall in treating this difeafe, is in confounding it with *colic*; a fpafmodic diforder, which requires a treatment effentially different, but which, neverthelefs, occafionally terminates in enteritis. The diagnoftic fymptoms of the two complaints have been already ftated at length, under the former article. See COLICA.

Enteritis occurs moft commonly in perfons fomewhat advanced in life, generally after the age of forty, or fifty; and it feems to be moft frequent in plethoric habits, and in thofe particularly who indulge in indolence and full living. In fome individuals there appears to be a conftitutional irritability of the inteftines, which renders them liable to attacks of inflammation, upon the application of flight caufes.

The *exciting caufes* of enteritis are various; among the moft common are obftructions in the bowels, which neceffarily retain the fæces, until thefe, by their quantity or quality, become extremely irritating, and excite inflammation. Thefe obftructions to the paffage of the ftools through the inteftinal canal are occafioned by different circumftances. A fpafmodic contraction of any part of the canal, as in colic, if it continue for any confiderable time, is liable to induce inflammation: a ftricture, occafioned by a chronic thickening of the coats of the bowels, fometimes brings it on: *intro-fufception*, or the inverted paffage of one part of the gut into the adjoining part, produces a fimilar effect; as well as the ftrangulation of the inteftine from *hernia*, or rupture: the formation of calculus in the inteftinal canal, which, though a rare occurrence, fometimes takes place, may alfo occafion a fimilar obftruction, and confequent inflammation. Enteritis is likewife excited by irritating fubftances conveyed into the inteftines, which, by their bulk, fhape, or indigeftibility, or by their chemical or fpecific acrimony, produce much excitement in the canals. Thus, the fwallowing of hard kernels, feeds, or ftones of fruit, of pieces of metal, &c. has often induced the difeafe; and the prefence of *fcybala*, or hardened fæces, and of calculous concretions, operates partly by the immediate irritation which they occafion. Thus alfo, ftrong concentrated acids or alkalis, fpirituous liquors, high feafoned food in large quantities, draftic purgatives, worms, &c. in the inteftinal canal, have excited inflammation in it in different inftances. Hence the difeafe has fometimes been the immediate effect of repletion, or of a fit of intoxication: and even a mild cathartic, when the bowels were loaded with much hardened fæces, which the medicine was incapable of removing, has, in fome rare cafes, produced inverted motion and *intus-fufception*, terminating in enteritis. A very common caufe of inflammation in the bowels is the application of cold to the legs and feet, or to the abdomen itfelf, efpecially if fudden or long continued. The retroceffion of gout, rheumatifm, eryfipelas, or chronic eruptions, from the external parts, is fometimes followed by fymptoms of inteftinal inflammation.

In the *cure* of enteritis, as in all other acute inflammatory difeafes, the leading object is to remove the inflammation, from which all the other fymptoms of the difeafe originate. This, though apparently an identical propofition, cannot be too ftrongly inculcated, in the treatment of enteritis; becaufe the exceffive conftipation of the bowels, which, in common with the reft of the fymptoms, is in general merely an effect of the inflammatory condition of the bowels, in fome part, is often attacked by the inattentive practitioner with active purgative medicines, as if it were the primary object, and the fource of all the mifchief. The inflammation is to be fubdued by blood-letting, from a large orifice, to an extent which muft be various according to the conftitution of the patient, and the violence of the fymptoms. This depletion may be aided in its effects by the application of leeches, and afterwards of a blifter to the abdomen; and by the ftricteft abftinence from all ftimulating and nutritious aliment. The blood-letting muft be repeated in a fhort time, if the fymptoms do not abate, and the ftrength of the patient is fufficient to fupport the evacuation; which can only be determined by the obfervation and experience of the practitioner. If the pulfe fhould become fuller and lefs wiry after the operation, it will afford a ftrong reafon for the repetition of it, fhould the continuance of other fymptoms appear to require it. The ufe of emollients externally was in great vogue among the ancients; and fomentations, or, what is better, the warm bath, may be reforted to with advantage. Celfus recommends the ufe of warm cataplafms, frequently changed, and covering the greater part of the trunk, "à mammis ufque ad inguina et fpinam," and alfo a bath of warm oil;—"demittere totum hominem in calidum oleum." De Medicinâ, lib. iv. cap. 13. The dirty applications of living animals, or the fkins of thofe recently killed, can only operate as emollients, and are neceffarily lefs effectual than fomentations; they are at prefent, therefore, fallen into difufe. Sydenham recommended the application of a live whelp to the abdomen in thefe cafes. Opera, fect. i. cap. 4. p. 77. Edit. Lugd. 1726.

It muft be obvious, that before the inflammation of the inteftines is leffened or removed by thefe meafures, any additional irritation to the membranes, already in an acute ftate of fenfibility, whether by the immediate ftimulus of a cathartic medicine, or by the contents of the bowels being forced forwards to the inflamed part, muft tend to aggravate the diforder, rather than to relieve it. In fact it is ufually found, that purgatives, given by the mouth, are not fuccefsful, where this previous diminution of the inflammation has not been effected. And when this has been accomplifhed, fome of the milder purgatives, as the neutral falts, fhould firft be adminiftered, the action of the inteftines downwards being at the fame time folicited by emollient glyfters, which alfo contribute to the fame relaxant purpofes as the external fomentations. Dr. Gregory ufed to remark, in his lectures, that a purgative medicine had often been known to operate as foon as a blifter, applied to the belly, began to rife, which had not acted previoufly: and this obfervation is ftill more commonly verified, after a free evacuation by blood-letting. See Edinburgh Med. and Surg. Journal, vol. i. p. 64. Some practitioners have attempted to open a paffage for the fæces, by mechanically diftending the large inteftines, by throwing up five, fix, or feven pints of warm water with an injecting fyringe. This expedient may be ufeful in fpafmodic colic; but it is objectionable, in enteritis, on feveral grounds. Such diftenfion can only be accomplifhed in the colon, or great gut; whereas the obftruction by inflammation is commonly in fome portion of the fmall inteftines, and therefore out of the reach of the enema. In the next place, any forcible diftenfion of an inflamed and thickened canal, if it could be accomplifhed, would rather conduce to an increafe of the inflammatory condition, than to leffen it by the removal of fæces. In a word, all meafures applied to the inflamed inteftine fhould be mild; fince forcible ones cannot but augment the inflammation, upon which the impeded function of the organ depends. By way of glyfter, therefore, a little common falt, magnefia vitriolata, or infufion of fenna, with gruel or warm water, will probably anfwer every good purpofe that can be expected from fuch an expedient. Tobacco fmoke has been often injected when milder means have failed, or infufions of tobacco; but their fuccefs, we believe, has not been often experienced. Indeed tobacco injections are liable to produce great ficknefs and irritation, if that herb be not ufed in very fmall quantities.

The extreme ficknefs which often accompanies enteritis, and by which every thing that is taken into the ftomach, whether liquid or folid, is rejected, renders it difficult, in fome cafes, to produce any effect upon the bowels by internal medicine. In this cafe, the irritability of the ftomach may be quieted by the faline effervefcing draught, or by a fmall opium pill, or, if this be rejected, by an opiate given in a glyfter; after which the neceffary laxative medicines may be retained, and accomplifh the intended object. It fhould be obferved, however, that the ftimulus of opium will prove rather injurious than ufeful, while the inflammation is unfubdued.

Where the inflammation has arifen from ftrangulated hernia, the operation, by which the ftrangulation is removed, and the inteftine returned into its place, can alone fave the life of the patient. See Hernia.

We have already had occafion to allude to a remedy for conftipation of the bowels, which has been recommended as a laft refource, namely, a quantity of crude quickfilver; and to point out the abfurdity of the hypothefes, which have led to its ufe, as well as fome of the ill confequences of it. Sydenham reprobates the practice, which appears to have been firft adopted about his time. Loc. cit. p. 76. See Constipation.

When the inflammation of the inteftines has been fubdued, the utmoft caution fhould be employed, with a view to the prevention of a relapfe, to which the convalefcent from enteritis is extremely liable. A thin, fpare, and laxative diet, confifting of vegetable fubftances, of gruels, or barley water, or thefe mixed with milk, muft be adhered to moft rigidly for a confiderable time after recovery; and all acrid, ftimulating fubftances, or thofe which are difficult of digeftion, fhould be moft fcrupuloufly avoided. The moft fatal effects have been obferved to take place, in fome inftances, from returning too foon to ordinary diet, after the removal of inflammation of the bowels. In order to guard againft a future recurrence of the difeafe, the application of cold to the abdomen and feet fhould be prevented by warm cloathing; and the occurrence of coftivenefs at all times avoided, by laxative diet or medicine, fo that no accumulation of fæces can take place, and the fteady action of the bowels be conftantly preferved.

ENTERMEW. See Falcon.

ENTEROCE'LE, (from ἔντερον, *an inteftine*, and κήλη, *a tumour*, or *rupture*,) in *Surgery;* a hernia is fo termed, when its contents are entirely compofed of inteftine.

ENTERODYNIA, from ἔντερον, *inteftine*, and ὀδύνη, *pain*, in *Medicine*, a term ufed by fome writers, as nearly fynonymous with colic, but expreffing a minor degree of pain; fuch, for inftance, as arifes from the irritation of vitiated bile, loaded bowels, worms, &c. and which, therefore, laxative medicines generally relieve.

ENTERO-EPIPLOCE'LE, (from ἔντερον, *an inteftine*, ἐπίπλοον, the *omentum*, and κήλη, *a tumour*,) in *Surgery*, a term applied to a hernia, which contains both a portion of the bowels, and a piece of the omentum.

ENTERO-HYDROCE'LE, (from ἔντερον, *an inteftine*, and ὑδροκήλη, *a dropfy of the fcrotum*,) a fcrotal hernia, containing a good deal of fluid.

ENTEROLOGY, from ἔντερον, *inteftinum, a gut*, and λόγος, *fermo, difcourfe*,) is properly a treatife of the bowels. Though the word is generally underftood to include the contents

contents of three cavities, head, breaft, and all the vifcera or belly.

ENTERO'MPHALOS, (from ἐντερον, *an inteftine*, and ὀμφαλος, the *navel*,) a hernia at the navel, and containing inteftine.

ENTERORA'PHE, (from ἐντερον, *an inteftine*, and ῥαφη, *a future*,) a future of the bowels.

ENTERO'SCHEOCELE, (from ἐντερον, *an inteftine*, and οσχεοκηλη, *a rupture, or hernia fituated in the fcrotum*,) a fcrotal hernia, the contents of which are entirely compofed of inteftine.

ENTERPEN, *To*, in *Falconry*, is a term applied to a hawk, when her feathers are wrapped up, fnarled, or entangled.

ENTERPLEADER, in *Law*. See INTERPLEADER.

ENTERPRISE, denotes an undertaking attended with fome difficulty and danger.

ENTERPRISE, in *Military Affairs*, appertains rather to thofe defultory expeditions which often prove of confiderable importance in their confequences; though, perhaps, apparently trivial, when compared with thofe great events that fometimes characterize a campaign. In fome inftances we fee the moft decided effects produced by the operations of enterprifing partifans, who, exclufive of the quantity of forage, and the intelligence they generally afford, diftrefs the enemy feverely, by compelling him to act with fuch circumfpection, and fo to ftrengthen his pofitions, as inevitably muft weaken his other operations, as well as create confiderable alarm among his troops, efpecially when detached in expofed fituations.

In fome countries, detached enterprifes feem to conftitute the chief incidents in warfare; thus, we find that irregular corps commanded by baron Trenck were peculiarly active, and haraffed the enemy beyond meafure! Thus, alfo, the Croats, the Pandours, and the Pindaries, of the Mahratta empire, the Sooties under the late Tippoo, and various other fuch predatory eftablifhments, commanded by officers of a fuitable difpofition, have ever been famous for annoying, and for cutting off the fupplies of their adverfaries.

No enterprife, whether military or naval, fhould be entrufted to the charge or conduct of an individual deficient in any one of the requifites for fuch a refponfible, and, indeed, fo arduous an appointment. In the firft place, a knowledge of the geography of that country he is to infeft, and of the language of its inhabitants, is indifpenfably requifite. His character for marked perfonal courage, and for the prompt application of fuitable remedies againft every fpecies of difafter, or of difappointment, fhould be confpicuous. He fhould poffefs that kind of deportment which preferves the ftricteft fubordination, while it fecures the affection, and excites the admiration, of all under his command. He fhould be expert in all military exercifes, and poffefs both an active mind, and the foundeft conftitution. With fuch valuable gifts, added to a certain conciliatory mode of conduct towards the peafantry, &c. of the diftrict in which he is to carry on his enterprifes, a partifan may perform wonders, and far outdo all the exploits an equal number of regulars could achieve under a lefs capable leader. The truth is, that, generally fpeaking, foldiers and failors are mere automatons, acting under the direction of an expert machinift, whofe character is ever appreciated according to the fuccefs of his movements. How far permanent reputation may be eftablifhed by the commander of fuch an auxiliary force, may be collected from that dread which was created by the Tarleton legion among the Americans, during their ftruggle with the mother country. That legion, even at this day, are fpoken of in terms of admiration, by the very people who fuffered fo feverely from the exertions and abilities of its commander.

It being obvious that, on many occafions, an army muft depend greatly for fupplies on the activity and talents of a partifan, we cannot too forcibly point out the peremptory neceffity which exifts, for the rejection of all who may be deficient in the above qualities, without which, it is unreafonable to expect that any enterprife of moment fhould ever be fafe to thofe who might be employed; much lefs could it be of fervice to thofe in whofe behalf it might be undertaken. Naval enterprifes require no lefs attention in fome cafes; though, for the moft part, we find them rather indebted for fuccefs to undaunted bravery, and a moderate portion of judgment. Thefe ordinarily are made under cover of, or fupported by, fome fufficient force; whereby, in cafe of defeat, they are refcued from total ruin: whereas, the military partifan rarely has fuch protection at hand.

ENTERSOLE. See MEZANINE.

ENTERTAIN. This term has, no doubt, crept into military phrafeology in confequence of the entertainment afforded at public-houfes, &c. to fuch candidates as prefer a fcarlet coat and a mufket, to a frock and a pitch-fork. We cannot fufficiently exprefs our regret, that no better mode has been ordinarily brought into practice, than that of plying men with liquor for the purpofe of inducing them to inlift. We are, indeed, rather infidels on the fubject of any numerous acceffions to the real ftrength of our armies, in confequence of this cuftom: for we have had occafion to learn, that a very large portion of the recruits obtained in confequence of inebriety, either abfcond at fome favourable moment, or prove to be the worft foldiers in their regiment. If drunkennefs has been habitual to them, they rarely relinquifh their addictednefs to liquor; and if, on the contrary, they had, until the moment of being inlifted, been of a fober difpofition, their peace of mind is totally deftroyed, and they ferve without alacrity, without zeal, and generally, too, without health: they are often known to fall a prey to remorfe!

We are fenfible that, fpeaking abftractedly, the affording of entertainment to perfons who appear defirous of inlifting, may be defended under the plea of ftate neceffity; but it becomes a very ferious queftion, whether the nation does not pay confiderably more in confequence of the monies expended in this way? alfo, whether it is found policy to allow military perfons to be in any fhape concerned in overwhelming the fenfes of that man, who is to be for life affociated with them, and who will not always be unmindful of the condition to which they may have brought him? To condemn a practice, faid to be fo neceffary towards our fafety as an independent nation, without offering a fubftitute of a more favourable defcription, might, perhaps, juftly fubject us to the imputation of prefumptuoufly branding the exifting cuftom with obloquy; we fhall, therefore, briefly remark, that, in all probability, not only as many, but more, valuable recruits would be obtained by defifting from what is vulgarly called *entertaining* the candidates; and from expending a very large portion of his bounty in liquor, rareefhows, and fuch diffipations as "make him poor indeed!" In place of this, let the whole of his bounty-money be given to the parifh from which he may have been taken, for the fupport of his family; and let the recruit himfelf be fubfifted and cloathed entirely at the expence of the ftate. Should the recruit have no family fubject to parochial aid, or likely to be fo, let his bounty money be referved until he fhould have ferved a certain time, and then to be given to him in inftalments; fo that he might not diffipate the whole adventitioufly, ventitiouſly, and that he ſhould be enabled, from time to time, to provide himſelf with various articles of apparel, or of comfort, ſuited to his profeſſion.

We cannot cloſe this ſubject without ſtrongly reprobating the practice of ſtopping certain ſums, for off reckonings, and neceſſaries. If the ſoldier is to pay for them, let it be by a plain and peremptory reduction of his pay, in exchange for which he ſhould receive certain articles from government; but let there be no account-current between the ſoldier and his officer, for feathers, lace, buckles, canteens, knapſacks, and ſuch like: this kind of dealing ſets aſide that reſpect which the former ought always to entertain for the latter, and, not unfrequently, occaſions a certain kind of ſuſpicion by no means tending to promote either eſteem or ſubordination. While reform ſeems to be the order of the day, it may, perhaps, be at leaſt faſhionable, if not praiſeworthy, to point out this as an inſtance in which much melioration might be very eaſily, and ſafely, effected.

ENTERTAINMENTS, *epulæ*, among the ancients, were of various kinds, as, 1. Funeral entertainments, *epulæ funebres*. 2. Entertainments given by the huſband on bringing home his wife, called *epulæ geniales*. 3. Thoſe beſtowed on the ſoldiers, called *epulæ militares;* which was done before or after an engagement, or on occaſion of proclaiming the general imperator. 4. Birth-day entertainments, *epulæ natalitiæ*.

There were many other kinds, denominated either from the place where, the perſons by whom, or the occaſion for which they were given.

ENTERVIEW, in *Falconry*, a term uſed for the ſecond year of a hawk's age.

ENTHALIUM, in *Natural Hiſtory*, a name given by ſome to a ſpecies of the tubuli marini, more uſually known by the name of penicillum marinum, and pinceau de mer. See Penicilli *Marini*.

ENTHUSIASM, Ενθουσιασμος, a poetic, or prophetic rage or fury, which tranſports the mind, inflames and raiſes the imagination, and makes it conceive and expreſs things extraordinary and ſurpriſing.

The word is derived from the Greek, ενθεος, or ενθους, a man animated in an extraordinary manner with the ſpirit of God; in whom God is, or whom God animates. Whence the verb ενθουσιαζω, or ενθουσιαω, and the noun ενθουσιασμος, *enthuſiaſm:* and ενθουσιαστης, *enthuſiaſt*, a perſon ſubject to ſuch tranſports.

M. de Piles defines enthuſiaſm to be a tranſport of the mind, whereby it is led to think and imagine things in a ſublime, ſurpriſing, yet probable manner.

The ſublime he thinks a neceſſary ingredient in the definition, as being the proper effect and production of enthuſiaſm.

This is the enthuſiaſm felt in poetry, oratory, muſic, painting, ſculpture, &c. (ſee the next article); but this enthuſiaſm which belongs to the works of art, is very different from that attributed to the ſibyls and prieſteſſes of the oracles, and heathen gods, which was little elſe but fanaticiſm, and conſiſted principally in grimace, and contortions of the body. See Oracle and Pythian.

There is a degree of aſſent, ſays Mr. Locke, which, with ſome men, has the ſame authority as either faith or reaſon; and that is enthuſiaſm, which, laying by reaſon, would ſet up revelation without it; whereby, in effect, it takes away both reaſon and revelation, and ſubſtitutes in the room of it the ungrounded fancies of a man's own brain, and aſſumes them for a foundation, both of opinion and conduct.

Immediate revelation being a much eaſier way for men to eſtabliſh their opinions, and regulate their conduct by, than the tedious labour of ſtrict reaſoning; it is no wonder, that ſome have been very apt to pretend to it: eſpecially in ſuch of their actions and opinions as they cannot account for by the ordinary methods of knowledge and principles of reaſon. Hence we ſee, that in all ages men in whom melancholy has mixed with devotion, or whoſe conceit of themſelves has raiſed them into an opinion of a greater familiarity with God than is allowed others, have often flattered themſelves with the perſuaſion of an immediate intercourſe with the Deity, and frequent communications with the Divine ſpirit.

Their minds being thus prepared, whatever groundleſs opinion comes to ſettle itſelf ſtrongly upon their fancies, is an illumination from the ſpirit of God; and, whatſoever odd action they find in themſelves an inclination to do, that impulſe is concluded to be a call or direction from heaven, and muſt be obeyed.

This we take to be properly enthuſiaſm; which, though riſing from the conceit of a warm and over-weening brain, works, where it once gets footing, more powerfully on the perſuaſions and actions of men than either reaſon or revelation, or both together; men being moſt forwardly obedient to the impulſes they receive from themſelves.

When men are once got into this way of immediate revelation, of illumination without ſearch, and certainty without proof, reaſon is loſt upon them; they are above it; they ſee the light infuſed into their underſtanding, and they cannot be miſtaken: like the light of bright ſun-ſhine, it ſhews itſelf, and needs no other proof but its own evidence; they feel the hand of God moving them within, and the impulſes of the ſpirit, and cannot be miſtaken in what they feel. But, of this ſeeming and feeling, it is a perception of an inclination to do ſomething, or of the Spirit of God moving that inclination: theſe are two very different perceptions, and ſhould be carefully diſtinguiſhed.

If they know the thing to be a truth, they muſt do it, either by its own ſelf-evidence, or by the rational proofs that make it out to be ſo: if they know it to be a truth, either of theſe two ways, they in vain ſuppoſe it to be a revelation; for thus, all truths, of what kind ſoever, which men uninſpired are enlightened with, come into their minds. If they ſay, they know it to be true, becauſe it is a revelation from God, the reaſon is good; but then it will be demanded, how they know it to be a revelation from God? If they ſay, by the light it brings with it, they ſhould conſider, whether this be ſaying any more than that it is a revelation, becauſe they believe it to be true; for all the light they ſpeak of is but a ſtrong perſuaſion of their own minds that it is a truth, which is a very unſafe ground to proceed on, either in our tenets or actions. True light in the mind is nothing elſe but the evidence of the truth of any propoſition; and if it be not ſelf-evident, all the light it can have is from the clearneſs of thoſe proofs upon which it is received. See Evidence.

God, when he makes the prophet, doth not unmake the man; he leaves his faculties in their natural ſtate, to enable him to judge of his inſpirations, whether they be of divine original or not. If he would have us aſſent to the truth of any propoſition, he either evidences that truth by the uſual methods of natural reaſon, or elſe makes it known to be a truth which he would have us aſſent to by his authority; and convinces us that it is from him, by ſome marks which reaſon cannot be miſtaken in. Eſſay on Hum. Underſt. book iv. chap. 19.

The holy men of old, who had revelations from God, had ſomething elſe beſides internal light, of aſſurance in their

their own minds, to teftify to them that it was from God; they had outward figns to convince them of the Author of thofe revelations; and when they were to convince others, they had a power given them to juftify the truth of their commiffion from heaven; and by vifible figns, to affert the divine authority of the meffage they were fent with. Mofes faw the bufh burning without being confumed, and heard a voice out of it. God, by another miracle, of his rod turned into a ferpent, affured him likewife of a power to teftify his miffion, by the fame miracle repeated before thofe to whom he was fent.

Enthufiafm is defined by Dr. Hartley (Obf. on Man) to be a miftaken perfuafion in any perfon, that he is a peculiar favourite with God; and that he receives fupernatural marks thereof. The vividnefs of the ideas of this clafs eafily generates this falfe perfuafion in perfons of ftrong fancies, little experience in divine things, and narrow underftandings, (and efpecially where the moral fenfe, and the fcrupulofity attending its growth and improvement, are but imperfectly formed,) by giving a reality and certainty to all the reveries of a man's own mind, and cementing the affociations in a preternatural manner. It may alfo be eafily contracted by contagion, as daily experience fhews; and indeed more eafily than moft other difpofitions, from the glaring language ufed by enthufiafts, and from the great flattery and fupport which enthufiafm affords to pride and felf-conceit. The ingredients, fays lord Lyttelton in his "Obfervations on the Converfion, &c. of St. Paul," of which enthufiafm is generally compofed, are great heat of temper, melancholy, ignorance, credulity, and vanity, or felf-conceit.

The true fources of enthufiafm, fays Mr. Hume in his "Effay on Superftition and Enthufiafm," are hope, pride, prefumption, a warm imagination, together with ignorance. From the influence of thefe caufes arife raptures, tranfports, and furprifing flights of fancy; and whilft confidence and prefumption ftill increafe, thefe raptures, being altogether unaccountable, and feeming quite beyond the reach of our ordinary faculties, are attributed to the immediate infpiration of that Divine Being, who is the object of devotion. In a little time the infpired perfon comes to regard himfelf as a diftinguifhed favourite of the Divinity; and when this phrenfy once takes place, which is the fummit of enthufiafm, every whimfy is confecrated. Human reafon, and even morality, are rejected as fallacious guides; and the fanatic madman delivers himfelf over, blindly, and without referve, to the fuppofed illapfes of the fpirit, and to infpiration from above.

Devotion, undirected, or unreftrained by reafon, degenerates into enthufiafm, or a religious phrenfy, founded in an apprehenfion of a prefent Divine energy on the mind, to which all its powers are fuppofed to be fubject, and by which a perfon is carried on without attention to any thing elfe as his guide, and producing not only great perturbation of mind, but moft amazing agitations of body. Many inftances of this kind occur, both in ancient and modern times, to the difgrace and injury of rational religion.

Mr. Hume (ubi fupra) makes feveral reflections concerning the different influences of enthufiafm and *fuperftition* (which fee) on government and fociety. He obferves, *firft*, that fuperftition is favourable to prieftly power, and enthufiafm not lefs, or rather more, contrary to it than found reafon and philofophy. He obferves, *fecondly*, that religions, which partake of enthufiafm, are, on their firft rife, more furious and violent than thofe which partake of fuperftition; but in a little time become more gentle and moderate. When enthufiafm rifes to that height as to infpire the deluded fanatic with the opinion of divine illuminations, and with a contempt for the common rules of reafon, morality, and prudence, it produces the moft cruel diforders in human fociety; but its fury is like that of thunder and tempeft, which exhauft themfelves in a little time, and leave the air more calm and ferene than it was before. When the firft fire of enthufiafm is fpent, men naturally, in all fanatical fects, fink into the greateft remiffnefs and coolnefs in facred matters; there being no body of men among them, endowed with fufficient authority, whofe intereft is concerned to fupport the religious fpirit: no rites, no ceremonies, no holy obfervances, which may enter into the common train of life, and preferve the facred principles from oblivion. For the influence of fuperftition, fee that article. He obferves, *thirdly*, that fuperftition is an enemy to civil liberty, and enthufiafm a friend to it.

ENTHUSIASM, in *Poetry*, *Eloquence*, and *Elocution*, is a fpecies of rapturous elevation and fervour, which tranfports the writer or fpeaker beyond the limits of apparent rule, and mere methodical propriety. Like genuine fublimity, to which it is very nearly allied, and with which it occafionally co-operates, in producing the higheft impreffions that can refult from human eloquence, it defies, perhaps, the exactnefs of logical definition; its very effence confifting in a ftate of feeling, at once fo potent and fo evanefcent, as to elude the cautious touch of analyfis. It belongs, therefore, only to perfons of fuperior genius, and by fuch alone muft be attempted; fince, like all fuperlative excellencies, it verges for ever on the brink of abfurdity; and criticifm has never yet been able to erect a fufficient barrier to defend its utmoft limits. Like every other paffion, it muft be felt before it can be expreffed; and the mind of the writer or the fpeaker muft be well fortified with knowledge on the fubject he is handling, and the judgment well exercifed in the nice difcriminations of tafte, of feeling, and of decorum, before he ventures to indulge it in compofition or in delivery, if he addreffes himfelf to the enlightened or educated portions of the community, or he will be worfe than difappointed of his object. In circles of a different defcription, however, it is evident that the mere femblance of enthufiafm, unaided by thefe preliminary qualifications, feldom fails of a very powerful effect: and, by this quality alone, bigotry and fanaticifm frequently accomplifh their end, and maintain abfolute dominion over the minds of their ignorant votaries. It is therefore fufficiently obvious, that it is a quality the orator, if he be fufceptible of it, fhould never fail to cherifh; and if he be not fufceptible of it, he is but a fragment of an orator. As for poetry, enthufiafm is admitted to be its very foul and effence. In the delivery of eloquence, or the recitation of poetry, genuine enthufiafm is expreffed by a deep and powerful afpiration, by an increafe of quantity in all the fyllables principally produced by the prolongation and increafe of the power of the voice on the liquids and liquifiable confonants; a reftrained vehemence, which, without any of the difgufting effects of vociferation, fpreads the undulations of found through an extended circle. It is generally accompanied by a confiderable dilatation of the noftrils, a protrufion of the eye-balls, and great tenfion and rigidity of the whole mufcular fyftem. Shakefpeare, who felt its influence fo frequently, has finely defcribed its operation in the fpeech of Henry V. before Harfleur:

> "Now fet the teeth, and ftretch the noftrils wide,
> Hold hard the breath, and bend up every fpirit
> To its full height."

The whole fpeech is one of the fineft effufions of enthufiafm ſiaſm ever penned, and requires in the reciter all the inſpiration of that powerful feeling.

ENTHUSIAST, Ενθυσιαστης, a perſon poſſeſſed with enthuſiaſm. See Enthusiasm, Fanatic, &c.

The word is generally underſtood in an ill ſenſe. It was applied by the ancients to a ſect of heretics, called alſo Maſſalians and Euchites; who, as Theodoret expreſſes it, were denominated enthuſiaſts, becauſe being poſſeſſed by the devil, they believed themſelves divinely inſpired. See Massalians and Euchites.

Among us, enthuſiaſt is ſometimes of like import with fanatic, and is applied to the Quakers, and ancient Anabaptiſts, and modern prophets, from their pretences to extraordinary lights, revelations, viſions, impulſes, &c. from heaven.

ENTHYMEME, in *Logic* and *Rhetoric*, an argument conſiſting only of two propoſitions, an antecedent, and a conſequent deduced from it.

The word is Greek, ενθυμημα, formed of the verb ενθυμεισθαι, to think, conceive, a compound of εν and θυμος, *mind.*

Ariſtotle calls it the rhetorical or probable argument; the ſchools, the imperfect ſyllogiſm, in contradiſtinction to the perfect, which conſiſts of three propoſitions, and is called the dialectical argument.

It muſt be obſerved, however, that the enthymeme is really a perfect ſyllogiſm in the mind, and only imperfect in the expreſſion, becauſe one of theſe premiſes is ſuppreſſed, as being ſufficiently clear and obvious, and eaſily ſupplied by the underſtanding of thoſe with whom we diſcourſe.

Thus, in every right-lined triangle, the three angles are equal to two right ones; and conſequently, they are ſo in an iſoſceles triangle, is an enthymeme; the propoſition, that an iſoſceles triangle is a right-lined triangle being omitted, as being ſufficiently known and granted.

The enthymeme is the moſt ſimple and elegant of all argumentations; being what a man, in arguing cloſely, commonly makes, without attending at all to the form. Thus, that verſe remaining of Ovid's tragedy, entitled Medea, contains an enthymeme: "Servare potui, perdere an poſſum rogas:" "I was able to ſave you; conſequently, to have deſtroyed you." All the beauty would have been loſt, had all the propoſitions been expreſſed; the mind is diſpleaſed with a rehearſal of what is no ways neceſſary.

Sometimes, alſo, the two propoſitions of an enthymeme are both included in a ſingle propoſition, which Ariſtotle calls an enthymematical ſentence, and gives this inſtance thereof: "Mortal, do not bear an immortal hatred." The whole enthymeme would be, "Thou art mortal; let not, therefore, thy hatred be immortal."

ENTIER, in the *Manege*, is uſed for a ſort of reſty horſe, that refuſes to turn, and is ſo far from following or obſerving the hand, that he reſiſts it. If your horſe is entier, and refuſes to turn to what hand you will, provided he flies, or parts from the heels, you have a remedy. by putting the Newcaſtle on him; that is a caveſſon, made after the duke of Newcaſtle's way.

The word is French, and is alſo uſed among them to denote a ſtone-horſe.

This term, in its common acceptation, is applied to a horſe that refuſes to turn, and whoſe refuſal proceeds from the awkwardneſs and ſtiffneſs of the body and limbs, and ſometimes from malice and bad habits. In ſome caſes, a hurt in his foot, leg, or ſhoulder, may be the cauſe of his refuſing to turn to that ſide where he feels any pain. A hurt in his reins or haunches, a curb or ſpaving, which, by hindering him to bend and reſt upon his hocks, may make him guilty of this diſobedience. Theſe are evils which art can do little towards curing. The term entier, in its figurative ſenſe, in which it is always to be underſtood in horſemanſhip, means a ſtiff horſe, or one that is not ſuppled, and therefore refuſes to turn, from the pain and difficulty which he finds in putting himſelf into a proper poſture. Accordingly the Italians, from whom the terms of horſemanſhip are chiefly taken and adopted, or naturalized by other nations, figuratively call a ſtiff and undiſciplined horſe, a whole, entire, or unbroken horſe; which, from the ſtiffneſs and tightneſs of his joints and muſcles, is not able to bend himſelf, but in turning moves all of a piece, like a beam, or bar of iron; while the active and ſuppled horſe, who can bend himſelf readily, and becomes part of the circle he deſcribes in turning, may be ſaid, like a chain, ſo to looſen and ſhift his limbs, as to break and divide himſelf, as it were, into parts; whence, perhaps, the term "horſe-breaker," for one who forms the paces, and qualifies horſes for being rode. Berenger's Hiſtory and Art of Horſemanſhip, vol. ii.

ENTIERTIE, from the French *entier*, is uſed in our *Law-books*, in contradiſtinction to moiety, and denotes the whole. Thus a bond, damages, &c. are ſaid to be entire, when they cannot be divided or apportioned.

ENTIRE Leaf, in *Syſtematic Botany*, *folium integerrimum*, a leaf whoſe edge is not cut or toothed; the term has no reference to *folium integrum*, an undivided leaf, which laſt is deſtitute of lobes or ſegments, without regard to its margin.

Entire *Tenancy*, in *Law*, is contradiſtinguiſhed to *ſeveral tenancy*, and ſignifies a ſole poſſeſſion in one man; whereas the other denotes a joint, or common one, in ſeveral. See Tenant and Joint-tenant.

Entire *Arms*. See Arms.

ENTITATIVELY, Entitative, implies an abſtraction, or ſeparation of all the circumſtances, from a thing under conſideration.

Thus, a thing is ſaid to be taken or conſidered entitatively, or ſecundum entitatem, when conſidered nakedly and preciſely, according to what it is in itſelf, without any thing extrinſic. *E. gr.* Peter entitatively taken, is Peter, as a thing, a ſubſtance, a man, &c. without any regard to his being a lord, a huſband, learned, &c.

ENTITY, in the *School Philoſophy*, a phyſical ens, or being, conſidered according to what it is in its natural capacity.

Some dealers in diſtinctions give us ſeveral kinds of entity.

Or, entity denotes the actual eſſence or exiſtence of any thinking thing. See Ens.

ENTLIBUCH, in *Geography*, a village of Switzerland, in the canton of Lucern, the principal place of a bailliage, which extends from the Emme-thal in the canton of Bern to the bridge near Wertenſtein, about 15 miles in length and 9 in its greateſt breadth; and contains 11,000 perſons. It is governed by a bailiff, who is always a ſenator of Lucern; he continues in office two years, and generally reſides in that capital. The bailliage is divided into three diſtricts; the upper, or Eſchliſmat, the middle, or Shuepfen, and the lower, or Entlibuch; each of which has its ſeparate courts of juſtice, from which an appeal lies to Lucern. The valley of Entlibuch is watered by ſeveral rivulets, winding for ſome way between two ridges of well-wooded hills, and abounding in pictureſque ſcenery. It contains ſeveral villages, of which the principal are Eſchliſmat, Shuepfen, and Entlibuch, which takes its name from the river Entle, and gives it to the whole diſtrict. The inhabitants chiefly follow

low agriculture; they rear large quantities of horned cattle, ſheep, goats, and ſwine; they alſo make and export cheeſe in great abundance. The peaſants of Entlibuch are much eſteemed for their independent ſpirit, vigour, and ſtrength; and are remarkable for keenneſs and vivacity, for great quickneſs in repartee, for a peculiarity of garb, and for many ſtriking cuſtoms, which diſtinguiſh them from the natives of circumjacent diſtricts. The valley of Entlibuch may be conſidered as one of thoſe parts which unite with the mild and cultivated the wild and rugged ſcenery of Switzerland; its acclivities gradually aſcend and terminate in mount Pilate, whoſe barren top is ſeen towering above the fertile and well-wooded hills. In the 13th century, Entlibuch was ſubject to the counts of Wolhauſen, and came by purchaſe, in 1299, to the emperor Albert. In the following century it was held as a fief from the houſe of Auſtria by ſeveral ſucceſſive counts; till the nation, grievouſly oppreſſed by Peter of Torrenberg in 1386, threw itſelf under the protection of Lucern. That republic continued to poſſeſs Entlibuch, as a feudal tenure under the houſe of Auſtria, till the year 1405; when the archduke Frederic renounced all the rights of ſovereignty. For above a century and a half, the inhabitants, inflamed with a deſire of independence, and excited by the example of the popular cantons, frequently roſe in arms, and attempted to eſtabliſh a democracy, but without ſucceſs. Their laſt inſurrection broke out in 1653; ſince which time they have continued in a ſtate of perfect tranquillity under the adminiſtration of Lucern, enjoying, with contentment, the privileges with which they are endowed. The peaſants of Entlibuch were diſtinguiſhed by their attachment to the government, and by their decided oppoſition to French principles, during the late revolution. Coxe's Travels in Switzerland, vol. i.

ENTOGANUM, in *Botany*, Gærtn. t. 68. See Melicope.

ENTOMOLITHUS, in *Natural Hiſtory* and *Mineralogy*, is the name of a genus of the animal order of remains (*reliquia*, or relicts) of a former race of beings, which inhabited the earth or its waters, and includes the different kinds of inſects found in a foſſil ſtate. According to Mr. William Martin (Outlines of the Knowledge of extraneous Foſſils, p. 191), the eſſential characters, or diagnoſtics of the permanent ſpecies in this genus, are to be ſought, in "the upper external covering of the thorax, united to that of the abdomen;" the temporary ſpecies of this genus are to compriſe the detached head, thorax, abdomen, limbs, &c. of foſſil animals, reſembling the recent ſpecies of inſects. See Reliquia.

ENTOMOLOGY, the ſcience of inſects, or, as literally rendered from the Greek, a *diſcourſe on inſects;* the term by which the ſtudy of theſe animated beings is expreſſed.

Inſect, from *inſectum*, Latin, is of later origin than ἔντομα, the term made uſe of by Ariſtotle, who flouriſhed in the fifth century, before the Chriſtian era, and was invented much earlier than the time of that celebrated philoſopher. Ariſtotle defines it to ſignify an animal which by inciſions is nearly ſevered into two or more parts, and the Latins, long before the time of Pliny, (who lived in the reign of Titus,) employed the word *inſectum*, from *inſecor*, which preciſely bears the ſame interpretation.

The inſect race conſtitutes the moſt conſiderable portion of the whole claſs of organized bodies poſſeſſing the vital principle of life. The number of aquatic beings concealed from our reſearch in the depths of the ocean cannot be within the reach of human eſtimate; it is to the terreſtrial tribes, or thoſe which inhabit the ſurface of our globe, that we alone allude; and the entire amount of theſe, including every order, is confeſſedly inferior in point of number to the ſingle claſs of inſects. Among the larger animals the diſcovery of a few new ſpecies, or of individuals not correctly aſcertained before, is eſteemed of conſequence; but ſo extenſive are the limits of entomology, that the diſcovery of a multitude of inſects under the ſame circumſtances fail to excite aſtoniſhment, though it may awaken curioſity; and, indeed, its frequency ſeems calculated to confirm the commonly received opinion, that the inſect race, in the diverſity of ſpecies, much more in the number of its individuals, muſt be almoſt boundleſs.

In this view the ſcience of entomology becomes one of the moſt important that can engage the mind of the natural philoſopher. It is the difficulty of diſcriminating the particular affinities and characters of theſe beings, ariſing from their amazing number and variety of form, in addition to their minuteneſs, that more ſtrongly enforces their claim to his conſideration. The naturaliſt who neglects the ſtudy of inſects, cannot deſerve our reſpect as a general obſerver of nature. His views are partial; his enquiries circumſcribed; he regards only an inconſiderable portion of animated nature; and his remarks are confined chiefly to thoſe which, from their magnitude and diſtinctneſs of character, preſent the leaſt obſtacle to inveſtigation.

The ſtudy of every claſs of animals is indiſputably attended with peculiar advantages; and in none is this aſſurance more clearly manifeſted than in the tribe of inſects. In the mazy labyrinths of entomology, the naturaliſt will find abundant ſcope for the exerciſe of his zeal and application, and in the courſe of his enquiries the full exertion of his penetration will be oftentimes required to the aſcertainment of truth. The amazing number of ſpecies it embraces; their forms ſo extraordinary; ſo infinitely varied; and yet ſo gradually approximating through an endleſs ſeries of tranſitions from one ſpecies to another; the diverſity of ſtructure obſervable in their antennæ, their limbs, bodies, wings, and every other particular which conſtitute the eſſential differences of their orders, genera, and ſpecies; added to the ſurpriſing changes in form which the generality of inſects undergo at ſtated periods of their life:—theſe are circumſtances which contribute to render them objects of the moſt curious ſpeculation to the naturaliſt, and we ſhall venture to affirm, that it is from a knowledge of theſe, their characters, tranſitions, metamorphoſis, and the various modes of life theſe little beings are deſtined to purſue, that he will obtain a more intimate acquaintance with the great laws of animated nature, than can poſſibly be derived from the contemplation of any other tribe in the creation.

As inſects ſurpaſs all other animals in their number, variety, and ſingularity, ſo alſo it is a natural inference that they muſt deſerve the greateſt ſhare of attention. The hiſtory of theſe creatures abound with the moſt valuable information in a philoſophic view, and ſtrongly recommend the ſtudy to the attention of every curious obſerver. Entomology poſſeſſes many other attractions, ſome at leaſt of which have not been well conſidered. The only one to which we ſhall particularly advert at this moment, is the beauty of inſects in general, a point on which there can be no difference of opinion. Theſe little creatures are rendered engaging from the gaiety of their natural hues: from combining oftentimes with the moſt graceful forms a diſplay of colouring very far excelling in ſplendour, vivacity, delicacy, and harmony of diſpoſition, that beſtowed by the hand of nature on her other works. One defect in their appearance muſt be nevertheleſs conceded; and this may be regarded in point of beauty as a material deficiency indeed: they are not always ſo conſiderable in magnitude, as to become, even with theſe embelliſhments, lifhments, ftrikingly attractive: were they only equal in fize to the minor tribes of birds and animals, their unrivalled elegance would certainly render them objects of high efteem in the general opinion of mankind.

But the diminutivenefs of infects ought to operate in a contrary manner on the mind of the philofopher. While this caufe oppofes the greater difficulty to the ftudy, it fhould more ftrongly incite inveftigation. This we are aware is not always confidered as an inducement, and the diminutivenefs of thefe creatures has been fometimes urged as a reafon that they do not merit the attention beftowed upon them. However injudicious this opinion ought in candour to be conceived, it has obtained the countenance of many; and among the number, of fome men at leaft who, from their fuperiority of talent, might be deemed incapable of advancing fuch an argument againft the ftudy of any department of natural fcience. Thus the ingenious Buffon, whofe attention, as is well known, was reftricted to the larger tribes of animals, intimates its inferiority in language fufficiently pointed. "Who (fays this lively author) gives us the grandeft and moft magnificent ideas of the creator of the univerfe? he who reprefents him in the plenitude of his power, directing the formation of funs and of planets, and guiding the revolutions of worlds, or he who difcovers him bufied in regulating the economy of a hive of bees, or deeply engaged in folding the wings of a beetle?"

How different is this from the fentiments expreffed by other philofophers, who, with more enlarged and liberal views, have held every branch of natural fcience in its proper eftimation! There are many who even affign a higher degree of perfection to the infect race than to other claffes of animals. We learn the opinion of Pliny from his own words. "In his tam parvis tamque fere nullis quæ ratio! quanta vis! quam inextricabilis perfectio!" Boyle declares, that for his own part his wonder was more excited by the contemplation of a mite than an elephant; and Reaumur fpeaks more decidedly to the fame effect, in language worthy of repetition. Pourquoi, (fays this author,) craindrions-nous de trop louer les ouvrages de l'Etre Suprême? Une machine nous paroît d'autant plus admirable, et elle fait chez nous d'autant plus d'honneur à fon inventeur, que, quoiqu' auffi fimple qu'il eft poffible par rapport à la fin à laquelle elle eft deftinée, il entre dans fa compofition un plus grand nombre de parties, et de parties très-différentes entre elles. Nous avons une grande idée du génie de l'ouvrier qui a fu réunir et fait concourir à la même fin, autant de parties différentes et néceffaires. Celui qui a fait, les machines animées que nous appelons des infectes, n'a affurément fait entrer dans leur compofition que les parties qui devoient y être. Combien, malgré leur petiteffe, ces machines nous doivent-elles paroître plus admirables que celle des grands animaux, s'il eft certain qu'il entre dans la compofition de leur corps beaucoup plus de parties qu'il n'en entre dans celle des corps énormes des élephans et des baleines! Pour faire paroître au jour un papillon, une mouche, un fcarabée, en un mot, tous les infectes, qui ont à fubir des transformations, il a fallu au moins faire l'equivalent de deux animaux, faire une chenille dans laquelle le papillon prit tout fon accroiffement, faire des larves dans lefquelles la mouche et la fcarabée puffent croître". Swammerdam is impreffed with the fame idea. "After an attentive examination (fays this writer) of the nature and anatomy of the fmalleft as well as the largeft animals, I cannot help allowing the leaft an equal or perhaps a fuperior degree of dignity to the former. If, while we diffect with care the larger animals, we are filled with wonder at the elegant difpofition of their parts, to what an height is our aftonifhment raifed, when we difcover all thefe parts arranged in the leaft, in the fame regular manner! Notwithftanding the fmallnefs of ants, nothing prevents us from preferring them to the larger animals, if we confider either their unwearied diligence, their wonderful ftrength, or their inimitable propenfity to labour."

Another objection, for we fhall not term it argument, has been advanced againft this ftudy, the validity of which cannot be fo thoroughly examined in this place as we could wifh; it has been ftated, that becaufe infects furnifh few of the articles of life they deferve no confideration. This is the language of ignorance, and fuch as we could eafily fhew to be of the moft futile kind. The ftudy of thefe creatures is as replete with utility; and the knowledge of them as effential to the benefit of mankind, as moft other branches of fcientific purfuit; nor fhall we fcruple to aver, that in this particular refpect entomology claims a decided fuperiority over every other department of zoology. But the fact is evident, that the importance of this fcience, at leaft in Britain, has never been duly appreciated, and this arifes from the moft obvious of all caufes, that it has not been fufficiently explained.

Infects may properly be divided into two kinds, thofe which are either directly or remotely beneficial, or injurious to the purpofes of mankind. Many infects, it is true, do not feem to affect us in any manner; but appearances in this refpect, let it be obferved, are not always to be relied upon. Others, and the number of thofe is very great, moft affuredly fall within the denomination of one or other, and even both the firft mentioned kinds, and for this reafon ought furely to demand our attention. In the ordinary concerns of life it is deemed of as much, if not greater confequence, to know our enemies, and afcertain the powers of annoyance they poffefs, as it is to learn what benefit we may be able to derive from our friends: let us apply this plain and rational argument to the ftudy of infects, and we think it will appear equally confiftent, when we affert that it is as important to know thofe which are injurious to our interefts, as thofe which contribute to our advantage. When we are convinced in what refpects particular infects have the means of doing us injury, we may guard againft their attacks, or apply a remedy to the evil, and if we neglect to obtain thofe fervices from the beneficial kinds which they are defigned by nature to afford us, it can be no proof of our wifdom.

Left, to the fuperficial obferver, our allufion to the utility of infects fhould appear theoretical, while the noxious propenfities of others may be too fully experienced in the affairs of agriculture, horticulture, and throughout the various branches of domeftic economy, to admit of doubt, we fhall be more explicit in this obfervation. The ravages of infects upon vegetation are detrimental to us; but let it be remembered alfo, that even in thefe depredations they fometimes repay the injury they commit. The locuft itfelf, the moft deftructive of all infects, and whofe myriads fpread defolation through the vegetable world, are not unproductive of advantage, except on fome very extraordinary occafions, when their multiplication exceeds all bounds. At other times they deprive mankind of a certain portion of his vegetable food, and, in return, their bodies afford him animal nutriment of a wholefome and palatable kind, and in infinitely greater abundance. The various forts of locufts are the common food on which the inhabitants of many parts of the world, at particular feafons, chiefly fubfift. The honey of bees, both of the wild and domeftic kinds, conftitute another primary article of food in many warm countries, in the prefent as in ancient times. The hydromel of the Ruffians, an excellent and delicious drink, is prepared

pared from honey, as our beverage is from malt. The various tribes of filk worms, (for of this kind there are feveral fpecies,) furnifh materials for the raiment univerfally worn by all ranks in the eaftern parts of the world, and hence in thofe countries the filky produce of thefe induftrious little beings is of as much real confequence to them, as the fleecy coat of the fheep is to us the ftaple article of clothing; as an object of traffic, filk is one of the utmoft importance in China and Tartary, and in thofe parts the paper in common ufe is alfo manufactured from the refufe of the fame material. The extenfive ufe of wax in all ages is well known; but it is lefs generally underftood that wax is not the produce of the bee alone; the wax infect of China is a very different creature, a fpecies of cicada in the larva ftate, and which, with the addition of a vegetable oil, forms the mixture of which the candles of that country confift. (Donov. Inf. China.) Certain infects are employed with fuccefs in medicine, and a further number might be applied to the fame purpofe; many others might be alfo rendered ufeful in the arts, and laftly, we need only advert to the valuable properties of the different fpecies of cochineal in the art of dyeing, to prove the abfurdity of an opinion very generally prevalent among us, that infects are a race of creatures too infignificant to deferve the notice of mankind!

But, were all thefe benefits unknown; and allowing that the ftudy of infects did not feem to be productive of any fubftantial advantages, how abfurd would it ftill be to treat fuch a fair and extenfive portion of the creation with neglect. The objection that they are in no manner conducive to our interefts, even if founded in truth, would be no evidence of the frivolity of the fcience itfelf, unlefs we are to conclude that the only enquiries which merit the rational attention of mankind, are thofe which tend to the gratification of felfifhnefs. If this be admitted as a plaufible objection, how many objects of philofophical inveftigation muft be rejected as frivolous!

From the earlieft period of which any authentic records remain, this race of animals has obtained the attention of every civilized age. The ftudy of thefe creatures has not affuredly been cultivated with equal ardour at all times, nor has every country produced entomologifts of confiderable talent. It will be fufficient to fhew, that the fcience itfelf has never remained in utter neglect, from the remoteft period in which the light of natural knowledge dawned upon the intellectual horizon of man. The experience of all ages diftinctly proves the charge of frivolity to be inapplicable to this ftudy: many advantages, befides thofe above enumerated, have been, and continue ftill to be, derived from this fource; and it is furthermore deferving of our obfervation, that among the number of its votaries in diftant periods of the world, we trace the names of the moft diftinguifhed characters that adorn the page of hiftory. Perhaps we are at this moment addreffing, among the circle of our readers, fome at leaft who, nurtured in habitual indifference towards the fubject under difcuffion, have incautioufly fallen into the error of confidering it as a trivial purfuit. But we are not without expectation, that even the flight obfervations which the limits of our paper allow, will direct their attention with more liberality towards this fubject, and we fhall not hefitate to think in the refult of this, they will eafily conceive much ftronger arguments in its favour than we have adduced. To the idle, or the thoughtlefs confirmed in prejudice, it would be in vain to offer any reafon in its behalf, and to thofe we fhall obferve with brevity, that whatever opinion they may be inclined to entertain of its frivolity, the fcience of entomology will be found in every civilized age and country to have engaged the ftudy of men endowed with talents as fplendid and judgment as refined, as the moft exalted for ability among thofe who affect to treat it unworthily.

Thefe obfervations opportunely introduce to our confideration a review of thofe writings which have contributed to enlighten the paths of fcience in this particular ftudy. The number of thefe; the value and intereft which muft unavoidably attach to their contents; and the names of thofe illuftrious characters by whom many of them were produced, will fully fanction, it is prefumed, the affurances before advanced. Thefe works, even in point of number alone, we have no doubt will be found infinitely more confiderable than moft imagine; and this circumftance, independently of any other, tends to prove that we are not fingular in our commendation of entomology either as an inftructive or ufeful fcience; as morally, and intellectually beneficial; for thofe who write on any fubject like the prefent, muft be impreffed with fome idea of its importance, and thefe opinions may be collected uniformly from the labours of writers on the ftudy of infects.

As we deem this fubject of confequence, it is our decided wifh, even in the curfory view to which our limits are reftricted, not to omit the mention of any work, however flight, that has been productive of material information. Our ftrictures, it will be underftood, are confined to thofe we have had fufficient opportunity to confult with fome attention; for this we confider due, in candour, to the refpective writers whofe labours are devoted to the elucidation of fcience. Sometimes we may be inclined to exprefs ourfelves with warmth in favour of merit, neglected, forgotten, mouldering in decay, or which, from latent motives, has never been fufficiently appreciated by later authors. If we err in this, let it be remembered, that in the truth of criticifm we oftentimes evince more judgment in beftowing praife, than awarding cenfure. But we wifh it to be explicitly underftood, that we do not confider it within our province, at prefent, to enter at large upon a critical analyfis of the multitude of writings before us. Our only object is to point out the exiftence of the moft valuable works that are extant within our own knowledge, defcribing at the fame time the leading intention of their authors refpectively: the collateral remarks can be only thofe immediately incidental to fuch inveftigation. The feveral works enumerated will be adverted to, as nearly as poffible, according to the order in which they appeared before the world; and hence our review, however curfory, will be attended with this peculiar advantage, that it will ferve to point out the progreffive improvements the fcience has derived from the labours of each fucceeding author, in a more perfpicuous form than could perhaps be accomplifhed in any other manner. It will alfo by this means be found calculated to afford the general reader

An Hiftorical view of the Rife, Progrefs, and Prefent State of Entomology.

The deftruction of the great public libraries of antiquity has for ever deprived us of the means of afcertaining precifely to what ftate of perfection this branch of fcience had attained, till within about two thoufand years of the prefent period. Of thofe times a few fcanty memorials alone remain, fufficient, however, to teftify that the ftudy of infects had then made fome progrefs, and was held in eftimation. Whatever may be our ideas with regard to ftill earlier times, it would be needlefs to obtrude them in this place. We fhall obferve only, that fome books muft have been written on the fubject before the exiftence of thofe which have defcended down to us: the reputation of fuch writings is preferved, and in certain inftances the names of authors recorded in the very earlieft of thofe works at prefent extant, which clearly demonſtrates the truth of this opinion. Time has not ſpared the labours of any writer on this ſubject of more remote date than the third, fourth, and fifth century before the Chriſtian era, and the amount of thoſe which have ſurvived is ſmall indeed; but inconſiderable as they are, in point of number, we may, notwithſtanding, collect from them that the ſtudy of inſects, in thoſe days, held a rank among the liberal purſuits of their philoſophers.

We may, indeed, proceed ſtill farther in this retroſpect, if the ſacred writings of the Hebrews be conſidered. Theſe abound with paſſages relating to particular kinds of inſects, as the locuſt, the caterpillar, flies, and vermin. Moſes, the earlieſt of the inſpired writers, had probably acquired ſome knowledge of this ſubject, in common with the other ſciences, from the ſages of Egypt; and among the books of Solomon, now loſt to the world, it is recorded that he treated on inſects, or "creeping things."

Hippocrates flouriſhed in the 80th Olympiad, or fifth century before the Chriſtian era; he wrote on inſects, as we are told by Pliny, in whoſe time ſome remains of the entomological obſervations of this celebrated character were probably extant. The writings of the early Greek and Latin writers, quoted by Pliny, afford extracts from this production of his labour.

The ſucceeding age gave birth to that diſtinguiſhed natural hiſtorian and philoſopher Ariſtotle: the production of whoſe labour, his hiſtory of animals, is worthy of the patronage beſtowed on its author by the conqueror of the univerſe. No one can impartially peruſe this ineſtimable treaſure of antiquity without confeſſing the intimate knowledge its writer muſt have poſſeſſed of the great arcana of nature.

This work of Ariſtotle is rather of an elementary kind, embracing a general, wide, and comprehenſive view of the animated creation, and does not, except on particular occaſions, deſcend to the deſcription of individuals or ſpecies. The inſect tribe is treated under different points of compariſon and view in ſeveral parts of the work. In the ſeventh chapter of his firſt book, he informs us, that the name ἔντομα is generic, or that of a family, and that they conſtitute one of his four orders of exſanguineous animals, and points out with great accuracy in what reſpect they differ from the molluſca, cruſtacea, and teſtacea, the other three families of this claſs of animals. By exſanguineous he means only that they have no red blood, for he ſpeaks generally to their bodies being retained in a ſtate of moiſture by other fluids. The firſt chapter of the fourth book affords a definition of the eſſential character of inſects, which conſiſts in the inciſions or cuts either on the back or belly, and ſometimes on both, by which their bodies appear to be almoſt divided into two or more parts. But that portion of his work which is more particularly devoted to inſects, is entitled Περὶ τῶν ἐκτὸς κο ρίων τῶν ἐν τόμων. In this he more fully deſcribes inſects to conſiſt of three parts, the head, trunk, and belly or abdomen; the ſecond part, or trunk, is denominated an intermediate portion, correſponding with the back and breaſt in other animals; and he alſo mentions as a character of inſects that they are furniſhed with feet.

The ſubſequent paſſages deſcribe different genera, or, as termed, tribes of inſects, in which he treats of thoſe which fly and thoſe which walk. Among thoſe furniſhed with wings, he ſpeaks of ſome having theſe parts entirely naked, and others that have them protected by a ſheath, or covering, as in the beetle kind: as he furthermore ſtates, that in ſome beetles theſe ſheaths divide or open when the inſect flies, and that in others they are inſeparably united. The inſects which have naked wings, he obſerves, poſſeſs either four, as in the bee, or two, like the muſca or common fly. Some of thoſe with four naked wings have ſtings at the end of the body, while beetles, and inſects with two naked wings, are deſtitute of this apparatus; but ſome of the latter, he tells us, have a proboſcis or inſtrument at the mouth, by means of which they draw blood from other animals. The horns before the eyes (by which he means the antennæ) attract his obſervation, and thoſe of the papiliones and grylli are particularly deſcribed. In his remarks on the different ſtructure of the feet, thoſe formed for leaping are exemplified by thoſe of the locuſt, and are compared to the poſterior feet of ſpringing animals. The humming noiſe of certain inſects in flight, the eruca, and various other circumſtances relative to this claſs of animated beings, have intereſted the philoſopher in this chapter.

The attentive entomologiſt will feel deeply ſenſible of the accuracy of every expreſſion, thought, and ſentiment, implied in the above-mentioned paſſages. He will be ſurpriſed at their conſiſtency. Their accordance with the entomological definitions of the beſt modern ſyſtematiſts will excite farther compariſon; and in the reſult of this inquiry it muſt be obvious, that with the acquired knowledge of two thouſand years ſince his time, ſo far as he does proceed, we cannot materially amend his obſervations. This will be admitted; and at the ſame time we believe even a curſory peruſal of the whole work will ſerve to ſhew, that whatever might be the merits of Ariſtotle, and we allow them to be tranſcendent, theſe writings evince too much acquaintance with the ſcience of nature, to be the produce of any individual genius ſhining with unborrowed light. When we reflect upon the ſlow and gradual progreſs with which all human knowledge is developed, we are really convinced that the ſcience of nature muſt have made ſome conſiderable advancements before his time; and that he has derived many eminent advantages from conſulting the works of more ancient naturaliſts: men whoſe original labours have been loſt to poſterity for ages, and the only traces of which at preſent extant are to be found embodied in his pages.

Ælian, in his work on animals, ΠΕΡΙ ΖΩΩΝ ΙΔΙΟΤΗΤΟΣ, appropriates ſeveral detached chapters to particular kinds of inſects, without entering in a methodical manner into the hiſtory of the tribe. Thoſe he does include are deſcribed with attention: as, for inſtance, the ſcorpions, Σκορπίων; ants, Μυρμήκων; ſpiders, Ἀράχνῃ; crickets, Τεττίγων; the generation of waſps, Περὶ τῆς Σφηκῶν γενέσεως; of cantharides, τῶν καλουμένων Κανθαρίδων, &c.

The Greek poet Phile, called alſo, from his ſuperior knowledge of natural hiſtory, "Phile Sapientiſſimi," introduces ſome pleaſing poetical effuſions relative to inſects among his poems on animals. The manners of the cicadæ, and the bees, τεττίγων, and μελιττῶν, are very prettily deſcribed in verſe by this writer. He entertains the ſame idea as Ælian, that the cicadæ, by which he means the cricket, (not the inſect named cicada by Linnæus,) lived on dew; and that the female was mute, while the male "enchanted the grove with the harmony of ſong." He ſpeaks alſo of the lampyris, and various other inſects. The beautiful ode of Anacreon to the cicada is familiar to many.

Among the Greek writers who immediately, or within a few centuries after, followed Ariſtotle in treating upon inſects, were Democritus, Neoptolemus, Ariſtomachus, Philiſtus, Nicander, Menecrates, Dionyſius Mago, Empedocles, Callimachus, Attalus, Apollodorus, Eriphilus, Eraſiſtratus, Aſclepius, Themiſo, Poſidonius the ſtoic, Meander of Priene, Euphronius of Athens, and Meander of Heraclea, Theophraſtus, and Heſodius. Theſe were authors after the time of Ariſtotle, and preceding or contemporary with Pliny. The Latin writers, during the ſame fame interval, were alfo numerous, and appear to have been influenced to purfue this ftudy in imitation of the Greeks, or were infenfibly led into it from attending to the culture of bees. The moft eminent among the latter were M. Varro, Hyginus, Scropha, Sarcana, Celfus Cornelius, Æmilius Macer, Virgil, Columella, Julius Aquila, Tarquilius, Umbritius, Cato Cenforius, Domitius, Calvinus, Trogus, Meliffus, Favonius, Fabianus, Mutianus, Nigidius, Manilius, and Opius. The cultivation of bees was attended to in thofe times with the moft enthufiaftic ardour, and their hiftory detailed by many eminent writers. We are told that Ariftamachus of Soli wrote upon this fubject, from the refult of fixty years experience; and that Philifcus the Thafian acquired the name of Agrius, from having employed his whole life in forefts and deferts, attending to thefe infects. The culture of filk-worms was another favourite object with the ancients, as we learn from Pliny, who relates that in his days garments of filk were greatly admired by the fair fex, becaufe, from the delicacy of its texture, it difplayed the beauty of their perfons almoft as diftinctly as though they were naked.

The eleventh book of Pliny treats of infects, as the moft fubtle of all animals in nature. He fpeaks of thofe which fly; fome with naked wings, and others with wings protected by a covering, as Ariftotle had previoufly obferved. The bees, wafps, hornets, fpiders, grafshoppers, locufts, ants, &c. are among the number of infects defcribed by this writer.

From the time of Pliny till the overthrow of the Roman empire, a period of feveral centuries, the fcience of infects feems to have made fome progrefs, though to what extent we may probably never learn. The names of writers in thofe times, and fome few fcattered memorials of their labours, are to be found recorded in the voluminous works of authors that appeared at the revival of learning in the fixteenth and following century. The number of thefe could not have been very inconfiderable: among the principal of them were Ætius, Paulus Ægineta, Alexander, Trallian, and Oribafius.

The laft-mentioned authors lived between the fourth and feventh century. After this time, through the dark ages, while ignorance in every fcience prevailed nearly over the whole world, this ftudy might have been little attended to. But we are not to conclude that even during this time it was utterly neglected. Learning had then taken a retrograde courfe from Greece and Rome towards thofe eaftern regions, from whence they had originally emanated; and the fciences, during this interval, were cultivated with fome fuccefs in Arabia. The advancement made by the Arabians in the ftudy of botany, between the ninth and twelfth century, is known to have been rather confiderable. Among the entomologifts of thofe ages we recognize fome of thofe Arabian botanifts; feveral of whom were diftinguifhed for their acquaintance with plants, as Rhazes, Avicenna, Avenzoar, and Averrhoes, each of whom wrote on infects.

From the twelfth to the fifteenth century, a darker period than the preceding, there are few writers on this fubject. The principal of thofe, at leaft within our knowledge, during this period, are Myrepfus, Hildegardis, Platerus, Arnoldus de Villa Nova, and Petrus Crefcentienfis. There are a few others, but they are too obfcure to deferve mention.

Some part of the general zoological work of Albertus Magnus, "De Animalibus," &c. relates to infects. Its author was bifhop of Ratifbon, and died in 1280; but his work, which is written in the Latin tongue, and was printed at Venice, did not appear till the year 1519.

In 1549, the work of Agricola, entitled, "De Animantibus fubterraneis," made its appearance; and in this we find one of the earlieft fyftematic arrangements of infects extant. This author reduces all infects to three principal claffes, namely, * thofe which walk, ** thofe which fly, and *** thofe which fwim; and under each clafs defcribes a number of fpecies.

About the middle of the fame century, Edward Wotton, a doctor of medicine in London, publifhed "De Differentiis Animalium;" a work relating, among other tribes of animals, to that of infects, a fcience in which its author excelled. This work is in folio, and bears date 1552; from which it muft have appeared three years before the author's death, which happened in 1555.

The work of Rondeletius of Montpellier, "Libri de Pifcibus Marinis," publifhed in 1555, or rather earlier, treats, as the title intimates, on fifhes, and other aquatic animals; to which, however, it is not entirely confined; for he alfo fpeaks of infects, and even accompanies fome of his defcriptions of thefe infects with figures cut on wood. Leffer mentions that in the library of the Jefuits at Ratifbon, there is a copy of this work in two volumes; on the margins of the leaves of which are large notes, faid to be in the hand-writing of Gefner. Whether thefe notes have in any manner appeared before the public we know not: the circumftance is repeated only for the purpofe of inquiry. If Leffer afforded any intimation of the nature of thofe notes, we might afcertain whether they are the fame with the obfervations of Gefner on Rondeletius, in his "Hiftoria Animalium," an edition of which we fufpect was printed foon after the work of Rondeletius appeared.

Conrad Gefner, efteemed the moft diligent inquirer into nature which his age produced, and who, in reward for his affiduity, obtained the title of the German Pliny, has treated flightly on infects in that part of his work which relates to the nature of ferpents, "De Serpentium Natura," &c. printed in 1587. His difcourfe is chiefly concerning the fcorpion tribe. Some tracts of this author appear to have been publifhed fo late as 1620; neither of thefe, however, are on the fubject of entomology.

A far more voluminous work than either of the foregoing was produced by the induftrious and learned Aldrovandus, in 1602; a folio volume of feveral hundred pages, with the title "De Animalibus Infectis," and forming part of his grand work on animals. Aldrovandus has not efcaped cenfure. In the "Amœnitates Academicæ," Forfkal confiders him as an indefatigable compiler, celebrated for the number of his works, but who thought he had acquitted himfelf in collecting together the undigefted obfervations of the ancients. We cannot avoid expreffing other fentiments; and notwithftanding that he has fallen into many errors of his predeceffors, this work entitles his memory to refpect. Aldrovandus was not merely a compiler; he availed himfelf of the labours of former writers, and in this refpect with lefs fervility, and certainly with more candour, than many who advance this objection againft him: for he generally refers to his authorities. Aldrovandus was profeffor of medicine in the univerfity of Bologna, and, according to his biographers, the ftudy of infects was his favourite object. In this purfuit he expended large fums of money, travelling for information, and in the employment of artifts; as he was unfortunately, like fome other eminent naturalifts, himfelf deficient in the talent of drawing. During the fpace of thirty years, he paid two hundred florins annually to a painter, folely occupied in the delineation of infects for him. From the fatigue of his refearches, this indefatigable naturalift was unhappily deprived of fight in his old age.

In

In his claſſification of inſects, he divided all theſe animals into two primary orders, the terreſtrial and the aquatic; the firſt called favica, the other non-favica. Theſe two claſſes are ſubdivided into many orders; the characters of which are determined by the number, nature, and poſition of the wings and feet.

The repreſentations of the inſect tribes, from their inferiority of ſize, added to the general minuteneſs of their characters, are rather more rudely expreſſed in the work of Aldrovandus, than the figures of the larger animals, which theſe volumes contain. A defect of this kind is leſs excuſable, becauſe from the liberality of Aldrovandus towards his artiſt it might not be expected; and furthermore, becauſe about that period a better taſte, and a deſire for more expenſive embelliſhments in works of this deſcription, began to prevail. The graphic art, or engraving on copper, though ſcarcely emerged from infancy, was now introduced in aid of this ſcience, in preference to cuts on wood, and with no ſmall ſucceſs, as we obſerve in the works of Hoefnagle, Hollar, and others of that period, whoſe labours are well known. Thoſe embelliſhments, though greatly admired in their time, were, however, too coſtly to be introduced into works of the ordinary kind; they were confined to the more expenſive productions, and, indeed, almoſt excluſively to thoſe produced by artiſts themſelves; for we ſeldom meet with them in any work of which the artiſt is not alſo the author. The beſt book of that period in our own country, for ſuch we conſider Mouffet's "Inſectorum Theatrum," affords only cuts on wood, an inſtance ſufficiently corroborative, as this work was printed in 1634. Even for the ſpace of nearly a century after this, copper-plate engravings were ſparingly introduced. The learned Liſter, in his edition of the works of Geodartius, ſo lately as 1682, laments the great expence of engravings, at the ſame time that he expreſſes his conviction that they are indiſpenſable in works of this kind. "I have taken great care of the deſigns," ſays this writer, "in transferring them upon copper plates, which I dare promiſe are exquiſitely performed by the beſt of our Engliſh artiſts, which was at my expence; and the bookſellers were not willing to reimburſe me."—"And upon this occaſion I muſt needs ſay, that natural hiſtory is much injured, through the little encouragement which is given to the artiſt, whoſe noble performances can never be enough rewarded; being not only neceſſary, but the very beauty and life of this kind of learning." But, to reſume the courſe of our ſubject in hiſtoric order, the next work immediately in ſucceſſion to Aldrovandus is that of Wolfang Frenzius, publiſhed in 1612, and called "Hiſtoria Animalium Sacra," a valuable work, as containing much original obſervation. After the manner of Agricola, he diſtributes all inſects into three claſſes, which he names aërea, aquatica, and terrea et reptantia. A ſmall octavo, printed three years after, though a ſlight production, ſhould be mentioned in this place; it is a treatiſe on ants, a pamphlet of about one hundred pages, and is written in Latin; the title "De formica," &c. by Jeremiah Wilde. The work of Fabius Columna, "Aquatilium et Terreſtrium aliquot Animalium Obſervationes," printed at Rome in 1616, relates alſo, in ſome degree, to inſects; and finally, in point of precedence to Hoefnagle, we have to notice another, a work of ſome moment, that appeared ſoon after, from the pen of Archibald Simpſon: this was publiſhed in North Britain, and from the motives of the author and ſingularity of its contents claims explicit mention. From the title of this book, which is ſufficiently explanatory, it will be perceived that entomology was only a remote object in the mind of the writer. The work derives its greateſt ſhare of intereſt, in our preſent view, from being one of the firſt publications connected with the ſtudy of inſects printed in Britain. This book, which is in quarto, was printed at Edinburgh in the year 1622, and bears the following title: "Hieroglyphica Animalium terreſtrium, volatilium, natatilium, reptilium, inſectorum, vegetivorum, metallorum, lapidium, &c. quæ in Scripturis Sacris inveniuntur et pluriorum aliorum, cum eorum interpretationibus."

At length our enquiry arrives at that particular period when the painting of inſects was eſteemed ſuitable and worthy of the pencil of the moſt ſkilful artiſts of the age, the painters retained with magnificent ſalaries in the courts of princes, and in the moſt poliſhed ſtates of Europe. Under the foſtering influence of ſuch patronage, it ought not to excite ſurpriſe that ſome advancement was made in this branch of the art. For our own part, we are not impreſſed with any very high opinion of the talents evinced in depicting theſe pleaſing objects, at leaſt by ſome of the artiſts thus employed. With ſuch inducements for the exertion of genius, and with the reward and credit naturally attached to their productions, they ought certainly to have ſucceeded better. But though the arts derived no very material advancement from their attention to this ſubject, to the cauſe of ſcience their aſſiduities were productive of infinite benefit. The cultivation of exotic plants, which about that time began to be held in proper eſtimation, afforded an ample field to thoſe artiſts whoſe labours were dedicated to the taſk of pourtraying theſe pleaſing objects. Their great forte prevailed in painting flowers, and though inſects offered ſo many charms of attraction, they appear at firſt to have been only introduced occaſionally, and as ſecondary objects, to their pictures. Theſe embelliſhments were attended with ſucceſs in proportion to their fidelity, force, and truth. In a ſtate of nature theſe lively creatures are conſtantly ſeen ſporting about the unfolding bloſſoms of the vegetable creation in ſearch of their nectareous ſuſtenance, and their introduction could not fail to infuſe a ſpirit of ideal animation into their beſt performances. Hence it ſeems, that inſects were afterwards repreſented in their compoſitions with a leſs ſparing hand; and, in the courſe of time, became with many artiſts the principal, inſtead of ſecondary object of imitation. Thus alſo, from caſual obſervers, thoſe artiſts were progreſſively led to a more intimate acquaintance with theſe creatures, and to an inquiry into their hiſtory, the novelty of which may be perceived to have amply gratified their curioſity, and rewarded their application. Their example fortunately inſpired a congenial taſte among their patrons, and hence, in the ſpace of a few years, a new and more propitious era ſeemed to dawn upon the ſcience of inſects. The ſtudy was by this means promoted, and rendered an object of attention among the higher orders connected with the moſt enlightened courts of Europe; as for inſtance, that of France, the imperial court of Germany, and thoſe of the princes of the empire.

An obſervation of the celebrated Juſſieu in the beginning of the laſt century is altogether applicable to this inveſtigation. "The arts and ſciences," ſays this writer, "owe their perfection to circumſtances which may appear the effect of chance," and the truth of this remark is completely verified in this particular inſtance; for, it muſt be recollected that the art of embroidery, a mechanical proceſs, and which in our days is ſuperſeded by the more dignified production of the pencil, is that which called forth the talents of the painter to the delineation of natural objects in the age adverted to. It was to the improvement of embroidery that his merits were at firſt ſubſervient; or at all events to a peculiar train of circumſtances ariſing originally from this cauſe, that we are to aſcribe the progreſs made in this branch of the profeſſion, from the cloſe of the ſixteenth till the middle of the ſucceeding century. About the reign of Henry IV. and Lewis XIII. of France, embroidery was in the zenith of faſhion, for the decoration of magnificent furniture, and drawings of the moſt beautiful plants were made expreſsly for the embroiderer's imitation. The obligation which botany lies under to this cauſe is well known, and that of entomology during the ſame period, if attentively conſidered, will be found no leſs conſpicuous.

The painters eminent for their abilities in this line, were Hoefnagle, Robert, Aubriet, De Bry, Vallet, and Robin. There were others to whom we ſhall advert more particularly afterwards. In order to demonſtrate the benefit which botany derived from the labours of ſuch artiſts, it need only be mentioned, that the celebrated Tournefort founded and arranged his ſyſtem of plants upon the drawings made by Robert and Aubriet for the royal library of France. The other artiſts alluded to were ſtill more converſant with the ſcienee of inſects than the former, and the labours of their pen have contributed, in uniſon with their pencil, to promote this ſpecies of knowledge. Some eſpecially were very ſuceeſsful in this reſpect.

Merian, Admiral, Schwertz, and Goedart, and alſo our own countryman Albin, were among the number of thoſe moſt eminent for their acquaintance with the hiſtory of inſects; and, were this liſt to be augmented with the names of other artiſts of ſomewhat later date, who have likewiſe diſtinguiſhed themſelves in the ſame manner, the reſult would teſtify that entomology, like many other branches of natural hiſtory, is greatly indebted for its advaneement to this claſs of authors. It is from the works of the artiſt, or of thoſe who by their application have rendered themſelves competent to delineate the objects they deſcribe, that the moſt valuable information has been obtained. The works of Röſel will ſufficiently teſtify the truth of this obſervation, but were any other confirmation neceſſary, we would advert to Lyonet who, though not an artiſt by profeſſion, felt proudly conſcious of his ſuperiority as a naturaliſt, becauſe from perſeverance he had acquired the talents of an artiſt. Are they not the imitative labours of this claſs that furniſh ample materials for the productions of thoſe who are mere deſcribers: writers, who oftentimes like hornets enter the hives of induſtry, and plunder without moleſtation?

The work of Hoefnagle, a thin volume in 4to. was publiſhed in 1630, under the title of "Diverſæ Inſectorum volatilium icones ad vivum depictæ per D. J. Hoefnagle, typiſque mandatæ à Nieolao Joannis Viſcher."

The plates altogether contain figures to the amount of three hundred and twenty-ſix. The execution of theſe acquired the artiſt no ſmall ſhare of celebrity, yet it muſt be acknowledged that they are not invariably deſerving of approbation; ſome at leaſt are very indifferent. Hoefnagle does not adopt any particular mode of arrangement, and he contented himſelf with repreſenting the inſects in the ſtates in which chance preſented them, without always following them through their progreſſive changes.

Only four years elapſed after this volume of Hoefnagle's plates were brought forward, before another production of infinitely greater conſequence as a work of ſcience appeared in our own capital, namely, the entomological work of Thomas Moufet. This, as it profeſſes to be, is an improvement on the work of Dr. Wotton, begun in the year 1550, about five years before his death: it was continued by Conrad Geſner, was afterwards enriched, as it is expreſſed by Thomas Penny, and at length aſſumed the improved form in which it was publiſhed in 1634, from the hands of Moufet. This laſt mentioned editor reviſed the order of its arrangement, corrected and enlarged the deſcriptive matter, and embelliſhed its pages with nearly five hundred wood-cuts, the greater portion of which, though rudely executed, are not deſtitute of merit. The work is intitled "Inſectorum ſive minimorum animalium theatrum: olim ab Edoardo Wottono, Conrado Geſnero, Thomaque Pennio inchoatum; tandem Tho. Moufet Londinâtis operâ ſumptibuſque; maximis concinnatum auctum, perfectum: et ad vivum expreſſis iconibus ſupra quingentis illuſtratum." This author divides his work into two parts, the firſt containing twenty-nine chapters, the latter forty-two, under which he reſpectively deſcribes the ſeveral tribes of inſects, known among the early writers by the names of veſpis, muſcis, papilionibus, cicindela, blattis, cantharide, bupreſti, meloe, &c. terms familiarized to the Linnæan ſcholar, but which are not always applied by Linnæus to the particular tribes of inſects, deſignated by theſe names in the work of Moufet and his predeceſſors: a fault we truſt to ſee one day amended.

Hollar gained conſiderable reputation by his iconical work, "Muſcarum, Scarabeorum Vermiumque variæ figuræ et formæ omnes primo ad vivum coloribus depictæ et ex collectione Arundeliana," &e. publiſhed at Antwerp in the year 1646. The drawings were preſerved in the Arundel cabinet; the plates are etchings in the uſual ſtyle of its author.

About an hundred and fifty pages of the extenſive work of J. Jonſton, "Hiſtoria Naturalis" is devoted to the ſubject of inſects, which tribes he diſtributes into four books, the firſt of which treats on terreſtrial inſects provided with legs and wings, the ſecond of terreſtrial inſects which have feet and no wings, the third of the terreſtrial apodal order, and the fourth of aquatic inſects. Theſe are illuſtrated by twenty-eight plates engraved on copper by the author, who was doctor in medicine.

Few authors are condemned with more critical ſeverity than Jonſton; his work is certainly a compilation, and as it has been ſtated, his materials are moſtly taken from the works of Aldrovandus, Moufet, and others. Forſkal denominates him a perſevering compiler, and at the ſame time obſerves that he has not added a ſingle remark to what was before diſcovered. Theſe obſervations appear in the "Amœnitates Academicæ," in which there is alſo another paper by Bladh, where we find the ſame ſentiments repeated. The opinion thus expreſſed is known to have the ſanction of Linnæus. This deficiency in the arts, to which he aſpired, is warmly cenſured by Lyonet, who declares his butterflies to be of unſufferable deformity, and in form, or outline, to be conſtantly alike in all the figures. As an artiſt, nevertheleſs, he had his admirers: if we can place any reliance on the truth of his biographers, he was not deſtitute of ability. Moncoyns ſays, he ſaw in the hand of Mr. Platern of Baſil a ſet of drawings executed by him with tolerable accuracy. And Leſſer himſelf owns that many years ago he was ſhewn others very prettily painted by him on blue paper, in the poſſeſſion of a nobleman belonging to the houſchold of one of the kings of Poland.

The work of Jonſton, which is in folio, and dated 1657, was publiſhed at Amſterdam. In the year following, we meet with an Engliſh tranſlation of Moufet's work, printed by Topſal, chaplain of St. Botolph's, in London. Nearly about the ſame time the work of Goedart, a Flemiſh painter, made its appearance in Holland in the language of that country. The laſt mentioned production deſerves more explicit mention, for we think its merits have never been very candidly eſtimated.

eſtimated. The engravings are deſcribed as of miſerable execution, and the figures ſo indifferent in point of reſemblance to the objects intended, that they could only in particular inſtances be underſtood; and again, on the contrary, the details are repreſented as ſo defective, that unleſs accompanied by his valuable plates, they would be uſeleſs. So much is advanced by his various annotators, and yet with all theſe imperfections, thoſe individuals have condeſcended at different times to favour the world with tranſlations of his work, originally written in Dutch, into the Latin, French, German, and Engliſh; and with various editions of the plates alſo. The truth is, that Goedart was a painter; the mere deſcribers, from unworthy motives, were offended that he ſhould preſume to write, while they profeſſed to be enraptured with his talents in the arts; and the artiſts denied him praiſe becauſe they conſidered him as a naturaliſt, not a painter. Were this work of Goedart the production of our days, it would be undeſerving of comment; but let us conſider the period in which it was produced, and abating our expectation of excellence in thoſe times either in the accuracy of obſervation, the hiſtory of inſects, the ſtyle of language, or correctneſs of deſign; and we muſt acknowledge it in every reſpect as a valuable performance. The beſt of his annotators, even the ingenious Liſter, to whom the original work was certainly under moſt obligation, has committed ſeveral errors in endeavouring to correct him.

For the ſpace of about twenty years Goedart devoted great attention to the ſtudy of inſects. He followed them through their progreſſive changes with great preciſion: this renders his book more extenſively acceptable, and his figures, which have never been ſurpaſſed by his predeceſſors, are for the moſt part ſo far correct as to be underſtood. The Dutch edition of Goedart's work being ſoon ſold off, the firſt volume of a Latin tranſlation, by Dr. Mey, miniſter of Middleburgh, was brought forward under the title of "Metamorphoſes et Hiſtoria Naturalis Inſectorum," in the year 1662; and a ſecond volume alſo, in the ſame language, tranſlated by M. P. Veezaerdt, miniſter in Zealand, who added thereto ſome remarks of his own. Another tranſlation of this latter part was afterwards publiſhed by Dr. Mey, with a farther addition of notes. Liſter allows thoſe annotators no credit for their labours; Goedart, he obſerves, left his writings in Dutch; "His Latin interpreters," ſays he, "have added comments indeed, but were men wholly ignorant in natural hiſtory, and their comments are mere rhapſodies, and altogether impertinent to the explication of any one hiſtory of Goedartius." Dr. Liſter re-arranged and corrected this work, and added at the ſame time many curious obſervations.

A hiſtory of animals and minerals, in the courſe of which the ſubject of inſects is noticed at ſome length, appeared in London in 1661, under the title of "Πανζωορυκτολογια."

The invention of the microſcope opened to the curious a new opportunity of penetrating into the myſteries of nature, and diſcriminating with accuracy the moſt delicate organs of the minor tribes of animals, which from their minuteneſs had evaded obſervation before, and among theſe the inſect race alone conſtituted ſuch a vaſt proportion, that we may attribute to this cauſe that ſpirit and perſeverance with which the ſtudy of theſe minute bodies was purſued about this particular period, and for the ſpace of ſome years after. The era of this invention is aſcribed to the year 1680, and although this does not appear to be ſtrictly accurate, ſince an apparatus correſponding with it was in uſe at the earlier date of 1618, and that glaſſes poſſeſſing the power of enlarging the appearance of objects very conſiderably were known among the ancients; yet, upon the whole, it may be concluded, that what is now underſtood by the microſcopical inſtrument, received ſo much improvement about the time firſt mentioned, that, in qualified terms, we muſt date its invention from that period. The diſcoveries made by the aſſiſtance of the microſcope within a few years after this time renders it a memorable epoch in the ſcience of natural hiſtory, and ſo far as relates to inſects, it is probably owing to the introduction of this valuable inſtrument into general uſe, that the names of Hooke, Power, Pierre Borel, Bonomo, Antoine Van Leuwenhöek, Joblot, and Hartſoeker (the latter of whom detected the circulation of the fluids in inſects); and many other inquiſitive individuals appear in the liſt of entomological phyſiologiſts, or anatomiſts.

The work of Power is in quarto, and was printed in 1664; this relates ſlightly to inſects as objects of microſcopical inveſtigation. Hooke's "Micrographia" appeared the year after, and treats of inſects in the ſame view. In the memoirs of the French Academy of Sciences in Paris, for 1666, there are ſome entomological obſervations by Mignot de la Voye; and in the fifth volume of the Philoſophical Tranſactions a paper relating to "inſects lodging themſelves in willows," by King and Willughby. But the letters of Liſter, which alſo appeared about the ſame time, or within the courſe of five or ſix years after, are ſtill more valuable; among theſe are "letters concerning a fly that is viviparous, and concerning an inſect feeding on henbain." "A conſiderable accompt touching vegetable excreſcencies;" "Letters about muſk-ſcented inſects, vegetable excreſcencies, and ichneumon-worms;" "A Letter containing the projection of the threads of Spiders, and Bees breeding in caſes made of leaves, a viviparous fly, &c."

A ſmall number of the inſects indigenous to Britain is deſcribed by Chriſtopher Merret, in his "Pinax rerum naturalium Britannicarum," &c. publiſhed at London in the year 1667.

An account of the tarantula engaged the pen of Wolferdas Sanguerdius (a medical profeſſor) about the middle of this century; his work, entitled "Tractatus phyſicus de Tarantula," appeared in the year 1668; it is a ſmall duodecimo of ſeventy pages, and was printed at Lyons. The general work of an Engliſh entomologiſt, Charleton, was the ſame year publiſhed in London, under the title of "Onomaſticon Zoicon, pluriorumque animalium differentias et nomina propria pluribus linguis exponens," in which we have a ſyſtematic arrangement of inſects after the manner of Aldrovandus. There is a mantiſſa of this work printed in folio in Oxford, in 1677.

Another work on entomology, a treatiſe profeſſedly elementary, was publiſhed at Leipſic, the year after the firſt part of Charleton's work appeared. It is in quarto, and is entitled "Diſſertatio de Inſectis in Genere," &c. Jacob Wolff, profeſſor of medicine at Jena, was the author.

Redi's "Experimenta circa Generationem Inſectorum," for the time in which it appears (1671), is an intereſting little book. Its author combats the doctrine of equivocal generation, maintained among the ancient philoſophers; and deduces its fallacy from a variety of experiments and obſervations of great critical accuracy; in the courſe of which he demonſtrates that every living creature is produced from an egg. The ſame work contains about thirty figures of the lice peculiar to particular birds, ſuch as the pigeon, ſwan, pie, heron, &c. The ſame writer alſo publiſhed his work on the generation of inſects in his native language, "Eſperienze in torno alla Generazione degl' Inſetti," 1688. There are ſeveral uſeful tracts by Redi on natural hiftory; but the above-mentioned is that which principally relates to entomology.

Another curious work, "Experienze intorno alla Generazione delle Zanzare," a fmall tract of about twenty pages, and embellifhed with one plate, was publifhed in 1679. It is entirely confined, as the title implies, to the common gnat (culex pipiens), and is written by F. P. Sangallo.

A writer, whofe celebrity for his anatomical knowledge of infects can never be erafed, while the fcience itfelf continues to be refpected, is the next in order for our confideration: this is the indefatigable Swammerdam. One of the moft important works of this acute obferver of nature, his general hiftory of infects, bears date 1669. We allude to the firft edition printed at Utrecht, in the Dutch language, under a Latin title, "Hiftoria Infectorum Generalis; ofte algemeenver handeling van de bloedeloofe Dierkens." Of this work it has been well obferved by a German critic, that it has no other fault than that of being written in a language not generally known. The work, in this original ftate, is in the quarto form, comprifing rather more than two hundred pages, and is illuftrated by figures contained in thirteen copper-plate engravings.

Some years paffed away before the excellence of this work, the admiration of the learned in later times, was in any manner acknowledged; and the fate of Swammerdam, a man who, in the generofity of his mind, had exhaufted the greater portion of his life in the completion of a work, fo wifely calculated to enlarge the boundaries of human knowledge, affords another and very ftriking inftance of genuine worth neglected:—another example of that culpable fpirit of ingratitude which living merit fo rarely fails to experience, in reward for the moft fplendid fervices their talents confer upon an illiberal world!—Chilling thought! that gloomy reflection which oftentimes fuppreffes the bright, the enviable, but too fatal exertions of genius, and fhrouds the mind in apathy and indifference! No fooner was the death of Swammerdam announced, than his merits were difcovered; and an anonymous tranflator rendered his book into French. Almoft immediately after, another appeared in Latin; and after fome time, another in Englifh: all which contributed, but too late, to the author's fame. He died in 1680. The firft French tranflation is dated 1682, and, like the original, is in quarto, and embellifhed with plates. The Latin tranflation correfponds with the two preceding, except that Hennius, in a fecond edition of the Latin copies, enlarged one chapter which treats on the analogy between infects and other animals and plants. The firft Latin edition, "Hiftoria Generalis Infectorum, Latinam fecit H. C. Henninus," was printed at Lyons in 1685; the augmented copy in 1693, at Utrecht. The Englifh tranflation is by Thomas Flloyd, and is printed with the edition of the "Biblia Naturæ," in our own language, publifhed in London, in 1758.

The latter work of Swammerdam was introduced to the public under very extraordinary circumftances. Such was the ill fuccefs of his former writings, that the "Biblia Naturæ," after being prepared in manufcript for prefs, was left unpublifhed. No bookfeller would venture to print it at his own rifk; and the means of Swammerdam were inadequate to its production. At the death of the writer, M. Thevenot, his friend, became poffeffed of his papers, and with the copy of this among the reft. With him they remained fome time, and then paffed into the hands of Du Verney, an able anatomift, who enriched his own cabinet with the manufcript of this work. With him it lay buried, till the zealous and illuftrious Boerhaave purchafed them; and he was no fooner poffeffed of it than he haftened to communicate this treafure to the world, and it was accordingly put to prefs in 1736. He included in this publication the former works of the author, and publifhed the whole under the title of "Biblia Naturæ, five Hiftoria Infectorum Belgice, cum Verfione Latina H. D. Gaubii, et Vita Auctoris per H. Boerhaave." This work is in folio: the firft volume, confifting of five hundred and fifty pages, appeared in 1737; and the fecond volume, of much greater bulk, and with many plates, in the year following.

The fyftem propofed by the author of this work, for the arrangement of infects, differs fo materially from that given by any preceding author, that we cannot avoid confidering it immediately relevant to our prefent fubject. The general or principal claffes into which infects are divided in his fyftem amount to four; and the characters of thefe relate to the metamorphofes the infects undergo, rather than to their appearance in the perfect ftate, the firft clafs excepted.

The firft of thefe four claffes comprehends thofe fubject to no change of form, but which quit the egg in the fame ftate and appearance they are to retain during life. This clafs includes fpiders, onifci, &c.; and muft be therefore underftood as admitting of an increafe in bulk, though not undergoing any change in form.

The fecond clafs includes thofe which, after leaving the egg, appear under the form of an infect without wings, the other members formed; in which ftate it eats and grows, till, having paffed into the fecond or nymph ftate, it iffues from thence with wings, and is in a condition capable of propagating its kind. The locufts and dragon-flies are included by its author in this clafs.

In the third clafs, the animal, after having iffued from the egg, where it remained in a difguifed ftate, and without food, appears under that of an infect which eats and grows, while the members of the animal into which it is to be converted are formed under the fkin, and which it at laft quits, and becomes a nymph or chryfalis (of the dormant kind). This clafs includes moths and butterflies, &c.

The fourth clafs confifts of thofe which, having arrived at the nymph ftate, like thofe before mentioned, do not divest themfelves of the fkin, in order to enter into that ftate, but affume the form of the nymph under its fkin, where it continues fhut up, till, quitting two fkins at once, it comes forth in the perfect ftate. The infects of this clafs, according to its writer, are exemplified in the ichneumon.

There are fome few fmall tracts publifhed by this author during his life, neither of which is of material confequence, except that on the natural hiftory and anatomy of the ephemera horaria, "Ephemeri Vita, of afbeeldingh van 's menfchen leven, vertoont in de Hiftorie van het uligent ende een-daghlevent Haft of Oever-aas," a work in octavo, printed at Amfterdam in 1675. Immediately after the author's deceafe, namely in 1681, there were no lefs than two tranflations of this work; one in quarto, in Englifh, and printed at London; the other by M. Thevenot, at Paris.

No work materially important on the fubject of entomology appeared after the firft edition of the work of Swammerdam, till the years 1678 and 1679, in which Lifter publifhed his valuable hiftory of Englifh fpiders, and Madame Merian her extenfive work on the metamorphofes of lepidopterous infects. In the interval between there were feveral publications, which, though not of the moft valuable kind, are fufficiently interefting to claim remark. Claude Perrault, one of the ableft writers on exotic infects of his age, and author of feveral papers in the Memoirs of the French Academy, produced a work in folio at Paris, in 1671, which treats

treats on insects, under the title of "Memoirs pour servir à l'Histoire naturelle des Animaux;" and to this some additions were made in 1676. The work of Ferrand of Naples also relates to insects, among other animals; and this appeared in 1672. The year after Frenzelio submitted his "Insecta novifolii cum nive delapsa;" and at Franckfort on the Main, D. W. Mollerus brought forward his "Meditatio de Insectis quibusdam Hungaricis prodigiosis anno proxime præterito, ex aëre una cum nive in agros delapsis," an useful treatise of 120 pages, with two wood cuts. In 1675, George Berclio printed at Upsal his elementary tract, περὶ τῶν ἐντόμων. The same year also, Samuel Bochart published his "Hierozoicon, sive bipartitum Opus de Animalibus sanctæ Scripturæ." Müller, in 1676, gave an orationary paper on the tarantula spider, "Dissertatio de Tarantula;" and Hermannus Grube, a curious little octavo volume on the same subject, "De Tarantula, et vi Musices in ejus curatione, conjecturæ physico-medicæ.

Dr. Lister distinguished himself in the annals of entomology about this period. Previous to the publication of his "Historia Animalium Angliæ Tractatus de Araneis," several papers by this author appeared in the Philosophical Transactions, the principal of which relate to this tribe of creatures; such as his observations on the darting of spiders, in the fourth and fifth volume; his paper entitled, "Some Inquiries concerning Spiders;" and his "Tabulæ compendiariæ Araneorum Angliæ," in the sixth volume. Lister's work on spiders, before mentioned, relates chiefly to those indigenous in England, and are arranged and designated by concise specific characters with much science, corresponding with that adopted afterwards by Linnæus. This is in quarto, and was printed at London in 1678; the appendix, "De Araneis addenda et emendanda," &c. in 1681. There is a translation of this work in the German language, by F. W. H. Martini, printed in 1778.

We are in possession of the first translation of the works of Goedart by Lister, a book printed at York in 1682, under the following title, "Johannes Godartius of insects, done into English and methodized, with the addition of notes; the figures etched upon copper by Mr. F. Pl." The name of Lister does not appear; but the initials at the close of the address to the reader are M. L.; and in our copy, the letter L is rendered Lister, in the hand-writing of an entomological collector well known in the earlier part of the last century. The latter circumstance, though not apparently of much moment, is related because the fact might admit of doubt, the work being anonymous, and perhaps forgotten. The impression consisted, as the preface acquaints us, but of 150 copies, which were intended only for the curious; and in the course of nearly 130 years, it may be naturally concluded many of these must have been lost. The notes in this book are very copious. In 1685, an edition of Goedart by Lister appeared in Latin. The translator in this, as in the former work, distributes the materials of Goedart's performances into a new form of arrangement, the merits of which are too obvious not to be considered as an improvement on the original production. He divides them altogether into ten sections; for they are not strictly, in every instance, what we might denominate *orders;* in some they certainly are. The first, second, and third sections are of the lepidoptera kind, and very clearly discriminate the papiliones from the moth tribe.

The 1st includes those with erect wings; these are the butterflies which fly by day, and the chrysalids of which are angular.

2d. Moths with the wings placed horizontally, and which proceed from the caterpillars called geometræ by Goedart, because of their gait, which is like that of a measurer of land.

3d. Moths with deflected wings, or those with hanging wings sitting closer to the body than in either of the two preceding.

4th. Libellulæ, or dragon flies.

5th. Bees.

6th. Beetles.

7th. Grasshoppers.

8th. Dipterous flies.

9th. Millepedes.

10th. Spiders.

Goedart spent forty years of his life, as he expresses it, "daily conversing with insects;" and from the course of his observations, it is manifest he was well acquainted with his subject. Lister is nevertheless unwilling to concede this point: he neither allows him credit as a naturalist or a writer, at the same time that he extols his excellent skill in limning. These opinions are delivered in a style of affected superiority over his author, neither becoming, nor strictly true; and seem to be dictated so nearly in the spirit of some more modern critics, that one cannot avoid smiling at the comparison. "Goedart," says he, "after forty years attention, seems to have made little advancement in his skill in the nature of insects: he seems rather to have diverted himself with them, than to have given himself any trouble to understand them; and yet after all, you will find him every where very just, and true in his observations, but in many places very short, and hardly intelligible." Our English annotator gained no reputation on the continent for these general remarks, although the merit of his notes relating to the metamorphoses of insects was acknowledged; the works of Goedart still maintained their credit.

Maria Sybilla Merian, vel Gräffinn, the wife of John Andrew Gräffinn, was a native of Franckfort on the Main, and early in life imbibed a taste for the study of insects, from being occupied at times in painting these pleasing objects as embellishments to her flower-pieces. The task of painting insects was performed by this fair artist with no very fastiduous share of accuracy. In point of drawing she rarely excels; and her productions, though splendid memorials of her talents, and the great encouragement she obtained, are marked by a peculiar exuberance of style incompatible with any faithful resemblance of nature. Her first work was published in 1679, and relates to European insects, chiefly those of the lepidopterous order, with their changes, and is entitled "Der Raupen wunderbare verwandeleng, und sonderbare blumen-nahrung:" another part appeared in 1683. These were published at Nuremberg. In 1718, another work by the same authoress was published at Amsterdam, called "Erucarum ortus, Alimentum et Paradoxa Metamorphosis." After this we have an history of the European insects, rendered from the Dutch text of Madame Merian into French, with an augmentation of the description of the plants by J. Marret, a work printed in folio at Amsterdam, in 1730. But the best of all her publications came out at the Hague in 1726, in a folio of superior size, with the title "De Generatione et Metamorphosibus Insectorum Surinamensium," &c.; the materials for which were collected by herself, or under her own inspection in Surinam. This lady had made a voyage from Holland to South America in 1699, for the avowed purpose of forming a collection of natural curiosities for this work, and was occupied at Surinam during the space of two years in taking drawings and descriptions of various objects for this purpose. This work is not entirely devoted to entomology, as, besides insects, it contains a miscellaneous

laneous aſſemblage of toads, lizards, ſerpents, and other reptiles, and likewiſe a pretty extenſive number of plants.

In the Philoſophical Tranſactions are to be found ſome obſervations concerning inſects, made in Virginia in 1680, with remarks by J. Petiver. Hoppio, in 1682, publiſhed at Jena a diſſertation on the gryllus migratorius. Two years after, another ſmall tract appeared alſo at Jena, a paper on ants, "Reſpublica Formicarum," by A. Schmidt. The fifteenth volume of the Philoſophical Tranſactions affords an account of the "Connough-worm," by Wm. Molyneux, a paper afterwards tranſlated into Latin, and inſerted in one of the continental journals under the title of "Obſervatio de Inſecto Hibernico vocato Connough-worm." Some few entomological obſervations of a miſcellaneous nature, extracted from the manuſcript hiſtory of Pembrokeſhire by George Owen of Henllys, lord of Kemmes, occurs in the eighteenth volume of the ſame Tranſactions. The original MS. of this hiſtory we have ſeen in the Britiſh Muſeum. Beſides the above, the Tranſactions about the ſame time contain ſeveral intereſting papers relative to inſects; as Allen's account of the gall-bee, and the death-watch, in vol. 20. "A Letter concerning an Inſect commonly called the Death-watch," vol. 22. which reſpects both ptinus pulſator, and hemerobius pulſatorius, written by William Durham; and alſo a ſupplement to an account of pediculus pulſatorius or death-watch, in vol. 24.

But, in point of priority, we ought previouſly to have mentioned the earlier works of Leeuwenhoek, a writer whoſe aſtoniſhing aſſiduity, aided by means of powerful microſcopes, has contributed more than any other man, except Swammerdam, to diſcloſe to our view the wonders of the inviſible creation, in the ſphere of which the minima of the inſect race become of the firſt conſideration. One of the firſt papers of this intelligent obſerver appears in the eighth volume of the Philoſophical Tranſactions, and is entitled "A Specimen of ſome Obſervations made by a Microſcope contrived by M. Leeuwenhoek." His communications to the world after this became numerous; and, as the object of his purſuit was of a nature to ſtimulate a ſpirit of inveſtigation, it could ſcarcely at the ſame time fail to excite controverſy. It led, therefore, to the production of many papers by different writers, all which tended, in ſome degree, to the further elucidation of the ſubject. As theſe, however, are only in part connected with entomology, it would be fruitleſs for us to follow, through the varied branches of diſcuſſion, and to ſelect thoſe particular paſſages which relate to our preſent inquiry; for theſe we refer the curious reader to Tranſactions of the Royal Society, from the eighth to the thirty-ſecond volume; and to various publications printed at Leyden and Delft in 1686, 1693, 1697, 1704, &c. Among the principal works of Leeuwenhoek, are "Anatomia, ſeu interiora rerum, cum animatarum tum inanimatarum (ſic) ope et beneficio exquiſitiſſimorum microſcopiorum detecta," 1687; "Arcana naturæ detecta," 1695; and "Opera omnia," 1722; an Engliſh edition of the ſelect works of this author was undertaken in London in 1798.

Geyerus, in 1687, was author of a medical tract in quarto printed at Leipſic and Frankfort, called "Tractatus phyſico-medicus de cantharidibus," and which, as the title implies, relates to the medicinal properties of thoſe well known inſects, the cantharides. Bononius, in the ſame year, publiſhed a letter at Florence, in which he enters on an extenſive detail of his obſervations on many inſects, with the microſcope, and lays claim to ſeveral diſcoveries. And J. F. Griendel, Von Ach, canon of the order of the Holy Ghoſt, produced his "Micrographia nova" at Nuremberg alſo at this time; a quarto volume of ſixty-four pages, ſome of which are dedicated to his microſcopical obſervations on inſects.

The work of Stephen Blankaart of Amſterdam made its appearance in 1688. Its author, a Dutch phyſician, was an aſſiduous collector, and in this inſtance produced a work, the plates of which have been as much admired for the beauty of their execution as the work in other reſpects has been condemned. Friſch, and after him Lyonet, conſider it as an indifferent production. It relates chiefly to the larva of different inſects, as the caterpillars of ſeventeen lepidopterous inſects, twelve maggots of flies, and a few other inſects, amounting altogether to forty-ſeven ſubjects. The title is, "Schou Berg der Rupſen, Wormer, Maden en vliegende Dierkens daar uit voort-kommende." The paper of John de Muralto, and alſo that of C. Mentzelius, relating to different inſects, appeared about this period; and the work of John Cyprien, "Hiſtoriæ Animalium," was alſo printed in 1688; it was publiſhed at Frankfort, and relates to inſects among other animals. A ſmall tract, an orationary paper of eight pages, with a ſingle plate, entitled "Chymica Formicarum," is from the pen of profeſſor Sperling in 1689. Koenig's "Regnum Animale," &c. printed in 1690; Bilberg's "Locuſtæ," a diſſertation, printed at Upſal in 1690; and "Hiſtoria Vermium" by Jungius, printed at Hamburgh in 1691, are all intereſting, and a paper by Sedileau, publiſhed in 1692 in the Memoirs of the French Academy, is rather curious; this latter is denominated "Obſervations ſur l'origine d'un eſpece de Papillon," and the inſect treated upon is bombyx pavonia γ major. The prodigious ravages occaſioned by the ſwarms of locuſts which, in the month of Auguſt 1693, over-ran Germany, and extended their ſcattered legions throughout the reſt of Europe, even to the borders of the moſt northern countries, were an event of ſuch an afflicting nature, that it could not fail to engage the obſervations of many writers, in the number of which we meet with the names of ſome naturaliſts of ability, whoſe diſſertations on this occaſion are acceptable. Treunero, Hebenſtreit, Woollenhaupt, Crellius, Kirkmajor, and Ludolfus, wrote at this time on the ſubject, relating the particulars of their appearance, the devaſtations committed, and the moſt effectual means of deſtroying them. The ſpecies was the common migratory kind, gryllus migratorius. Theſe tracts were generally trifling in point of ſize, that of Hebenſtreit, however, "De Locuſtis immenſo agmine aërum noſtrum implentibus, et quid portendere putentur," conſiſts of 65 pages and one plate, and that of Ludolphus, entitled "Diſſertatio de Locuſtis, anno præterito immenſa copia in Germania viſis, cum diatriba, qua ſententia autoris de שלוים defenditur," is a folio of eighty-eight pages, and embelliſhed with figures.

Albino publiſhed a ſmall tract on the cantharides in 1694, and the following year "Jacobi Petiveri Muſæum," a ſmall octavo, was publiſhed in London. Theſe, with the elementary work of Jacobæus, "Diſſertatio de vermibus et inſectis," and that of Baglivus, printed at Rome in 1696, on the effects of the bite of the tarantula, and a paper of Homberg on the libellula virgo in the Memoirs of the French Academy for 1699, appear to be the only publications deſerving of mention till the commencement of the eighteenth century.

The earlier part of the eighteenth century forms an era in which the ſcience of entomology was cultivated with the happieſt ſucceſs. It is with ſome pride alſo, we obſerve, that even in the comparatively improved ſtate to which the ſcience had then attained, it derived no incon-

 ſiderable

fiderable advancement through the labours of our own countrymen. The works of Ray and Lifter, with thofe of Petiver in England, and thofe of the indefatigable Reaumur in France, contributed effentially to this purpofe, and to the prefent day ferve in fome meafure to maintain the reputation of fcience. The works of thofe authors were fucceeded within the firft fifty or fixty years by other works of high confideration, as will be found hereafter. In the interval of time that elapfed between the publications of thofe more extenfive and valuable works, others of lefs importance, but which yet deferve mention, made their appearance; as, for inftance, in 1701 the fmall, but curious differtation of Heucherus, called "Araneum homini perniciofum et falutarem;" the little treatife by Vallerio of Upfal on the tarantula, publifhed the year after; the entomological part of the work of G. B Rumphius, in 1705, and that of Ruifch, "Theatrum univerfale omnium animalium," publifhed in 1710—1718. Henninger produced a fmall medical tract relating to millepedes, in 1711. Wedelio on an old fubject, the utility of the cantharides, in the Materia Medica, at Jena, in 1717; and Whitaker, the year following, on the fame infect: the remarks of J. Pontedera, "De Cicada," &c. annexed to his botanical work; and two tracts by Laurentius Roberg, medical profeffor at Upfal, "Formicarum Natura," and "Libella infecta."

It was in the year 1702 that Petiver produced the firft decade of his "Gazophylacium naturæ et artis," the publication of which was carried on progreffively till for about ten years after, during which period the work was extended to ten decades, each containing plates exclufive of the "claffical and topical catalogues." This work relates to infects among other animals, plants, and foffils. About twelve months before the author's death, which happened in 1718, there was, however, another work printed by him under the title of "Papilionum Britanniæ Icones," &c. and which, as the title expreffes, relates to the Englifh butterflies, and is entirely confined to entomology.

A work by Ray, appropriated to this branch of fcience, was publifhed in 1705, under the title of "Methodus Infectorum, feu in methodum aliqualem digefta," and which can be confidered only as the introduction or prelude to the great work, "Hiftoria Infectorum," which the world received in 1710, through the care of Dr. Derham; for Ray did not live to fee it publifhed.

This celebrated naturalift divides all infects into two principal claffes, thofe which undergo transformation in their form, and fuch as do not pafs through any tranformation after being produced in the firft inftance. Each of the two principal claffes are fub-divided into feveral orders, which are varioufly characterized, as by the number of the feet, or by being deftitute of thofe limbs. Some are determined by the habitation of the infects; by the fize or conformation of various parts of the body; by the odour they emit; the form of the caterpillars, and various other peculiarities. This arrangement is in part conformable with the writer preceding; the intranfmutablia, or order of thofe which do not pafs through any metamorphofes, is due to Willughby; and the three orders of changeable infects correfpond with the 12th, 13th, and 14th orders of Swammerdam's claffification. His clafs of changeable infects is divided into feveral families, as vaginipennes, from having the wings covered with a fheath, papiliones, quadripennes, bipennes, &c. There is an appendix to this work by Lifter, "Appendix de Scarabæis Britannicis," &c. Ray, like many other writers, includes certain tribes of the vermes with infects, from which they are feparated by Linnæus; it is poffible that Ray might conceive what has been fince proved by indubitable authority, that fome few, at leaft, of the fuppofed vermes are no other than the larvæ of infects.

The work of Albin, for the time in which it was executed, was confidered as an elegant publication; it is in one volume quarto, containing one hundred copper plates, with a brief defcription of the objects reprefented in each, and was originally fold at four guineas a copy, a great price in thofe times, being publifhed in the year 1720. If we miftake not, another edition is dated a few years later; there is certainly one printed with notes and obfervations by Dr. Derham, in 1749. Albin was author of a work on Englifh fpiders, in which the lice of feveral animals and birds are reprefented from the plates of Redi.

At the fame time that Albin was engaged in the preparation of the above-mentioned work in England, J. L. Frifch, rector of the Royal Academy at Berlin, was occupied on his hiftory of the infects of Germany, "Befchreibung von Infecten in Deufchland," the firft part of which appeared in 1720; the whole work confifts of thirteen parts, and each part is embellifhed with three plates. Copies of this work have been printed fince that time; the lateft we have feen bears date 1766.

Valifinieri, in his work, entitled "Efperienze et Offervazioni intorno agli infetti," publifhed in 1730, diftributes all infects into four claffes, according to the different places in which they are found. The firft comprehends thofe infects which live on plants; the fecond, fuch as live in water and other fluids; the third, thofe that live in the earth, or among ftony fubftances; and the fourth, thofe which fubfift on the other animals, or in their bodies.

Reaumur produced the firft volume of his "Memoirs pour fervir à l'Hiftoire des Infectes," at Paris, in the year 1734. The five fucceeding volumes appeared between that time and 1742. This voluminous work contains fome thoufand pages, and nearly two hundred plates; and is one of the beft productions on the fubject that has been fubmitted to the world. There are two editions of this work, one publifhed in Paris by its author, in quarto fize; the other is in octavo, a pirated concern by the Dutch bookfellers.

After the works of Ray, Lifter, and Petiver, the intelligent entomologifts of our own country, in the commencement of this century, the name of Bradley ought perhaps to have been introduced. His publication, "A Philofophical Account of the Works of Nature," which was printed in London fo early as the year 1721, contains a brief account of infects. This author, though a profeffor of botany in one of the univerfities, feems not to have been poffeffed of any very extenfive or accurate information on this fubject of entomology; his work at leaft abounds in the marvellous, but was, perhaps, for this very reafon, more likely in his time to have been perufed with pleafure by the common reader. As a popular work, it was not in other refpects without its advantages. The works of Reaumur in France contributed materially to facilitate the ftudy of entomology on the continent. And about the fame time that he was engaged in this field of enquiry, feveral tracts and papers made their appearance from other individuals. In the memoirs of the French Academy for 1731, there is one entitled "Efperiences fur les Scorpions," by Maupertuis; and in 1734, fome others by Trew, as "Infectorum quodam genere," "De duabus Erucis," and "Peculiare quoddam Quercus excrefcentiarum genus," all which are inferted in the "Commerc. Literar." of Nuremberg. Thefe papers immediately preceded the publication of the firft entomological work which the celebrated Linnæus produced to the world.

The principal writings of Linnæus on this branch of natural

tural ſcience are to be found in his deſervedly eſteemed production the "Syſtema Naturæ, ſive regna tria naturæ ſyſtematice propoſita per claſſes, ordines, genera, et ſpecies;" the firſt edition of which is in folio, and was publiſhed in 1735. Linnæus in this work diſtributes inſects into four orders, according to the number and form or nature of their wings, under the ſeveral names of coleoptera, angioptera, hemiptera, and aptera. The firſt order contains thoſe inſects which have covered wings; the ſecond thoſe with naked wings, as butter-flies, dragon-flies, ephemeræ, &c. In the third, he enumerates crickets, locuſts, bugs, &c.; and in the fourth, thoſe which have limbs, but no wings, as the ſpider, lobſter, &c. Beſides theſe four orders, this primary arrangement of inſects comprehends three other orders of animals, referred ſince to the vermes claſs, but which, at the period of the firſt publication of the "Syſtema," Linnæus conſidered to be genuine inſects. The firſt of theſe includes all creeping "inſects" whoſe body is naked and deſtitute of limbs, as the earth-worm and the leech: the ſecond, both land and ſea-ſhell animals; and the third, thoſe furniſhed with limbs, as the echinus, aſterias, &c.

Linnæus by no means deviated from the received opinion of his time, in placing the firſt and third of theſe laſt mentioned tribes of animals with inſects. Theſe bodies were conſidered as appertaining to the inſect race by moſt of his immediate predeceſſors, and by ſome naturaliſts in earlier times. In a ſubſequent edition of the Linnæan work, theſe orders are ſeparated, and the latter conſtituted into a diſtinct claſs after the manner of Ariſtotle, who points out the natural obvious difference which prevails between theſe two orders of animals with ſo much clearneſs, that we are not without ſome ſurprize his example was overlooked by Linnæus in the firſt inſtance. Linnæus, according to this plan, in his later works, ſeparates the echini, &c. under the denomination of vermes. The inſects alone were then extended by him from four to ſeven orders. This is the arrangement which his claſs "Inſecta" finally aſſumed in the edition of 1767, and which is ſtill adopted by the admirers of Linnæus. The following are the definitions of the ſeveral orders eſtabliſhed by this eminent naturaliſt.

Coleoptera, ſuch as have cruſtaceous elytra, or ſhells, which ſhut together, and form a longitudinal ſuture down the back of the inſect, as in the chafer-beetle. In moſt inſects of this claſs, the elytra cover the abdomen entirely, in others but partially, as in the ear-wig, &c. The word is derived from κολεὸς, *a ſheath*, and πτερὸν, *a wing*.

Hemiptera, which have their upper wings moſt commonly half cruſtaceous, and half membranaceous, not divided by a longitudinal ſuture, but incumbent on each other; as in the water ſcorpion and graſshopper. From ἥμισυ, *half*, and πτερὸν, *a wing*.

Lepidoptera, having four wings covered with fine ſcales in the form of powder or meal; as in the butterfly and moth, from λεπὶς, *a ſcale*, and πτερὸν, *a wing*.

Neuroptera. In this order the wings are membranaceous, tranſparent, and naked, and are generally reticulated with veins or nerves; the tail is without a ſting, as in the libellula or dragon-fly. The term is derived from νεῦρον, *a nerve*, and πτερὸν, *a wing*.

Hymenoptera, have four membranaceous wings, and the tail furniſhed with a ſting for various purpoſes, as in the waſp, ichneumon, &c. From ὑμὴν, *a membrane*, or *pellicle*, and πτερὸν, *a wing*.

Diptera, with two wings only, and poiſers as in the houſe-fly; from δύω, *two*, and πτερὸν, *a wing*.

Aptera, have no wings; as the ſpider, &c. from ἀ, *without*, and πτερὸν, *a wing*.

The great perſpicuity of the Linnæan ſyſtem of entomology aroſe from its author having made choice of the moſt obvious characters which inſects afford for the leading diſtinctions of his orders, ſuch for inſtance as the number, texture, and poſition or folds of the wings, or the abſence of theſe parts; and in the conſtruction of the genera, the like attention being devoted to the form of the head, thorax, and wings; and in particular to the ſtructure of the antennæ: theſe latter being conſpicuous in moſt inſects, and ſo infinitely varied in their appearance as to conſtitute in general a permanent definition. That there are other characters which, in the opinion of later entomologiſts, are better adapted to the purpoſe of claſſification the reader muſt be aware, but theſe, although really preferable in ſome reſpects, are perhaps too minute to become always uſeful. The ſtructure of the various parts of the mouth, the character on which the Fabrician ſyſtem is founded, however definitive, and therefore excellent, requires that degree of attentive ſcrutiny in their examination, which is rarely beſtowed by the ordinary obſerver of nature; and which cannot for this reaſon be ſo well calculated for the general purpoſe of diſcriminating the families of inſects, as thoſe which are at once too obvious to be miſtaken.

The ſimplicity of the arrangement adopted by Linnæus, the celebrity of his name, and the princely patronage under which he wrote, conſpired with other favourable circumſtances to render this ſcience more univerſally cultivated, admired, and reſpected about his time, than it had probably been at any former period. The credit due to this naturaliſt for his labours in entomology is great. This we allow, but, let us alſo remember, that he is not alone entitled to our commendation for the arrangement propoſed in his work. We muſt in candour acknowledge the merits of many among his predeceſſors, who wrote under circumſtances of leſs encouragement, and have nevertheleſs excelled in this ſcience: men to whom the writings of Linnæus ſtand in a very high degree indebted, and without the aid of which it is impoſſible to imagine the ſyſtem, which now commands our admiration, could have been produced, at leaſt in its preſent ſtate of purity.

From the various entomological works extant before the time of Linnæus, it may be collected that the hiſtory of theſe creatures was deeply inveſtigated prior to the appearance of his writings; and even that ſyſtem itſelf, the prominent feature of his labours, from progreſſive advancement, had gradually attained to a ſtate of conſiderable perfection. In the works of Ariſtotle and Pliny, in thoſe of Agricola, Aldrovandus, Frenzius, Mouſet, Swammerdam, Ray, Willughby, Liſter, Valliſnieri, and various others whoſe names have been already repeated, we diſtinctly perceive, with ſome occaſional variation, the outline of the ſuperſtructure raiſed in the "Syſtema Naturæ."

Theſe valuable ſources of information furniſhed him with abundant materials, from which he ſelected with profound judgment, and interwove with ability, induſtry, and ſucceſs. Linnæus was in this reſpect commendable; he did not ſuffer his mind to be ſwerved on this occaſion from any ambitious or innovating motives; and ſo far as he deemed it conſiſtent with his plan, he appears to have adhered to the examples of his predeceſſors. The characters of his ordines are to be found in ſeveral earlier publications than his own, and ſo likewiſe are moſt of his genera, and the far greater number of his ſpecies. But theſe he remoulded throughout with ſo much ſkill, that this "Syſtema" conſtitutes the central point in which the ſcattered rays of natural ſcience are concentrated with more preciſion than they really appear in the original authors, to whoſe induſtry he ſtands indebted. It was

was in the concife and very expreffive ftyle which Linnæus adopts in all his works, and which was almoft peculiar to himfelf, that he excelled.

Our limits are inadequate to the fair difcuffion of this important fubject; and of this we feel fo deeply fenfible, that for the prefent we fhall wave all further comment, referving to ourfelves a future opportunity for entering upon a more extenfive view of the merits of the Linnæan fyftem, as contrafted with thofe of other authors who have appeared fince his time, and which have obtained the fanction of public approval.

After the firft edition of the "Syftema Naturæ," Linnæus wrote feveral papers on the fubject of entomology; fome of which are printed in the Tranfactions of the Royal Society of Upfal. One of the earlieft of thefe appeared in 1739, under the title of "Om Renarus Brömfkulor i Lapland;" and another dated Stockholm, in the fame year, "Tal om Märkwardighter uti Infecterne." In 1746, we find a paper, jointly the production of Linnæus and Degeer, relative to the lantern-fly of China (fulgora candeleria); and about the fame time, his "Fauna Suecica," an enlarged and improved edition of which was publifhed in 1761. That elegant infect, panorpa coa, a fcarce fpecies at that period, forms the fubject of a fmall Linnæan paper in 1747. His differtations "Miracula Infectorum," and "Noxa Infectorum," bear the fame date, 1752: they were both printed at Upfal, and poffefs merit: the latter is in particular valuable, from the object in the contemplation of the writer. Six years after this he produced a differtation, called "Pandora Infectorum;" the year after, a paper on the coccus; and in 1761, his "Fundamenta Entomologiæ," a book in thofe days of confiderable value as an elementary work, or introduction to this ftudy. There is a tranflation of the tract by W. Curtis, printed at London in 1772. His laft entomological paper is upon the genus paufus, a curious coleopterous tribe, diftinguifhed by the comparatively enormous magnitude of the antennæ.

The work of L'Admiral, entitled "Naawkeurige Waarneemingen van Geftaltverwiffelende gekorwene Diertjes," appeared in 1740 at Amfterdam. It is in folio, and contains a feries of elaborately finifhed etchings, which, though engraven in a diffimilar ftyle, have fomewhat the air of Merian's work on the infects of Surinam, or as is diftinctly copied in the Aurelian of Mofes Harris. The work of L'Admiral is confined to the European infects, of which it comprehends about fifty fpecies of the larger kinds, and thofe principally of the lepidopterous tribe. Thefe are reprefented in a heavy, though not unpleafing, and often very beautiful manner, in various attitudes, with large branches of the different kinds of plants on which they feed; and in moft inftances, the perfect infect is accompanied on the fame plate with the larva and pupa. L'Admiral's work began in numbers, and was intended to contain, according to its author, one hundred plates and four hundred pages of letter-prefs. This defign was never completed. There are few copies with more than twenty-five plates, and about five pages of letter-prefs. Our copy contains thirty-two plates and twenty pages, and is the moft complete in this refpect we have feen.

A fmall treatife relative to the larvæ of phalænæ, by Dethardiug, "Difquifitio Phyfica Vermium in Norvegia, qui novi vifi," was publifhed in quarto in 1742. The fame year, the tarantula fpider engaged the attention of Francefco Serao of Naples, who on this fubject only has given a quarto of two hundred and fixty pages, entitled, "Della Tarantola o vero Fala gio di Puglia." The hiftory of the tarantula about this time engaged the pen of feveral curious perfons; and, among others, N. Caputus had the year preceding publifhed a book nearly the fame fize, "De Tarantulæ Anatome et Morfu."

The work of Leffer, "Infecto-theologia," &c. written in the German language, and better known from the French tranflation by Lyonet in 1742, entitled "Theologie des Infectes," is rather a curious than valuable publication. The fuccefs of this book in Germany renders it worthy of particular mention. The views of its author, (a clergyman at Nördhaufen,) as he himfelf explains, was to "promote the glory of God." He does not afpire to the eftablifhment of any new facts relative to entomology: his attention is directed folely to the felection of fuch anecdotes and particulars of the hiftory of infects, gleaned from other works, as could be rendered a convenient medium for the theological remarks with which his pages abound. The piety of his mind we fhall not diftruft: to an entomologift his work is of no material worth; he was not very well acquainted with this fubject, and his remarks are often erroneous. As a theological production, and in this view the author wifhed it to be confidered, certain paffages in the work of Leffer may have an ufeful tendency: it is calculated to expofe fome glaring errors in the writings of other theologians, who in a fpirit of fanaticifm had entered upon the fame fubject. One of his beft chapters on this head is that relating to the "abufe of infects in theology;" in which he points out the grofs outrage on reafon committed by the pagans, in making certain infects the idols of their worfhip; and remarks how much more abfurd it muft appear, that the Jews and even Chriftians fhould have followed their example: a fact inferred by him from various authorities. The Jews are accufed of ftating many wonderful things relative to infects, which can only be confidered as fables. Among others, after repeating the facred text, 1 Kings, vi. 7. concerning the erection of the temple, which was "built of ftone made ready before it was brought thither; fo that neither hammer, nor ax, nor any tool of iron was heard in the houfe, while it was building," he ftates, that the Jews explain this paffage in the following manner. The workmen, they affirm, employed a worm to fhape the ftones; which infect, named fchamir, cut and broke them to pieces in places where applied. They add, that it was the figure of a grain of barley, and was kept in a leaden box, becaufe, had it reached any rocks, it would have cleft and deftroyed them. This fable, with fome others invented by the rabbis, is particularly mentioned. Among the legends of Catholic fuperftition he felects other anecdotes equally remarkable. Baldus, he fays, in order to prove the real prefence in the eucharift, relates that a number of bees being found on holy ground, paid it homage, and carried a portion of it refpectfully to their hive. Baptifte tells us, that a fpider having accidentally fallen into the chalice, while St. Francis was faying mafs, the holy man determined to fwallow it; and adds, that the fpider came afterwards out of the bone of his leg. But to conclude with one of thefe tales of fanaticifm not unworthy of record with the reft: it is gravely ftated that St. Francis, once walking in a garden, faw a grafshopper, which immediately quitted the plant it fat upon, and perched on his hand; he ordered it to fing to the praifes of God, and with a pretty loud voice it immediately began a very fine pfalm! If fuch holy impoftures were actually liftened to with any faith, the time of Leffer could not be mifapplied, as a divine, in endeavouring to expofe their abfurdity.

Degeer publifhed at Stockholm, in the year 1744, an interefting little octavo on the utility of the ftudy of infects, called "Tal om nyttan, fom Infecterne och deras fkärfkådande,

dande, tilſkynda oſs;" in which he points out the advantages likely to reſult from our acquaintance with this tribe of animals, and which appears to be the firſt tract expreſsly written under this view of entomology. About this ſame period, Röſel of Nuremburg, by profeſſion a miniature painter, was engaged in the preparation of a valuable entomological work, the firſt part of which was ſhortly after produced to the world. This work bears the title "Der Monatlich-heraufgegebenen Inſecten-Beluſtigung," and conſiſts of ſeveral volumes in quarto. The firſt part was produced in 1746, and two ſucceeding volumes in 1749 and 1755; to theſe a fourth volume was added by his relation Kleemannin, 1761, two years after the death of Röſel; and ſince that period Kleemanahus publiſhed three other parts in continuation.

Röſel does not adopt any ſcientific order of arrangement: his work was produced as a miſcellany, and, according to the title, as an amuſement in the ſtudy of inſects. Many of the inſects included are European; others are natives of Aſia, America, &c. Beſides inſects, ſome few of the cruſtacea are contained; and a portion of the third volume is devoted to the vermes tribe. The text is in the German language, and exceedingly copious; the ſlighteſt peculiarity in every individual inſect being deſcanted upon with as much minuteneſs as the more important details of its hiſtory. The plates are numerous and intereſting. The ſupplemental faſciculi given by Kleemann, "Beyträge zur Natur-und Inſecten-Geſchichte," &c. relate to European inſects, and a ſmall number of the extra European kinds.

A tract, dedicated to the purpoſe of explaining the advantages ariſing from the ſtudy of inſects, was printed in 1747, by C. F. Mennander, "Diſſertatio de Uſu Cognitionis Inſectorum." Bazin, the ſame year, publiſhed his "Abregé de l'Hiſtoire des Inſectes, pour ſervir de ſuite à l'Hiſtoire naturelle des Abeilles," in Paris; and in London, William Gould, "An Account of Engliſh Ants." T. C. Hoppe publiſhed, the year after, two ſmall entomological tracts, as "Antwort-Schreiben auf Hrn Schreibers zweifel," at Gera; and "Eichen-Weiden-und Dornroſen," at Leipſic; and J. Dutfield of London, ſix numbers of a natural hiſtory of Engliſh moths and butterflies, after which the work diſcontinued.

About this ſame period, or rather earlier, but certainly before the year 1749, a work was undertaken in London by Benjamin Wilks, under the title of "The Engliſh Moths and Butterflies, together with the Plants, Flowers, and Fruits whereon they feed, and are uſually found." This publication, conſiſting originally of plates only, appeared in the firſt inſtance without a date. From collateral circumſtances we are, however, enabled to ſtate that it muſt have preceded the year laſt mentioned; becauſe at that time the whole work, conſiſting of 120 plates, was nearly completed, as we learn from comments upon that work in the third volume of Röſel's Inſecten Beluſtigung. The nature of this work is rather incorrectly ſtated in its title page; for the plants on which the groups of inſects are reſpectively diſplayed are not thoſe which conſtitute their natural food: they conſiſt of gaudy flowers, auriculas, roſes, monſtrous varieties of cultured plants, fruits, &c. the introduction of which, in preference to their natural food, has incurred blame. But another charge, and one in our opinion of more importance, is brought againſt our author by Röſel; an imputation tending to depreciate the reſpectability of the Engliſh entomologiſts of that particular criſis, when the ſcience ought, from the labours of former writers, to have ſtood in this country on very high ground, and the public judgment to have been ſo far matured as to diſcover impoſition. He plainly accuſes our author of piracy; and when we reflect on the celebrity this work has heretofore enjoyed as an original production, it does attach ſome little reproach at leaſt that facts ſtated with the utmoſt publicity on the continent ſhould have remained unknown to us. The remarks are curious; and as in all probability they have not before met the eye of the Engliſh reader, we ſhall tranſlate the paſſage in this place: "In dem nachtragoder 3," &c. "In the ſupplement, or third part of my Amuſements of Inſects, I have mentioned a certain work which Mr. Wilks in London publiſhes monthly, and promiſed that I would be more circumſtantial at another time. Since then the plates amount to ninety, all which I have examined with great attention: they are as yet deſtitute of any deſcription, which, however, is to appear at ſome future period. If the notice which accompanies theſe plates deſerves credit, all thoſe inſects are drawn after life; but to thoſe who know other works, and examine theſe plates with caution, it ſoon appears that the author has copied ſeveral from Albin's inſects, from Merian's book, and a great many from my own. Whether he has been ſucceſsful in his attempt, I leave to the judgment of others. An ape mimicks every thing, but does not always ſucceed. This may appear to many to be too ſevere; but let them conſider that the author counterfeits the works of others, and gives them out as his own. I venture to aſſert that in the future deſcription of his work, he will take care not to tell us from what books he has compiled his own; for he already ſtrives to hide on his plates whatever he has copied from others, by reverſing the figures, or by giving them a different poſition." Vol. iii. p. 192, A.D. 1749. This we muſt conſider as in ſome meaſure the language of reſentment for the liberties taken with his work: it is neverthele ſs in ſubſtance true; for the eye of the artiſt will perceive, on comparing the two publications, that Wilks has taken an unlimited range through the firſt volume of Röſel. The remarks are repeated at length, becauſe we wiſh to impreſs on the public mind the value and importance of any genuine work, in preference to productions of this nature. Wilks was the publiſher of "Twelve new Deſigns of Butterflies," in which the inſects are diſpoſed in ſtars, feſtoons, circles, or other whimſical groups, forming what are uſually denominated "Butterfly pictures."

The firſt volume of the invaluable work of baron Charles de Geer, the "Memoirs pour ſervir à l'Hiſtoire des Inſectes," was printed at Stockholm in 1752, and was received with every demonſtration of praiſe, to which its merits are entitled. From the teſtimony of the author's talents which this volume afforded, the continuation was expected with impatience; but nine years elapſed before the ſecond volume appeared, and it was altogether twenty-ſix years from its commencement to its termination. It was completed in 1778, in which year the labours of its author cloſed with his life. De Geer was the author of many other publications, which are to be found diſperſed through the Tranſactions of various learned ſocieties; but that above noticed is the moſt conſiderable of his works.

Dr. Hill, in his hiſtory of animals, publiſhed in London in the year 1752, divides inſects into three claſſes: the firſt of which, apteria, comprehends all inſects without wings; the ſecond, pteraria, is devoted to the winged kinds; and the third, called gymnarthridia, conſiſts of thoſe which have ſoft and naked bodies, and are furniſhed with limbs. The apteria is divided into two families; and pteraria, or the winged inſects, into diptera and tetraptera, or thoſe with two wings and four wings.

The "Entomologia Carniolica" of Scopoli appeared in 1753.

1753. This author diftributes all the infects of which he treats into orders, genera, fpecies, and varieties, nearly after the manner of Linnæus; changing, neverthelefs, the names they bear in the works of the latter for others he deemed more appropriate. Thus, for example, probofcidea is fubftituted for hemiptera, in reference to the beak by which thefe infects are diftinguifhed; aculeata for hymenoptera, from the abdominal fting; halterata for diptera; and pedeftria for aptera.

As a fyftematic work, this publication of Scopoli is of fmall importance; in other refpects it is valuable. The arrangement of infects, better known on the continent as the fyftem of Scopoli, appeared in a work, entitled "Introductio ad Hiftoriam naturalem," printed fo lately as the year 1777, and which, as the title expreffes, does not relate exclufively to the fcience of entomology. He divides infects into five tribes, under the fingular appellations of Swammerdamii-lucifuga, Geoffroy-gymnoptera, Roefelii-lepidoptera, Reaumurii-probofcidea, and Frifchii-coleoptera: by this means, identifying each particular tribe with the name of an author, who in his opinion had been moft fuccefsful in the explanation of that to which his name is attached.

The order lucifuga includes two genera, cruftacea and pedicularia; gymnoptera comprehends halterata, aculeata, and caudata; lepidoptera, the genera fphinx, phalæna, and papilio; probofcidea are divided into two parts, the terreftrial and aquatic; and the coleoptera, in the fame manner, confift of two families, the inhabitants of the water and thofe of the land.

The ardour with which the fcience of entomology was cultivated about this period in various parts of Europe, is to be afcribed to the occafional labours of Linnæus and his immediate coadjutors, whofe example excited the moft laudable affiduity; and though no work of any material confequence appeared exactly at this time, we may fafely conclude that this fpirit of emulation laid the foundation of feveral which were fubmitted to the world a few years after. Among the entomological tracts and papers of this time, fome only are worthy of notice. Kalm, a name familiar to the botanift, beftowed attention on this fubject, as we perceive from a paper on a fpecies of cicada, (feptemdecim,) written in the Swedifh language; and alfo from another by the fame author on acarus americanus: thefe appeared in 1754. The year after G. W. Sigwart treats flightly on coleopterous infects; and Sauvages produced fome papers of little moment in the Memoirs of the French Academy. And now we proceed gradually to the confideration of other works of greater confequence; the ufeful work of Clerk on the fpiders of Sweden, printed in 4to. at Stockholm, in 1757, is one of the beft works extant on this curious tribe. Another production by the fame author is alfo valuable, his "Icones infectorum rariorum," a thin and fmall quarto, publifhed two years after. Indeed, this laft mentioned work may be confidered as having the immediate fanction of Linnæus, from being produced under his own direction, and, we believe, infpection. The work contains a moderate number of coloured plates, fome of which are appropriated to the difplay of felect exotic infects of the moth and butterfly tribe, and others to the more choice and rare lepidopterous infects of Europe, all which are highly finifhed in colours. There were only a few copies of this work printed off, and it is now become fcarce, and bears a confiderable piece. Dr. Smith poffeffes one copy, that originally in the library of Linnæus, and there is another in that of fir Jofeph Banks.

An interefting little work, called "Infecta Mufei Græcenfis," from the pen of Nicolaus Poda, publifhed in 1761, affords an account of the infects of Greece, arranged in the Linnæan manner. The fame year an introductory work to the ftudy of infects by J. H. Sulzer, was printed at Zurich: it is in quarto, with a number of plates, and bears the title of "Die Kennzeichen der Infekten durch 24 kupfertafeln erläutert, und mit derfelben natürlichen gefchichte begleitet." The fame writer, in 1776, produced another publication alfo introductory to the fcience of infects, called "Abgekürtze gefchichte der Infecten," illuftrated with thirty-two coloured plates; which latter, with five or fix additional plates, form the hiftorical part of the quarto work publifhed in Switzerland, in 1789, by J. J. Roemer, as an elucidation of the Linnæan and Fabrician fyftems. The title of the latter is "Genera Infectorum Linnæi et Fabricii iconibus illuftrata." The outline of the Fabrician fyftem, which this work contains, is conformable with that propofed in the earlieft work of the laft mentioned entomologift.

As a fyftematic production, the work of Geoffroy, printed at Paris in 1762, demands the particular attention of the modern entomologift. The work is entitled "Hiftoire abrégée des Infectes," and comprifes all the infect tribes in the fix following claffes: 1ft, coleopteres; 2d, hemipteres; 3d, tetraptères à ailes farineufes; 4th, tetrapteres à ailes nues; 5th, dipteres; 6th, apteres. The firft clafs correfponds with the Linnæan coleoptera; the fecond is more accurately regulated by the form of the probofcis; the third agrees with the lepidoptera, having the wings covered with fine powder; the naked-wing tribe unite the neuroptera and hymenoptera; the dipteres and apteres are the fame with the Linnæan orders. It is a material diftinction of this fyftem, that the characters of the orders are determined chiefly by the number of joints in the feet; the generical characters are taken from various parts of the body, wings, &c. The genera differ exceedingly in their conftruction from thofe of Linnæus, and many of them are in ufe to this day among the continental writers.

Brünniche is the author of two entomological tracts, printed about the fame period, as, "Prodromus Infectologiæ Siællandicæ," and an elementary work in Latin and Danifh, called "Entomologia fiftens Infectorum tabulas fyftematicas, cum introductione et iconibus." Sepp began his work, "Befchouwing der wondern gods in de minftgeachte fchepzelen of Nederlandfche Infecten," in the year 1762; it is dedicated entirely to the more uncommon moths and butterflies of Holland; the text is in the Dutch language, and the plates, which are not numerous, are admired for their peculiar neatnefs, being engraven in the dot or ftipple ftyle, with confiderable delicacy.

This elaborate kind of engraving was in great efteem about the period adverted to, as appears from the encomiums beftowed on the plates executed by the hand of Lyonet, for his laborious work, "Traité Anatomique de la Chenille," printed in Holland the fame year. This work of Lyonet is a treatife dedicated folely to the anatomy of the caterpillar, which lives in the wood of the willow, (phalæna coffus,) upon the diffection of which this author enters with fuch minutenefs of inveftigation, that his defcriptions of this object alone occupy rather more than fix hundred quarto pages. The plates, eighteen in number, with the exception of the firft, which reprefents the microfcope employed in his examinations, are entirely appropriated to the reprefentations of the mufcles, tendons, fibres, medullary veffels, fpiracles, &c. every part of which throughout the whole animal are exhibited in their natural and magnified appearance. Thefe plates, as before intimated, are finifhed fpecimens of the ftipple ftyle of engraving then prevalent, and which,

which, from the cloſeneſs of its texture, nearly reſembles mezzotinto.

Lyonet is ſaid to have left at his death two manuſcripts on the ſubject of entomology, neither of which have, to our knowledge, appeared before the world. One of theſe is inſcribed "Œuvres Melées ſur les Inſectes," and contains his obſervations on the inſects found in the environs of the Hague, where he reſided. The other, an "Eſſai Anatomique ſur la Chryſalide et la Phalene qui range le bois de ſaule," a work on the ſame plan, and forming a continuation of the hiſtory of the ſame inſect, as his former eſſay on the caterpillar. This unpubliſhed work on the chryſalis and fly was to be accompanied by no leſs than fifty-four plates, all the drawings of which were executed, and ſome of the plates engraved, previouſly to the death of the author, which happened, at an advanced age, in 1789.

The ſcience derived ſome improvement from the various publications of Schæffer between the years 1764 and 1777. He produced, among others, an elementary work in German, "Zweifel und Schwürigkeiten, welche in der Inſectenlehre annoch vorwalten," and another, entitled "Elementa Entomologica," containing no leſs than 132 plates, appropriated to the illuſtration of the principles of his ſyſtem; and an additional ſection with two more plates, deſcribing the various apparatus for catching, and the manner of feeding inſects, microſcopes for examining them, &c. "Vierter abſchnitt von den Werkzeugen der Bedhandlung und Sammlung der Inſecten." The moſt important of Schæffer's works, is that entitled "Icones Inſectorum circa Ratiſbonam indigenorum," compriſed in three volumes 4to. with a vaſt number of coloured plates, the latter of which poſſeſs a character of great peculiarity in having two impreſſions on every print, one on the front of the leaf as uſual, and the other on the back; by which means the plates are compriſed in half the number of leaves they would otherwiſe occupy. The claſſification of Schæffer differs extremely from that of Linnæus; it approaches that propoſed by Geoffroy, from which, however, it is ſtill ſo far diſtinct, that being a ſyſtem in ſome repute, it may not be amiſs to preſent an outline of it in this place.

Schæffer divides all inſects into ſeven claſſes, in the following manner;

1. Inſecta coleoptero-macroptera, inſects whoſe elytra are cruſtaceous throughout their whole length, and extend beyond the abdomen when cloſed.

2. Inſecta coleoptero-microptera, differ from the former only in having the wing-caſes ſhorter than the abdomen.

3. Inſecta coleoptero-hymenoptera, or hemiptera, ſuch as have the elytra half cruſtaceous, or becoming membranaceous towards their extremity.

4. Inſecta hymeno-lepidoptera, or having wings imbricated with ſcales.

5. Inſecta hymeno-gymnoptera, or with naked and membranaceous wings, comprehending the two Linnæan orders neuroptera and hymenoptera.

6. Inſecta diptera, or inſects having two wings.

7. Inſecta aptera, or without wings.

The ſecond part of "Zoophylacium Gronovianum," by Laur. Theod. Gronovius, contains the deſcription of about ſix hundred inſects with ſynonyms after the Linnæan manner, accompanied by four illuſtrative plates. The work is in folio, and was printed at Leyden in 1764.

Seba, in his ſplendid folio work, "Theſaurus Naturæ," publiſhed at Amſterdam in 1765, deſcribes a number of the larger kinds of extra European inſects, with figures executed with great force, and in a ſtyle correſponding with the other plates of his work.

In 1769, Berkenhout publiſhed the firſt edition of his "Outlines of Natural Hiſtory of Britain;" ſince which time two other editions of the ſame work have appeared. That portion of the work which is devoted to entomology includes a ſmall ſelection of the ſpecies moſt conſpicuous for their ſize, under each of the Linnæan genera, the inſects being arranged throughout in the order of that ſyſtem. The number of inſects deſcribed amount to about ſix hundred. The work is deſtitute of figures.

Among the number of exotic inſects figured in the plates of "The Hiſtory of Birds," and the "Gleanings," by George Edwards, ſome are intereſting from their beauty. There are a few alſo remarkable for their rarity, particularly ſcarabæus atlas, one of the three larger "Indian beetles;" libellula chinenſis, called "the green-winged libellula;" and the larva or pupa of an extraordinary gibbous kind of locuſt, repreſented only, we believe, in this work. Inſects were not ſparingly introduced, notwithſtanding that they were conſidered only as ornamental objects, the work being devoted principally to ornithology. In the courſe of the whole of this voluminous production, more than fifty ſpecies of the inſect tribes are noticed, the greater part of which are butterflies. Edwards began this publication in 1743, from which period it was continued progreſſively till 1764. The catalogue was publiſhed in 1770, and forms part of the tracts entitled "Edwards on Natural Hiſtory."

John Reinhold Forſter, one of the eminent naturaliſts who accompanied the celebrated Capt. Cook in his voyage round the world, has left us a catalogue of Britiſh inſects printed in 1770. It is only a liſt of Latin names of a certain number of ſpecies, and was intended as a prelude to the copious work on the inſects of this country, which its author intended to write. This catalogue, however, and his "Novæ Inſectorum Centuriæ," which appeared in London the year after, are the only entolomogical works that author publiſhed. Of the latter we ought to ſpeak more at large. The avowed purpoſe of this little book, as the reader is informed in the preface, was to give a deſcription of one hundred inſects not mentioned in the lateſt work of the illuſtrious Linnæus. The inſects included are partly indigenous, ſome are from China, and others from South America. The greater number of theſe are coleopterous inſects, and are arranged after the manner of Linnæus, though the genera anthribus and ciſtela are taken from Geoffroy. It may be laſtly obſerved, that although theſe inſects do really appear to be undeſcribed by Linnæus, ſome few of them were previouſly made known to the world by the works of Schæffer and Drury. This its author was aware of, but as they had eſcaped the obſervation of the author, whoſe work he was ſolicitous to improve, it was ſtill conſidered right to introduce them.

The firſt volume of the "Illuſtrations of Natural Hiſtory, wherein are exhibited figures of exotic inſects," &c. by D. Drury, was publiſhed in 1770. The plates, fifty in number, form a miſcellaneous aſſemblage of the more beautiful extra European inſects, which the extenſive collection of its author afforded. The ſecond volume was produced three years after the firſt; and the third, which concludes the work, ſo far as the author proceeded with the publication, appeared in 1782. Beſides the inſects repreſented in theſe volumes, the extenſive cabinet of the author contained many very choice ſpecimens, reſerved as materials for the fourth volume which was in contemplation; and among the reſt, a number of curious ſpecies collected in the interior of Africa, and other countries rarely viſited by Europeans, the introduction of which would have rendered the fourth volume of much greater intereſt to the entomologiſt than either

either of the preceding; this may be collected from the manuſcripts of Mr. Drury, in the poſſeſſion of the writer of this article, and which are now before us. From an inſpection of theſe papers, it likewiſe appears, that the author intended, in a reviſal of his former volumes, to have aſſigned the Fabrician names to all the inſects contained, ſo far as theſe could be obtained, and that for this purpoſe Fabricius had himſelf furniſhed Mr. Drury with a number of names and references, independently of thoſe which had been publiſhed in his "Species Inſectorum," a paper by Sebaſtiani, "Inſecta ad aquas Mattiacas ſuper nive deprehenſa," bears the ſame date with Drury's firſt volume of exotic inſects, and as nearly as we can aſcertain Kahn was about this very period engaged at Berlin in his publication "Anecdoten zur Inſekten-geſchichte," a work written in German, and publiſhed in numbers. The tract of Kahn, relative to the mode of catching and preſerving inſects, called "Kurze anleitung Inſecten zu ſammlen," is dated 1773.

The "Inſtitutions of Entomology," by Thomas Pattinſon Yeats, is the only production of its unfortunate author relative to this ſubject: it is a tranſlation of the Linnæan orders and genera, collated with three other ſyſtems, namely, thoſe of Geoffroy, Schæffer, and Scopoli, together with obſervations by the tranſlator. This was a valuable book at the time of its production. In the preſent day it is become rather obſolete; and it is in particular defective in the compariſon drawn between the Linnæan ſyſtem and that of Scopoli; not from any error of the tranſlator, but an event that could not be anticipated. Scopoli coincided nearly with Linnæus in his arrangement of inſects, when he wrote his "Entomologia Carniolica;" after which, however, he abandoned that method, and adopted another; that which has ſince obtained currency on the continent under the name of "Scopoli's Syſtem." This laſt mentioned work was not printed till four years after the tranſlation by Yeats.

"The Aurelian's Pocket Companion," by Moſes Harris, is a kind of alphabetical catalogue of the larger butterflies, ſphinges, and moths collected in England by its author: a tract of no utility to the naturaliſt, unleſs he firſt condeſcends to become an adept in the jargon of the aurelian, or, as now termed, the entomological ſociety; the inſects being throughout deſignated by the ſilly names impoſed by the few illiterate perſons aſſociated under this denomination. In this Engliſh lexicon of entomology, we have "The Wall," "The Bark," "The Turnpike-gate Keeper," "Ghoſt," "Old Woman," "Diſh-clout," and a vaſt number of others equally capricious and replete with abſurdity.

J. C. Fabricius, the indiſputable founder of a new ſyſtem of entomology, publiſhed in the year 1775, his "Syſtema Entomologica," in which the principles of his novel mode of claſſification is for the firſt time developed. The eſſential characters of the claſſes are determined from the organs of manducation, or mouth (inſtrumenta cibaria). In this work inſects of every deſcription are comprehended in eight claſſes to which the ſeveral names of eleutherata, ulonata, ſyneſtata, agonata, ungonata, gloſſata, rhingota, and antliata, are aſſigned.

This work obtained for its author very high reputation, and ſuch further inducements to the proſecution of his entomological ſtudies, that in the courſe of a few years after ſeveral other works appeared from his pen on the ſame ſubject, among which were his "Species Inſectorum," "Entomologia Syſtematica," &c. in all which his original manner of claſſification was adopted with progreſſive improvement. His "Supplementum Entomologiæ Syſtematicæ," preſents an outline of his ſyſtem in its lateſt ſtate, and is the baſis on which the laſt work in which he was engaged, his "Syſtema Eleutheratorum" was undertaken. Part only of this valuable work has hitherto appeared, its completion being impeded, if not finally interrupted, through the death of the author; but ſo far as he did proceed, the arrangement propoſed in his ſupplement is adopted, and we cannot entertain any other concluſion than that it would have been acceded to throughout. This may hence be admitted as the beſt he had formed in the opinion of its author, and a concluſion, the reſult of ſo much extenſive knowledge in the ſcience as Fabricius poſſeſſed, deſerves our ſerious conſideration.

In this ſyſtem Fabricius diſtributes all inſects into thirteen claſſes, the characters of which are as follow:

Claſs 1. *Eleutherata.* Jaws bare, free, and bearing feelers.

2. *Ulonata.* Jaws covered by an obtuſe mouth-piece

3. *Syniſtata.* Jaws elbowed near the baſe, and connected to the lower lip.

4. *Piezata.* Jaws horny, compreſſed, and uſually elongated.

5. *Odonata.* Jaws horny, dentated; palpi two.

6. *Mitoſata.* Jaws horny, vaulted; no palpi.

7. *Unogatæ.* Jaws horny, unguiculated.

8. *Polygnata.* Jaws ſeveral (uſually two) within the lip.

9. *Kleiſtagnatha.* Jaws ſeveral, outſide the lip.

10. *Exochnata.* Jaws ſeveral, outſide the lip, and covered by the palpi.

11. *Gloſſata.* Mouth compoſed of a ſpiral tongue, ſituated between two palpi.

12. *Rhyngota.* Mouth compoſed of a beak or articulated ſheath.

13. *Antliata.* Mouth compoſed of a ſucker, not articulated.

This able entomologiſt is the author of various tracts on entomology, written in the Latin and German languages; and alſo of two principal introductory works, "Genera Inſectorum," and "Philoſophia Entomologia."

The inſects of Switzerland are deſcribed by J. C. Fueſſlin, in an intereſting little work, to which its author gives the title "Verzeichnis der ihm bekannten Schweitzerſchen Inſeckten," printed at Zurich, and bearing the ſame date (1775) with the Fabrician "Syſtema Entomologica."

The number of inſects figured in the "New Illuſtrations of Zoology," by Peter Brown, in 1776, is by no means conſiderable; ſome few of which it does contain are nevertheleſs ſufficiemtly important in point of rarity to deſerve explicit mention. The purple-winged locuſt is, in particular, a magnificent inſect: at the time this artiſt made his drawing, the ſpecimen, which is preſumed to be unique, was in the poſſeſſion of Mr. Tunſtal; at preſent it enriches the ſplendid collection of Mr. Macleay. The work of Stoll, it ſhould be obſerved, affords likewiſe a figure of this ſpecies, and which, it is believed, was taken from the ſame ſpecimen previouſly to its being purchaſed in Holland for Mr. Tunſtal.

The extenſive ſyſtematic work of J. A. E. Goeze, called "Entomologiſche beyträge zu des Ritter Linné zwölften aufgabe des Natur ſyſtems," began to be publiſhed at Leipſic in 1777, and was continued progreſſively in parts till 1783. In the ſame year, with the commencement of this publicaton, Eſper produced in Germany the firſt part of his uſeful book on the lepidopterous tribe of inſects, "Die Schmetterling in Abbildung nach der natur mit beſchreibungen," a work with many plates, and of which a ſecond part was publiſhed in 1779. Between that time and 1786 two other parts appeared likewiſe, and which altogether form a very a very extenfive publication. Two other very coftly works, devoted exclufively to this beautiful order of infects, were alfo begun in 1779, one at Paris in the French language; the other in Holland, and in the language of that country: the firft of thefe is entirely appropriated to the infects of Europe, and is named "Papillons d'Europe, peints d'après nature;" the latter is by Pieter Cramer, and confifts of the extra European fpecies. The title of this work is, "De uit landfche kapellen, voorkomende in de drie waereld deelen Afia, Africa, en America," and including the continuation publifhed about the year 1782, confifts of four volumes quarto, with many plates. The production of thefe expenfive works fufficiently demonftrates the encouragement beftowed on the fubject of entomology upon the continent of Europe.

An elementary work by James Barbut, bearing the title of "The Genera Infectorum of Linnæus, exemplified by various fpecimens of Englifh Infects," was publifhed in London in 1781; and which, befides the text, contains altogether about twenty-two plates, two of which are explanatory, and the reft comprehend indifferent figures of a fmall number of fpecies in each genera. As an illuftration of the Linnæan fyftem, this work may be in fome refpects ufeful to the Englifh reader: its views are too limited to admit of more general utility. The author does not feem to be aware of the improvements the fcience had undergone upon the continent, in the interval between the publication of the "Genera Infectorum" of Linnæus, and the time in which he wrote, and has not therefore drawn thofe comparifons between them, which, without innovation on either, could not fail to have placed the fcience in a more lucid point of view. It is, indeed, to the filence of Englifh writers in this refpect, generally arifing either from the want of information, from fentiments of illiberality, or from negligence, that we muft afcribe the very low ftate of entomological knowledge in Britain, even to the prefent period. Francifcus de Paula Schrank diftinguifhed himfelf by his enumeration of the infects of Auftria in 1781, written in Latin, "Enumeratio Infectorum Auftriæ indigenorum," afterwards rendered into German by Fuefsly. The fame year John Nepomuk von Laicharting publifhed at Zurich his catalogue of the infects of the Tyrol, "Verzeichnifs und befchreibung der Tyroler Infecten," a fecond part of which appeared in 1784. Laicharting adopts a fyftem fomewhat different from that of Linnæus; he divides infects into ten claffes, characterized from various parts of the body. His claffes are fcarabæides, grylloïdes, cimicoïdes, papilionoïdes, libelluloïdes, vefpoïdes, mufcoïdes, cancroïdes, aranoïdes, and onifcoïdes. In 1782, a paper by Morand was publifhed in the Tranfactions of the Paris Academy, entitled "Memoire fur les vers de Truffes, et fur les mouches qui en proviennent." A fmall octavo by J. S. Semler, in the German language, bears the fame date, and is worthy of attention, "Verfuch eines Diarium über die Œconomie mancher Infecten im Winter," and there is befides this another more extenfive book printed in 1783, relative to the aphides, called "Nachlefe zur Bonnetifchen Infektologie." A catalogue of lepidopteræ, written by Lang in the German language, came out in the fame year. And, laftly, a "Short hiftory of the brown tail Moth," by W. Curtis. The caterpillars of this moth, it may be recollected by many readers, appeared in fuch immenfe fwarms in the fields furrounding London during the fummer of 1782, and from their ravages defpoiled fo many trees of their foliage, as to create very ferious apprehenfions of approaching deftruction to the whole vegetable tribe. The object of this pamphlet was to prove that graminiferous plants, not being the natural food of thefe voracious vermin, would efcape their attack. This circumftance alone will ferve to teftify, that fome benefit at leaft may refult from an acquaintance with the fcience of infects. Its author was by this means enabled to difpel the uneafinefs occafioned through the appearance of thefe fuppofed minifters of famine; and which prevailed to fuch an alarming extent throughout the whole population of this vaft metropolis, that prayers were ordered to be read in all the churches to avert the impending calamity.

An elementary work by J. A. B. Bergftræffer, a fmall octavo, entitled "Entomologia, fcholarum in ufus concinnata," was publifhed in 1784; this author had previoufly diftinguifhed himfelf by his German work, entitled "Nomenclatur und befchreibung der Infecten in der Grafschaft Hanau-Müntzenberg," &c.

The entomological tracts publifhed about this period, and rather earlier by Thunberg, contributed to promote this fcience; his differtations, named "Novæ Infectorum," of which feveral appeared between 1781, and ten years after; and alfo his "Differtatio fiftens Infecta Suecica," the firft of which occurs in 1784, are interefting. The relation of his travels to the Eaft abounds with information refpecting natural hiftory, and relates in fome degree to entomology; and he alfo produced a curious memoir on the paufus genus, called "Befkrinfning poa tuänne nya Infecter," befides other tracts in the Swedifh and Latin languages.

Retzius, in 1783, produced his "Genera et Species Infectorum," in which the method of Degeer is fimplified, and the Linnæan terminology adapted to that performance. Infects, according to this fyftem, are divided into fourteen claffes; namely, lepidoptera, alinguia, neuroptera, hymenoptera, fiphonata, dermaptera, hemiptera, coleoptera, halterata, probofcidea, fuctoria, ancenata, atrachelia, and cruftacea.

Harrer wrote on the infects of Germany, in a fmall book printed in 1784. The year after Jablonfky began the important fyftematical work, called "Natur fyftem aller bekannter in-und aufländifchen Infecken," printed at Berlin; about the fame time Fourcroy publifhed his catalogue of the infects found in the neighbourhood of Paris in Latin, under the title of "Entomologia Parifienfis;" and another illuftration of the elements of entomology, written in German, appeared at Leipfic from the pen of Schmiedlein. Some African infects, that inhabit the Cape of Good Hope, were defcribed in 1786 by Xavier Walfen; and two publications on the lepidopteræ of Germany, and both written in the language of that country, came out in the fame year, one by W. Gefenius, the other bearing the title of "Beitrage zur gefchichte der Schmetterlinge," and printed at Augfburg, is by Hübner.

The infects of Naples are defcribed by Dominicus Cyrillus in a folio work publifhed in 1787, called "Entomologiæ Neapolitanæ." A curious and ufeful little tract on the oeftrus, or gad-fly genus, was the fame year printed at Leipfic by J. S. Fifcher under the title of "Obfervationes de Œftrovino atque bovino factæ," to which a copious appendix was annexed in 1788. The cochineal infects difcovered at Madras fome few years before, gave rife to a feries of letters on this important fubject, by James Anderfon, addreffed from Madras to fir Jofeph Banks, fourteen of which were printed together in that country in the year 1788; there are, befides thefe, two other letters which have been publifhed fince, alfo a feparate publication by the fame author, containing an account of the importation of American cochineal infects into Hindooftan. Swederus, in 1788, publifhed a monograph on that curious coleopterous genus

cerapterus,

cerapterus, in a memoir entitled " Beſkrifning poa elt nytt genus ibland inſecterna, hörande til Coleoptera."

The ſcience of entomology obtained ſome further advantages about this period, from the publication of the enlarged edition of the Linnæan " Syſtema Naturæ," by J. F. Gmelin; not from poſſeſſing in itſelf any peculiar merit, but becauſe as a general, and therefore uſeful work, it combines much valuable information, compiled from the labours of various naturaliſts of the firſt conſequence ſince the time of Linnæus. In the entomological part, conſiſting of three volumes, publiſhed at Leipſic in 1788, the editor is conſiderably indebted to the writings of Fabricius; for although he rejects his mode of claſſification, his orders, and moſt of his genera, he has copied no inconſiderable portion of his new ſpecies, and by that means very materially augmented and improved the original work of Linnæus. Beſides this, the pleaſing works of Stoll contributed about this time to facilitate the ſtudy of the hemipterous order of inſects, from affording figures of many extraordinary ſpecies of the locuſt, fulgora, cicada, cimex, and other tribes, extant in the various continental cabinets at that time, and, among others, that of the prince of Orange. His firſt work is called " Natuurlykye af beeldingen en beſchryvingen der Cicaden in alle vier waerelds deelen." The two publiſhed ſince are only a continuation, including other genera beſides the cicadæ, as the locuſtæ, phaſmæ, &c. Theſe works were printed at Amſterdam. The work of M. B. Borkhauſen, written in the German language, relates entirely to European inſects of the lepidoptera kind, and bears the title of " Naturgeſchichte der Europaiſchen Schmetterlinge nach Syſtematiſcher ordnung." The firſt part appeared at Franckfort in 1788; and ſince that time the work has been conſiderably extended. The article entomology, inſerted in Hall's Encyclopædia, as it appeared originally in 1788, was written by Marſham, and is exemplified by three plates; and about the ſame time, Roemer publiſhed in Switzerland his " Genera Inſectorum Linnæi et Fabricii iconibus illuſtrata," including thirty-ſeven explanatory plates, nearly all of which, however, had previouſly conſtituted the work of Sulzer.

Immediately after this, the publication of one of the moſt voluminous works on entomology that has been attempted was undertaken at Paris, by G. A. Olivier. Its title is conciſely " Entomologie, ou Hiſtoire naturelle des Inſectes;" from which we may infer, that its author propoſed to have treated on every claſs and order, and, in conformity with the firſt part, to have accompanied the whole with figures. Several faſciculi or numbers were publiſhed, amounting altogether to about three volumes; the whole of which are confined to the order coleoptera, and that even remains very incomplete. So far as it does proceed, the work is valuable. Olivier is the author of ſeveral other entomological writings. In the " Journal d'Hiſtoire Naturelle," he has a memoir, " Sur l'Utilité de l'etude des Inſectes, relativement à l'Agriculture et aux Arts." He is alſo the propoſer of a methodical diviſion of inſects, in the " Dictionnaire Entomologique." According to this plan, inſects are to be divided into four parts, namely, 1. Inſects with four wings; 2. Inſects with two wings and two wing-caſes; 3. Inſects with two wings; 4. Inſects without wings in either ſex. Theſe are ſubdivided into eight orders, the characters of which are taken from the mouth.

The inſects of Europe were further deſcribed by C. de Villers, in a ſmall work publiſhed at Lyons, in 1789, under the title of " Linnæi Entomologia," &c.; in which he profeſſes to avail himſelf of the works of Scopoli, Geoffroy, Degeer, Fabricius, and others. Paykull was at this time engaged alſo upon the inſects of Sweden, at leaſt on the coleopteræ; and this year he publiſhed his " Monagraphia Staphylinorum Sueciæ;" and which, a while after, was ſucceeded by two other tracts on the curculiones and the carabi, " Monagraphia Curculionum Sueciæ," and " Monagraphia Caraborum Sueciæ." But the moſt extenſive of the works of Paykull is his " Fauna Suecica," in three octavo volumes, printed at Upſal in 1799.

In the " Journal für die Entomologie," the name of Meyer occurs as the author of ſome remarks on the melolontha. Preyler, in the year 1790, publiſhed at Prague a " Verzeichniſs," or catalogue of the inſects of Bohemia. Quenſel is the author of a tract on the papilio, entitled, " Beſkrifningar öfer 8 nya Suenſka Dagfjärillar;" and alſo of another on noctua pruni, " Beſkrifning öfver en y Nattfjäril."

The firſt part of a conſiderable work, " The Natural Hiſtory of Britiſh Inſects by E. Donovan," appeared in the early part of the year 1792; and having obtained a favourable reception, has been continued in a courſe of monthly numbers from that period to the preſent time (1809). The deſign of this undertaking is to afford ſcientific and general deſcriptions, accompanied by appropriate coloured figures of every inſect diſcovered in this country; and ſo far as that deſirable object could be accompliſhed, in all their various ſtates of transformation. In its preſent form, the work conſiſts of fifteen volumes; the number of plates exceed 500, and theſe include an extenſive variety of ſpecies. Without incurring the charge of preſumption, the writer of this article believes he may be allowed to obſerve that the preſent conſtitutes the moſt copious work of its kind that has hitherto, or probably ever may be undertaken, as an elucidation of the entomology of Britain.

The inſects of Germany afforded materials for another entomological work of a local nature, commenced by Dr. G. W. F. Panzer, in 1793, under the title of " Faunæ Inſectorum Initia, oder Deutſchlands Inſecten;" and this was ſhortly after ſucceeded by his " Entomologia Germanica," &c.; both which are written in German and Latin, and are illuſtrated by plates. Dr. Smith's " Tour on the Continent in 1786-7," was publiſhed alſo in 1793; and this claims our particular mention, as it will be found to contain ſome curious obſervations reſpecting the inſects of the countries he viſited. About the ſame time, a French edition of Fueſsly's " Archiv der Inſektengeſchichte" made its appearance in quarto, with the original plates.

A valuable ſyſtematic paper, propoſing " a new arrangement of the papilios" by Mr. William Jones, occurs in the ſecond volume of the Tranſactions of the Linnæan Society, printed at London in 1794. The object of this communication is to point out, that the ſhape of the wings, which form a principal character with Linnæus in his diſtribution of this genus into families, though various at the firſt view, approach each other ſo gradually, that it is impoſſible to draw from them the diſtinguiſhing line between each family. The number of ſpecies known to Linnæus are eſtimated at rather more than 274, whereas the writer obſerves he had ſeen above 1000 in various cabinets, and about 400 more repreſented in various publications; and from an attentive examination of theſe is induced to offer the following amendments to the characters of each family, as defined by Linnæus. The latter author deſcribes the *Equites* as having " the upper wings longer from the poſterior angle to the point than to the baſe; and the antennæ often filiform:" this is corrected by ſaying, " the upper wings are longer from the poſterior angle to the point than to the baſe, occaſioned by having four nerves inſtead of three, viſible in every other family. The palpi frequently only a brush; under wings, with a connecting nerve in the centre, and without an abdominal groove."—*Heliconii.* "Wings narrow, entire, often naked, or deprived of scales; the upper wings long, the inferior short." Linn. To this character is added, that the upper wings have "a connecting nerve in the centre, very slightly grooved to admit the abdomen, which is in general long, as are also the antennæ."—*Danai.* "Wings entire." Linn. Addition: "the under with a connecting nerve in the centre, and a deep abdominal groove; palpi projecting."—*Nymphales.* "Wings denticulated." Linn. Addition: "the under without a connecting nerve in the centre, and with a deep abdominal groove; palpi projected."—*Plebeii.* "Small, rurales; spots on the wings obscure." Linn. Addition: "thorax and abdomen slender; under wings without a connecting nerve; antennæ clubbed:" and these are divided into two sections, those with long, weak, flexible tails; and those without tails, and having the wings entire.—*Plebeii urbicolæ.* "Spots on the wings for the most part transparent." Linn. These Mr. Jones divides into three families, according to the following character. * Thorax and abdomen short, thick, or broad; under wings without a connecting nerve; antennæ uncinated, or crooked at the extremity. ** With upper wings pointed at the extremity, and long in proportion to their width. *** Upper wings less extended, and together with their under wings more rotund; their margins entire. There still remain some papiliones, which do not rank with any division above mentioned: these are generally of a large size, without an abdominal groove; have no connecting nerve; their antennæ generally acuminated; and the veins of both upper and under wings extending from their root to the extremity nearly in straight lines. The author of this paper constitutes these as a new family, under the name of romani.

We ought not to dismiss our abstract of the above paper, without observing that, from the great attention bestowed on the papiliones by Mr. Jones, his opinion is of unquestionable authority. The species, which it is intimated the writer has seen in various cabinets to the amount of 1000, or perhaps more, have not to our own knowledge been observed merely: Mr. Jones has taken the trouble, for the gratification of himself and his scientific friends, to paint every species, and that in a very correct and elegant manner. The collection of drawings thus formed affords an unparalleled display of this beautiful tribe of insects.

In 1795, "The Papilios of Great Britain," a quarto work with plates, by William Lewin, was published in London. Whether it was the intention of the author to have proceeded further with this publication is uncertain: it finally terminated with the completion of the butterflies. About the same period the coleopterous insects of Sweden were published in the language of that country, by D. E. Naezén, some part of whose works had, however, been produced to the public before that period. His books (for there are two) are entitled "Beskrifning poa noagra, vid Umeoa fundene okände arter ibland Skalbaggarne," and "Beskrifning poa noagra vid Umeoa fundne Insecter, dels okande, dels foorut otydeligen bemarkte ochi Fauna Suecica ej uptagne." A Latin tract, printed in 1795, by D. H. Hoppe, contains an enumeration of the coleopterous insects found in the invirons of Erlang, in Franconia; and in the same year, Latreille published his work, entitled, "Precis du Charactére des Genres." In this last-mentioned work, insects are divided into two principal classes, namely, those with wings, and those without wings. The orders are coleopterès, orthopterès, hémipterès, neuropteres, lépidoptères, suceurs, thysanoures, parasites, acéphales, entomostracés, crustacés, and myriapodes. An arrangement of the insect tribes, in a manner somewhat different, occurs in "Tableau Methodique des Insectes," by the same author. An important paper on the oestrus genus, by B. Clark, inserted in the third volume of the Linnæan Society Transactions, is duly noticed under the article Bot. The last production we have to mention in the present year is a small tract, accompanied by a coloured figure of an extremely beautiful and singularly formed beetle, in the cabinet of Mr. Francillon; a species of scarabæus, having the posterior legs remarkable both for their length and thickness, and hence denominated the kangaroo beetle (scarabæus macropus). The insect is presumed to be a native of Potosi, in South America.

The second volume of "Catalogus Bibliothecæ Historico Naturalis, Josephi Banks baroneti," &c. by J. Dryander, comprehending the entomological works of that invaluable library, issued from the press in 1796. From the classic manner in which each production is arranged in an appropriate department, according to its leading character, this work must be considered as forming in itself a valuable bibliothecal system of entomological writers. As an assemblage of references, we cannot speak too highly of its contents.

"The Natural History of the rarer Lepidopterous Insects of Georgia," in North America, forms a pleasing accession to our knowledge of those particular species which it is the object of this work to elucidate. The number of insects contained in the two costly volumes, of which the work consists, amounts to about one hundred. These constitute an ample selection of the larger kinds of the butterfly, sphinx, and moth tribes, peculiar to that region. Each insect is represented with its larva, pupa, and an example of one of the plants on which it is known to subsist. This work is written by Dr. J. E. Smith, from a series of notes and drawings made by Mr. Abbot, an assiduous collector in North America; and besides combining the practical information derived from the latter source, is rendered valuable by the numerous additional observations of the author. This work appeared in 1797.

Clairville, the author of a work on the insects of Switzerland, published in 1798, proposes to divide insects into eight orders, somewhat after the manner of Linnæus, but to distinguish them under other names, and to denominate them classes instead of orders. The names he proposes are elytropteres, dictyopterès, thlebopteres, halterepteres, lepidopteres, hémiménoptères, rophoptères, and pododunères.

In the same year with the preceding, "Donovan's Natural History of the Insects of China" appeared in London. This is the only work dedicated to the display of the entomological productions of that vast empire that has been published. The materials which constitute the basis of this volume, and from which it was in a great measure composed, were obtained from the first and most authentic sources; including examples of the insects collected at the time of the embassy of lord Macartney, in addition to many others obtained from various cabinets of the highest celebrity, and the communications of friends. The work is embellished with fifty coloured plates. A translation of this publication has appeared on the continent in the French, and another in the German language.

The year 1800 was productive of several valuable works on the subject of entomology; in Sweden, Paykull this year published his "Fauna Suecica," a much admired publication, in three volumes octavo. Cuvier, with the assistance of

Duméril,

Dumèril, brought forward in Paris his celebrated "Anatomie Comparée," a work which, however ill fuited to the philofophic tafte of our own country, is a production of very extraordinary merit. The organization of the various tribes of infects is treated at great length in the lectures relating to invertebral animals. This work affords us alfo a new fyftematical arrangement, in which all infects are divided into two principal fections; thofe with jaws, and thofe without jaws. In the firft of thefe orders are comprehended the gnathaptères, neuroptères, hymenopteres, coleopteres, and orthopteres; the fecond, confifting of fuch as are deftitute of jaws, are, hemipteres, lepidopteres, dipteres, and apteres. The fifth volume of "Bibl. Hift. Nat. Bankfiana," the addenda of which contains fome further mention of entomological writers, was alfo publifhed in 1800. The laft work that appeared in the prefent year was "Donovan's Infects of India," a publication correfponding in fize, and ftyle of embellifhment, with the "Infects of China," and, like that work, embracing in a general, though fcientific view, a comprehenfive difplay of the more curious, rare, and fplendid fpecies peculiar to thofe fertile regions, the entomology of which it is defigned to explain. This work, as in the former inftance, is conftituted from the firft fources of original information. The more immediate intention is the elucidation of the entomological production of the Britifh poffeffions in India; but it contains alfo a variety of infects of the more beautiful kinds difcovered in the interior of that vaft continent, and in the iflands fituated in the Indian feas.

Lamarck's "Syftême des Animaux fans Vertèbres," printed at Paris in the 9th year of the revolution (1801), prefents a new mode of arrangement for infects. Thefe its author propofes to divide into three primary claffes; namely, 1ft, thofe with mandibles and jaws; 2d, thofe with mandibles and a kind of trunk; 3d, thofe without mandibles, but having a trunk or fucker. The firft of thefe claffes contains the coleopteres, orthopteres, and neuropteres; the fecond is confined to the fingle order hymenopteres; and the third includes the lepidopteres, hemipteres, dipteres, and apteres. The coleopteræ are fub-divided into three families, according to the number of joints in the feet, as thofe with five joints in all the feet; thofe with five joints in each the four anterior feet, and four in thofe of the pofterior pair; and thofe with only three jcints in all the feet. Moft of the Linnæan aptera are removed to another clafs preceding the infect tribe; the only Linnæan genus of aptera, admitted by Lamarck into his order apteres, is the pulex.

The publication of "Marfham's Entomologia Britannica" commenced in the year 1802, with the production of the volume in which the coleopteræ are defcribed. As the outline of the arrangement adopted by this author is ftrictly Linnæan, thofe after the manner of that naturalift conftitute the firft feries, and are to be fucceeded progreffively by the hemiptera, lepidoptera, and other remaining tribes. For the purpofe of this continuation very ample materials are provided. Mr. Marfham, whofe abilities as an entomologift are well known, has devoted many years of his life to this laudable object: his collection of Britifh infects is of the firft clafs, and his manufcripts of the moft valuable kind. The completion of this work muft be therefore anticipated as a defirable event. The merit of the firft volume is acknowledged, and fhould the future part appear with correfponding excellence, we could not hefitate in pronouncing it one of the moft important works of its kind that has appeared.

Kirby's "Apum Angliæ" was alfo printed in 1802. This work contains much curious information relative to the bees of this country; a path of entomology in which its ingenious author has trod with great fuccefs. The Linnæan genus apis Mr. Kirby conceives it neceffary to divide into two genera, to one of which he retained the original name, the other he terms melitta, and under both genera he defcribes many fpecies, fome of which are noticed for the firft time in this interefting work. Latreille, who has written on the Linnæan genus apis, and is efteemed an entomologift of ability, pronounces this "un bon travail." The ninth volume of the Tranfactions of the Linnæan Society contains an ingenious paper on the apian genus of Herbft by Kirby; and there are alfo two or three other papers difperfed in thofe volumes, by the fame writer, well deferving of attention.

The contents of the fecond and third volumes of Turton's tranflation of the Linnæan "Syftema Naturæ a Gmelin," relate entirely to entomology This work deferves further obfervation. The editor does not, in treating of infects, confine himfelf to the direct tranflation of his author; he introduces fome commendable improvements in the arrangement after the Fabrician manner; and he befides incorporates from other entomological works of credit, publifhed fince the time of Gmelin, whatever prominent traits of information he conceived calculated to amend the original work. We may eafily perceive that Dr. Turton has availed himfelf of the Fabrician "Entomologia Syftematica" to a greater extent than Gmelin, and has by this means rendered more effential fervice to the Englifh reader.

The pages of "Donovan's Tour through South Wales and Monmouthfhire," lately publifhed, are interfperfed with obfervations on the various natural productions of the interefting tract of country immediately under confideration. Thofe digreffions, from objects of more general moment, if fuch the reader be inclined to deem them, we at leaft may prefume to think important; and fo far as thefe relate to the fcience of entomology in particular, conceive they may, without impropriety, be adverted to in this place.

"Donovan's Infects of New Holland," including alfo thofe of New Zealand, New Guinea, and the feveral iflands in the Great Southern and Pacific ocean: this accords with the "Infects of India," already mentioned, being in quarto, with fcientific and general defcriptions, and in having the fimilar accompaniments of accurately coloured plates. Of this work it will be alone fufficient to obferve, that through the diftinguifhed favour beftowed on the defign, the author was allowed to enrich his volume with delineations of thofe uncommon infects collected during the voyage of captain Cook, by thofe celebrated naturalifts who accompanied that circumnavigator round the world, and which appear for the firft time in this work.

The fixth volume of "Shaw's General Zoology" is offered as an illuftration of the fcience of entomology. The work profeffes only to elucidate the Linnæan genera of infects, with the hiftory of the principal fpecies. This being the intention of its ingenious author, the work is comprized in a very moderate compafs. The plates are rather numerous, and in general remarkable for the neatnefs of engraving. Thefe, however, are not original, being compiled from the plates of Seba, Rofel, Swammerdam, Barbut, and others. The "Naturalift's Mifcellany" contains a variety of coloured figures of the more fplendid kinds of exotic infects, with defcriptions extremely fuitable to the general clafs of readers, for whofe purpofe they are defigned.

Laftly, we ought to mention the work of Coquebert, entitled "Illuftratio iconographia," recently publifhed in France: the late entomological tracts of Olivier and La-

treille,

treille, the "Faune Parifienne" of Walcknaer, and the papers on different tribes of infects inferted in the Tranfactions of the Linnæan Society of London; the Societé d'Hiftoire Naturelle of Paris, and thofe of various other learned inftitutions, through the medium of which they are diftributed to public obfervation.

Our review of entomological writings is at length drawn to conclufion. In its progrefs we have endeavoured to include every work of importance in this department of fcience, that has appeared. To what has been advanced refpecting thefe, nothing material can be added in this place; it was our aim, throughout the prefent inquiry, to point out the leading character of each work, while paffing under immediate confideration, and for this reafon we fhall abftain from offering any general comments. By connecting the whole in the order of time in which they were produced, our object has been to fhow at one glance, fo far at leaft as our flight comparifons would permit, thofe effential refpects in which each has materially improved upon his predeceffor; and by that means mark the progreffive advancement made in the fcience with fome precifion. We fhall finally difmifs this part of our fubject with obferving, that it is poffible fome few works of real worth may have efcaped our mention; the number of thefe, however, we are perfuaded, muft be very inconfiderable, and confined to fuch as have recently appeared in countries remote from Britain.

Claffification.

It will be obferved, from the preceding obfervations, that naturalifts entertain very diftinct opinions as to the principles on which the claffification of infects ought to be founded. This diverfity of idea arifes from the different views under which they have been confidered. Valifneri divides infects into four claffes, according to the places in which they live, as plants, in water, in the earth, or upon the bodies of other animals. Agricola into three, namely, thofe which walk, fly, and fwim; Frenzius, into flying infects, aquatic infects, and terreftrial or creeping infects. Swammerdam diftributes them into claffes from their appearance in the ftates preceding their final transformation, without particular regard to the laft or complete ftate. In this refpect Swammerdam is followed by Ray, whofe two primary claffes are, of thofe which undergo transformation, and thofe which do not; and his orders are determined from their metamorphofes, and the number of their feet. Lifter has given a fyftem founded on the figure of the egg in which the infect is inclofed, and the number of the feet. The difference obfervable in the texture, and alfo in the number of the wings, form the diftinctions of the primary divifions of Linnæus. And laftly, the principal characters upon which infects are diftributed, in the arrangement of Fabricius, is taken from the ftructure of the mouth. Each of the fyftems founded on thofe diffimilar characters have gained admirers. The characters of the Linnæan and Fabrician fyftems appear the beft, and are moft univerfally approved.

General obfervations on Infects.

Infects are a race of animals deftitute of internal bones, in which refpect they accord with a very extenfive number of natural families in the lower orders of animated beings. Their bodies are kept in a ftate of moifture by the circulation of lymphatic tranfparent juices inftead of red blood, and in this particular agree with the worm tribe. They have no diftinct heart, external ears, openings at the nofe, or noftrils, nor teeth in the mouth; and fome affert that they are deftitute of voice. An infect is divided into fegments, or joints, and covered externally with a tough or bony fkin, which is either naked or clothed with down. The head is furnifhed with moveable antennæ, and the body with feet.

Thefe animals are deftitute of vifible external organs of breathing at the mouth, their refpiration is performed through the lateral apertures, or fpiracles of the body and thorax.

They have two eyes, in which refpect they agree with the larger tribe of animals: they have no eyelids, and their eyes are rarely placed on a pedicle; the diopfis is an exception.

The antennæ are fituated on the head before the eyes; and are compofed of an indefinite number of articulations; in genuine infects, the antennæ never exceed two. The cancri have a greater number, and many of the Linnæan apteræ have none.

The feelers are articulated, moveable, variable in number from two to fix, and are affixed contiguous to the mouth.

The mouth is ufually fituated beneath the head.

The jaws are difpofed tranfverfely in the head, and move laterally, by which means they are diftinguifhed from moft other animals.

The trunk is placed between the head and the abdomen.

The abdomen is ufually annulated with five fegments, and is fometimes armed at the end with a fting.

The legs are ufually fix in number, and are attached to the trunk. Each leg confifts of three diftinct divifions, the thigh, fhank, and feet.

The wings are either two or four; fome of thofe with two wings only are protected by a fhelly covering, as in the coleopteræ.

Infects are oviparous; depofit their eggs in an impregnated ftate in general, and do not brood over them, or their young. Moft infects undergo a triple transformation, the egg producing a grub or larva, which becomes, when full grown, a pupa, and the later producing the perfect fly. The fexes are male and female; there are alfo neuters in fome fpecies devoted to labour for the former. Infects caft their fkins, and therein agree with reptiles. They are faid to inhabit thofe plants on which they ufually feed.

Defcription of the component parts of Infects.

The external parts of which infects confift are divided into four principal fections, the head, trunk, abdomen, and members, each of which require to be feparately confidered.

Caput, or *Head.*—Under this term is included the firft, or principal organ, the head, properly fo denominated in its collective form. This part is fuppofed to be the principal feat of the fenfes, as in all others of the larger and apparently more perfect animals. Internally it contains the medullary fubftance or brain; its exterior characters are, the mouth, eyes, ftemmata, antennæ, front, vertex, and throat.

In fome infects the head is very large in comparifon with their body. The proportion between the head and body is not the fame in all infects, even in the different ftages of growth or transformation. In the caterpillars, which have this part horny, it is generally fmall before they moult, or change their fkin, and becomes larger after each moulting.

This part is almoft conftantly diftinct from the thorax: in the coleoptera it is connected clofe to the latter: the hemiptera offer many examples in which the head is flightly attached, as in the genera blatta, acheta, phafma, mantis, &c.: in the lepidoptera order the head is not always very intimately fituated to the thorax; there is a fmall interval fometimes between which the articulation of the neck may be feen,

feen, when the head is inclined downward. The fucceeding order, neuroptera, afford numberlefs inftances of the head being placed upon a flender ligamentous pedicle at a diftance from the thorax : in hymenoptera and diptera the head is rather remote, fometimes being placed on a fmall tubercle in the anterior part of the thorax ; and in the laft, or apterous order of Linnæan infects, feveral of the genera are diftinguifhed by having the head and thorax confounded with each other, as in fcorpio, aranea, monoculus, &c.

The connection between the head and thorax in infects fubfifts by one of two modes of articulation ; the firft, in which the point of contact is folid, and the motion depends upon the fhape of this part, or another in which the articulation is formed by a ligament. In the articulation of the head by the contact of the folid parts, the head has commonly, at the part anfwering to the neck, one or two fmooth tubercles, which are received into correfpondent cavities on the anterior part of the thorax. This is exemplified in the genera fcarabæus, lucanus, cerambyx, and moft other coleoptera, and which hence have the power of moving the head backward or forward, and thus of directing the mouth downward. Another mode of folid articulation takes place when the pofterior part of the head is rounded, and turns on its axis in a correfpondent focket on the anterior part of the thorax, as in the brentus, &c. The axis of motion is then in the centre of the joint, and the mouth of the infect can be directed either upward or downward, or to the right and left. A third fort of articulation occurs when the head is truncated behind, and joins by a flat furface either to a tubercle of the thorax or to another flat and correfponding furface, as is feen in many of the hymenoptera and diptera. In fome kinds of the Fabrician attelabi, this folid articulation is accomplifhed by another means : the head of thefe infects terminate behind in a round tubercle, which is received into a correfpondent cavity of the thorax : the inferior edge of this cavity is notched, and thus confines the motion of the head to one direction.

The ligamentous connection of the head and thorax is fhewn in the blatta, forficula, mantis, and feveral of the neuroptera. In this mode of articulation, the motion of the head is very extenfive, and confined only towards the back, in which direction it is oppofed by the projection of the back. The mufcles which move the head are fituated within the thorax : the membranes or ligaments extend from the anterior part of the collar to the furface of the occipital foramen.

Brain, or Medullary Subftance.—According to the " Fundamenta Entomologiæ," it was the idea of Linnæus, that infects have no brain in the head ; an opinion often repeated fince his time, but which, from the obfervations of the ableft phyfiologifts of the prefent period, proves to be unfounded. Linnæus does not deny the exiftence of a medullary thread in this part of infects, but ftates that he never could difcover it to be organifed; and hence, he fays, the hippobofca equina, or horfe-fly, will run, live, nay even form an union with the oppofite fex, after being deprived of its head, to fay nothing of many others, which are capable of living for a confiderable while in a decapitated condition. From the anatomical inveftigations of Cuvier it is, neverthelefs, fufficiently obvious, that independently of a nervous medullary thread, infects have a brain diftinctly organifed, from which this thread and other nerves arife, and that its feat is in the head, as in the more noble tribe of animals. The exiftence of a true brain in infects was believed by many writers before the time of Linnæus, and by fome after ; but, generally fpeaking, the opinion of this celebrated naturalift was affented to, and enquiry ceafed, till its confideration was revived by Fabricius, and the phyfiologifts of France, the moft diftinguifhed of whom is Cuvier, and from the refult of their obfervations it may be affirmed, that infects, as well as moft other animals, have a genuine brain.

Fabricius is reputed to be the firft who difcovered the true brain in infects. That Fabricius affirms the fact, and that as an entomologift his affertion was fuccefsfully oppofed to the opinion of Linnæus in this refpect, is not to be denied, yet the merit of difcovery is by no means due to this writer. His obfervations on the brain, the organs of hearing, and other fenfations of infects, were made chiefly on the lobfter or cray-fifh, animals of the cruftaceous kind, and which, though in fome refpects analogous, we do not admit to be of the infect race. But if they were, can we have fo entirely forgotten the anatomical inveftigations of cancer aftacus by Roefel, as to allow Fabricius the credit of difcovering thofe very organs which he defcribes many years before ; and if he really obferved thofe organs in genuine infects, can we overlook the laborious anatomical enquiries of Swammerdam, or the minute refearches of Lyonet, in which the exiftence of fuch an organ is rendered manifeft, with no other view than to award the merit of its difcovery to Fabricius ?

No phyfiologift whatever has purfued this interefting fubject of enquiry fo far as Cuvier. This attentive and fkilful obferver examined a confiderable number of the different tribes of infects, in order to afcertain their internal organization, and has eftablifhed, beyond difpute, if any doubt could ftill remain, that infects have a brain in the head. From Cuvier we alfo learn that the brain is not conftantly of the fame ftructure in all infects ; in fome tribes this organ confifts of one lobe, in others of two, and in others again of four ; and the nerves arifing from them differ alfo very materially in different families, and fometimes even in fpecies. But befides this diffimilarity, there is another circumftance infinitely more remarkable, the form of the brain and medullary nerves in certain infects, are afcertained to undergo a confiderable change, as well as the external organs, in paffing from the larvæ to the perfect ftate. The moft extraordinary of thefe deferve notice, and the circumftance being ftated may ftimulate others, perhaps, to a farther enquiry, in the refult of which, it is apprehended, a fimilar change, will be obferved, in a far greater number of the infect race than may be at prefent conceived.

Brain in Coleopterous Infects.—The larva of a large beetle, common in Europe, and known by naturalifts under the name of fcarabæus nafícornis, affords a favourable opportunity for the afcertainment of this fact ; it is of a large fize, and the change it undergoes in paffing to the winged ftate is very confiderable. The brain in this larva is fituated under the great fcale which covers the head, immediately above the origin of the œfophagus. It confifts of two approximate lobes, which are very diftinct at the front and back part. Four nerves arife from the anterior part, two on each fide, which are loft in the cirri and parietes of the mouth, one pair of nerves arifes alfo from the lateral and fomewhat pofterior part of the brain, which, embracing the œfophagus, proceeds below to form a nervous cord ; and another pair is produced from the lower furface of the brain. In the perfect infect, the nervous cord prefents a very confpicuous difference ; in the larva there is only a fingle ganglion, but the perfect infect has feveral, and which are very diftinct. The firft is fituated above the condyle : it proceeds from the two pofterior filaments of the brain, and is diftributed to the mufcles which move the head on the corfelet. Its pofterior part produces two filaments, which pafs into the breaft, where they unite towards the middle,

middle, and form a triangular ganglion, from the fides of which three pairs of nerves arife, and are diftributed to the mufcles. Its pofterior angle detaches two parallel nerves which proceed into the breaft, where they form a third and fourth ganglion, fituated very near each other, and apparently divided into two lobes by a longitudinal furrow. All the other nerves of the body proceed from thefe two ganglia, by an irradiation precifely in the fame manner as in the larva.

The nerves in the larva of the ftag beetle (lucanus cervus) differ greatly from that of the foregoing infect. The brain confifts of two contiguous and almoft fpherical lobes, which produce four nerves anteriorly; two beneath and two behind, which latter form a collar round the œfophagus, and uniting underneath compofe the nervous cord of the body. The cord is formed of eight ganglia, and extends to the ninth ring of the body. In the perfect ftate the brain confifts likewife of two approximate lobes of a fpherical form. There are alfo two ganglia on the lateral parts of the brain, which are almoft as large as each of the lobes: in form they refemble a pear, and reft on the brain by their bafe: the two anterior pairs of nerves arifing from the brain terminate in the palpi and other parts of the mouth. The brain produces alfo two very long and flender nerves behind, and the difpofition of the nerves arifing from the various parts differ very much from thofe obfervable in the larva.

The nervous fyftem of the larva of hydrophilus piceus, or great water beetle (dytifcus, Linn.), will ferve to illuftrate thofe of an extenfive number of other coleopterous infects, fuch as the larva of cerambyces, dytifci, carabi, ftaphylini, &c. Some little variation will be found, but the analogy is very confpicuous. The brain in the larva of this infect is fituated in the head above the origin of the œfophagus; it is formed of two lobes, which lie very clofe together. From its anterior part it detaches fome filaments to the palpi, the antennæ, and the parietes of the mouth. Its lateral parts produce two cords, which furround the œfophagus, and which are the origin of the nervous cord fituated inferiorly. The chief nervous cord is compofed of ten ganglia, each of which produces three pairs of nerves, which are loft in the mufcles of the abdomen. In the perfect infect the brain confifts of two fpherical bulbs, which are clofely united. The lateral parts give origin to the optic nerves. The anterior part of the brain detaches fome filaments intended for the parietes of the mouth. In the fame place is alfo a fmall fpherical ganglion, which feems to belong to the recurrent nerve that accompanies the œfophagus. The brain in the larva of dytifcus marginalis is different from that in the larva of hydrophilus piceus, although thofe two infects are fo clofely allied in genera; in the latter it is fpherical, and confifts of a fingle lobe, it is fituated in the head above the origin of the œfophagus: its anterior part produces fome filaments for the mouth, and its lateral parts the two optic nerves: the latter are compofed of two parts, which are very diftinct in form. That portion next to the brain is of an oval figure, pointed at the extremity which joins the brain, the other extremity is rounded, and produces a flender nerve, which paffes directly to the eye.

Hemiptera.—The ftructure of the nervous fyftem in the larvæ of hemipterous infects does not often differ very fenfibly, it is faid, from that which is exhibited in the perfect infect to which they refpectively belong. But the fmall number of this tribe already examined do not authorife us to fpeak on this fubject with much confidence. A confiderable difference prevails in this refpect between the perfect infects of fome oppofite genera, as appears from thofe which Cuvier defcribes. In the cock-roach, blatta americana, the brain is compofed of two lobes, feparated by a very diftinct notch anteriorly. The optic nerves arife on the fides, and its anterior part detaches fome filaments to the parietes of the mouth, and to the inftruments of manducation. The nervous cords, which form the medulla, arife from its inferior furface. In the great green locuft (gryllus viridiffimus) the brain is fituated in the head above the œfophagus; it confifts of two lobes, which are pyriform, united at their bafe, and prolonged at their other extremity into an optic nerve for the eye of each fide. The anterior part alfo produces two nerves of a pyramidal form, the bafe of which refts upon the brain. The brain of the mole-cricket (acheta gryllo-talpa) is compofed of two rounded lobes, which are particularly diftinct at the pofterior part. The nervous fyftem of the water fcorpion (nepa cinerea) is different. This confifts of three ganglia, the firft of which (properly the brain) is fituated in the head. It is formed of two approximate pyriform lobes, which touch each other at the bafe, while their fummits are directed obliquely forward towards the eyes in which they terminate: the middle and anterior part of thefe lobes alfo produce filaments for the parts of the mouth; the third, which is more voluminous than the brain, lies near the bafe of the fecond pair of legs.

Lepidoptera.—The nervous fyftem of caterpillars, or lepidopterous infects in the ftate of larvæ, confifts of a feries of thirteen principal ganglia, which furnifh filaments to all the other parts of the body. The firft of thefe ganglia is what may properly be confidered as the brain: it is fituated in the cavity of the head above the œfophagus, and confifts of two round tubercles, which are concave beneath, and correfpond to the convexity of the œfophagus. This ganglion communicates with the reft of the nervous cord by two thick filaments, which embrace the œfophagus, and which are united below it to the anterior and lateral parts of the next ganglion; and it befides produces eight pairs of nerves. The firft partly unites with other filaments; produces fome for the œfophagus, and forms feveral remarkable ganglia below the lower lip. The largeft and moft pofterior, which Lyonet has named the firft frontal ganglion, is prolonged behind into a thick recurrent nerve, which is continued the whole length of the body contiguous to the back. The fecond pair of the brain appears chiefly intended for the antennæ, though it furnifhes feveral filaments to the neighbouring parts, and the others for the more remote portions of the body. Thefe obfervations are from Lyonet, and relate principally to the larva of the goat moth (phalæna coffus of Linnæus.) Few of the lepidopterous infects in the winged ftate have yet been examined for the purpofe of afcertaining the ftructure of the brain. In phalæna difpar this organ is almoft fpherical; there is, however, a longitunal furrow on the middle line. Its anterior part produces fome exceeding flender nerves. There are alfo two large optic nerves on the fides which proceed into the concavity of the eye, where they terminate by a bulb, from whence arife a great number of filaments.

Neuroptera.—In the larva of the lion-ant, (myrmellon formicarius) the nervous medulla, proceeding from the brain in the head, confifts firft of two ganglia, which are compofed of two lobes fituated clofe together, and are placed in the thorax; the remainder of the nervous medulla, confifting of eight ganglia placed in very clofe feries, and each formed of two lobes, is contained in the abdomen. The larva of the ephemeræ has eleven ganglia, exclufive of the brain, which furnifhes two large optic nerves. The larvæ of the libellulæ, or dragon flies, have a fmall two-lobed brain, which produces optic nerves, larger or fmaller in different fpecies.

The Fabrician genus æſhna has the largeſt. The reſt of the nervous ſyſtem forms a ſeries of ganglia of different ſizes. In the æſhna the thorax contains ſix, the two laſt of which are the largeſt, and there are ſeven ſmall and equal ganglia in the abdomen. In the winged ſtate the brain is formed of two very ſmall lobes, and the optic nerves are dilated into the form of two very large plates, which have the figure of a kidney, and which is ſpread upon all the inner ſurface of the eye next the head. The remainder of their medullary cord is exceedingly ſlender, and furniſhed with twelve or thirteen ſmall ganglia, the laſt of which is, as uſual, connected with the organs of generation.

Hymenoptera.—The brain in the larvæ of ſome kinds of tenthredines, which have the head large, is broad and ſhort, and ſeems to conſiſt of four bulbs of equal magnitude, and the form of which is nearly ſpherical; the two external ones ſerve as the baſe of the optic nerves, which are ſlender, and enlarge a little at their other extremity. The firſt ganglion is produced by two very ſmall nerves, which ariſe from the inferior ſurface of the brain, and which, after having embraced the œſophagus, unite under the firſt ring of the body; it furniſhes filaments to the muſcles of the feet, and terminates poſteriorly in two other nerves, which, at the diſtance of one line, produce a ſecond ganglion, and ſo on in ſucceſſion: the nervous cord is in this manner formed of eleven ganglia, excluſive of the brain: all the ganglia are of a roundiſh form, and diminiſh in thickneſs as they recede from the head. The brain of one of the hymenopterous tribe in the winged ſtate (the common bee) is rather ſmall, and is divided into four lobes. It produces the nerves which are diſtributed to the different parts of the mouth, and the two large optic nerves which are dilated, and applied behind each eye, as in the libellulæ. There are afterwards ſeven ganglia, three of which are in the thorax and four in the abdomen. The nerves of the laſt chiefly ſupply the ſexual organs.

Diptera.—The nerves of the larvæ, in ſome of the Linnæan muſcæ, as m. chamæleon, &c. (ſtratiomys, Fabr.) have ſome reſemblance to thoſe of the larva of ſcarabæus naſicornis. The brain is formed of two lobes placed cloſe together and almoſt ſpherical; it is ſituated above the œſophagus, on a level with the ſecond ring of the body. A number of ſmall nervous filaments ariſes from its anterior part, and they are diſtributed to various parts of the mouth. The poſterior part of theſe two lobes ſends forth two thick branches, which embrace the œſophagus, and form the origin of the nervous medulla. This nervous cord is very ſhort, and in diameter one half leſs than that of the brain. It conſiſts of eleven ganglia placed very near each other, each of which produces one pair of nerves.

A more ſingular appearance is exhibited in the ſtructure of the nervous ſyſtem of muſca putris than that juſt deſcribed. The brain is ſituated immediately above the origin of the œſophagus behind the head; it is very large in proportion to the reſt of the body. The anterior part is notched, poſterior rounded, and appears altogether as if formed of two lobes. A pair of nerves ariſes from the anterior part of the brain, proceeds forward, and is diſtributed to the mouth. Theſe nerves become conſpicuouſly large previouſly to diſtribution. Poſteriorly the brain preſents an aperture which affords a paſſage for the œſophagus: the nervous part, ſituated at the ſides, may be regarded as cords which produce the medulla, and all below the œſophagus as the medulla itſelf.

Muſca tenax (Linn.) in the perfect ſtate has a ſmall brain, formed of two lobes, which are ſituated very near together, but diſtinguiſhed by a longitudinal furrow; the anterior part produces a large nerve, which is afterwards diſtributed to the antennæ and the proboſcis. In aſilus crabroniformis is a ſingle cord uniting the abdominal ganglia, which are ſix in number. The brain itſelf is ſimilar to that of the ſyrphus (as in muſca inanis, &c.) but the bulbs formed by the optic nerves are ſtill broader in proportion to the extent of the eyes they have to inveſt.

Aptera.—In the great centipede, ſcolopendra morſitans, the brain has a very ſingular form: the two lobes of which it is compoſed are almoſt ſpherical; the optic nerve is produced laterally and is very ſhort. The filaments are four in number, but two nerves ariſe anteriorly which are ſo very thick, that they appear part of the brain, to which they are equal in diameter. Theſe nerves are particularly intended for the antennæ, into which we obſerve them enter. The two cords which embrace the œſophagus proceed directly downward, and form a large ganglion at the union of the firſt ring with the head. The firſt ganglion produces two nerves poſteriorly, and ſeveral towards the ſides. A ganglion, preciſely of the ſame ſhape, is placed above each of the articulations: thus there are in all twenty-four very diſtinct ganglia in this inſect, from each of which are detached three pairs of nerves.

Mouth.—In order to afford ſome idea of the amazing difference that prevails in the ſtructure of the ſeveral parts or organs which conſtitute the mouth, it will be only requiſite to obſerve that the claſſification of all inſects, in the Fabrician ſyſtem, is founded on this character. There are ten principal parts of which the mouth conſiſts; and it is from the relative proportion of each, from the diſſimilarity in the form, poſition, variation in number, or occaſional peculiarities, that the moſt permanent characters are deduced. Theſe parts have one diſadvantage: they are generally ſmall, and from this circumſtance have not been ſo univerſally adopted in the arrangement of inſects as they would otherwiſe. Without, however, beſtowing ſome little attention to theſe organs, it is impoſſible to diſtribute inſects into their natural order with any great degree of certainty.

The organs of the mouth were ſlightly regarded by Linnæus; and to this cauſe alone we may attribute ſome few ſerious errors in the works of that naturaliſt. The parts he deſcribes are the roſtrum (or proboſcis), maxillæ, lingua, and labium ſuperius. Some of theſe are not ſufficiently diſcriminated; his roſtrum and proboſcis are not different; the maxillæ are confounded with the mandibulæ; and the labium ſuperius is not, as the expreſſion implies, the upper lip of the inſect, this latter part being ſituated under it. Fabricius defines theſe parts with more preciſion, as he derives his eſſential characters from them. In the arrangement of Olivier, in the works of Latreille, and moſt other modern writers on entomology, the eſſential characters are eſtabliſhed chiefly on the peculiarities of theſe organs.

The ten principal parts of which the mouth conſiſts are the following.

Labium ſuperius, or upper lip: a tranſverſe, ſoft, moveable piece of a coriaceous or membranaceous nature, known from its ſituation at the anterior or upper part of the mouth. This part is very diſtinct in many of the coleoptera, and in the gryllus, apis, and ſome other genera. Linnæus ſometimes confounds the upper lip with the clypeus or ſhield of the head; and ſimilar inſtances occur in the works of Fabricius. Theſe two parts may be diſtinguiſhed by one invariable character; the clypeus is fixed, and forms a portion of the head; the upper lip is moveable.

Labium inferius: the piece which terminates the mouth beneath, and which is ſometimes lengthened, ſo as to form the inſtrument called ligula. It is ſoft, flexible, uſually bifid,

bifid, and has the posterior pair of feelers placed at the base.

Mandibulæ, mandibles: two hard pieces, in substance resembling horn, which are placed one at each side of the mouth, below the upper lip. These have a lateral motion, while the upper and lower lip move up and down, as in other animals. These differ from the maxillæ, with which they are sometimes confounded, by not having any of the palpi or feelers attached to them. In rapacious insects, these are larger and more powerful than in those which perforate wood; and the latter again have stronger mandibles than insects which feed only on herbage or leaves.

Maxillæ: two small pieces of a somewhat membranaceous consistency, and in figure different from the mandibles. These are commonly indented at the extremity, and nearly all ciliated at the inner edge. They are placed under the mandibles, and above the lower lip; their motion is lateral. In those insects which have more than one pair of feelers, the posterior ones take their origin from the sides of the maxillæ.

Galeæ.—Shields of the mouth, two membranaceous appendages, usually of a large size and cylindrical form, placed one on each side, at the exterior part of the jaw, and which cover and protect the organs of the mouth, conjointly with the lips. The galeæ are inserted at the back of the jaws, as is well exemplified in the gryllus tribe.

Organs of Taste.

These appertaining of course, like the foregoing, to the mouth, and of which they constitute the most material part, admit of considerable variety in their formation, and in some particular tribes differ so greatly as to have obtained distinct names in the works of entomologists, according to their precise form; such, for example, as ligula, lingua, rostrum, proboscis, and haustellum.

Ligula.—This is the part considered by many authors as the lower lip; its situation is immediately under the jaws; and it consists of a single piece, which is of a soft texture, often bifid, and, if attentively examined at the base, will be found of a horny substance.

In the coleoptera, and some of the hemiptera, as the blatta, phasma, gryllus, &c. this tongue terminates at the point in a membranaceous substance: its form is extremely various in the different genera. The hymenoptera and some neuroptera have the tongue or ligula situated in the same manner; but it is in these concave, and is frequently prolonged into a sort of proboscis, which sometimes exceeds the length of the whole body. It is membranaceous, but of a soft and spongy texture, and well suited for receiving the impressions of taste. This kind of tongue is extremely well exemplified in the bee.

Lingua: tongue, the involuted tubular organ which constitutes the whole mouth in lepidopterous insects. This is of a setaceous form, and either very long, as in the papilio and sphinx genera, or short, as in most of the bombyces and other moths. It consists of two filamentous pieces, which are externally convex, concave within, and connected longitudinally by a suture along the middle above and beneath. These in uniting form a cylinder, through which the nectareous juices of the flowers on which these insects subsist are drawn up with facility. These two pieces are not very closely united, and may be separated by means of a needle point. When the insect takes its food, this tube is exserted; at other times it is rolled up spirally between the palpi.

A curious circumstance is mentioned by Degeer, relative to the tongue of the butterfly. Having cut off the tongue of a papilio antiopa, almost as soon as it was emancipated from the chrysalis, it moved and rolled itself up at intervals for a considerable time: an hour after it had been cut off it repeated the same motions, recommencing them every time it was touched. It was observed that the same effect did not follow, if the butterfly had been liberated from the chrysalis for a few days.

Rostrum, or beak: the part which forms the mouth in many of the hemipterous order of insects. This instrument is moveable, articulated, and bent under the breast. Within this beak is hollow, and contains, as in a sheath, three or more very fine and delicate bristles, the points of which these insects introduce into the body of the animal, or substance of the plants, from which they draw nourishment. The rostrum is conspicuous in the genera cicada, nepa, and cimex.

Proboscis.—The trunk is inserted in place of the mouth, in most dipterous insects. It is rather fleshy, retractile, of a single piece, and often cylindrical; the end forming two lips, which are of a soft substance, and from the delicacy of their teguments must possess the faculty of taste in a very high degree.

Haustellum.—Formed of two or more very small and delicate filaments, inclosed in a sheath of two valves.

Lingua, rostrum, and proboscis, are Linnæan terms: the first is adopted according to the definition of that system; the two latter are synonymous with Linnæus. Ligula is a Fabrician expression, indicating the lower lip.

Palpi.—Feelers. These are the small, moveable, filiform organs, or appendages, placed at each side the mouth in the generality of insects. In some respects they resemble the antennæ, but are more distinctly articulated. They vary in number in different insects, being either two, four, or six, and are commonly inserted at each side the exterior part of the jaw. In those which have only one pair, they are usually situated on the upper lip; when two or more, the posterior ones are generally on the lower lip; and in some insects furnished with a sucking trunk, they are oftentimes found inserted at each side of that organ. These feelers are composed of several joints, the number of which vary. Like the antennæ, to which they bear analogy, they are endowed with powers of motion, but still more extensively. They also serve, like the antennæ, as an essential character in the construction of genera; and from their situation, the number of joints, termination, and relative proportion and size, are exceedingly useful for that purpose.

These feelers, as their name implies, are considered as the organs of touch; and this is conceived probable, because the insect agitates these parts, and presses its food with them before it begins to eat. Some have supposed them to be the organs of hearing; and others of a sense peculiar to insects, which we are ignorant of. It has been ascertained from experiment, that they are not absolutely necessary to the life of the insect, and that it even sustains their loss without much apparent inconvenience. Feelers are not common to all insects. There are many whole genera destitute of them; as, for example, the fulgora, cicada, the several genera of the Linnæan cimices, nepa, notonecta, and various others.

Certain kinds of insects are provided with feelers, both in the larva and perfect state, as is particularly exemplified in the dytiscus and hydrophilus genera, and again in the libellulæ; and it is worthy of remark, that these organs appear to be more immediately useful to the carnivorous tribes of insects than to those which feed on plants.

Olfactory organs.—Nature has denied the insect race that particular part which is properly called the nose; and it is further

further evident, that there is no organ within the head appropriated to the fenfe of fmell. From analogy, and comparifon with other animals, naturalifts have been led to feek this organ in the head: and as infects afford the moft convincing evidence of being poffeffed of this faculty, fome have placed it in the antennæ, and others in the feelers; neither of which, from attentive examination, appears calculated for this purpofe.

It is fufficiently clear that infects poffefs the faculty of fmell, if not in a very eminent degree, and that in many refpects they are rather guided by this fenfe than by the force of inftinct. Infects difcover their food at a great diftance, and, as it is fuppofed, by this means; and it is concluded likewife, that butterflies and moths are directed by the fame fenfe to the difcovery of their mates. A female of phalæna quercus (eggar moth), inclofed in a box, and thus expofed in an avenue of a wood, will attract the males in numbers to the fame fpot; and though fhe cannot poffibly be feen, they will appear fully fenfible of her prefence. Admitting that thefe circumftances may be otherwife accounted for, one argument at leaft bears ftrongly in its favour, namely, that of the flefh fly (mufca vomitoria) being fo far deceived by the fimilarity of odour, as to lay its eggs on plants of the ftapelia genus inftead of animal fubftances. Thefe infects, as the name implies, fubfift in the larva ftate on flefh, preferring that which is putrid, or haftening to the ftage of putrefaction, and from whence, in confequence, a powerful odour arifes. The plants of the ftapelia genus have the fame fmell; and the parent infect, mifled by this means, actually depofits her eggs on thefe plants.

As inftinct never errs, though judgment may, it is a natural inference that the infect is not in this inftance under the controul of inftinct, but of her own will, becaufe otherwife fhe would not fail to lay thofe eggs in flefh, where the larva, when hatched, would be provided with food; while, on the contrary, the plants refemble this food only in its offenfive odour, and thus, when hatched, the infant brood inevitably perifh. Does not this afford prefumptive evidence at leaft, that the infect is directed to thefe plants by the organs of fmell?

If infects then evince fuch apparent proofs that they do poffefs this faculty, and that it appears likewife the feat of this faculty does not refide in the head, it muft be fought after in fome other part. The organs of fmell, in all animals which refpire air, is fituated at the entrance of the organs of refpiration: from this circumftance it is conceived moft likely that the refpiratory fpiracles on each fide the body muft be the true organs of that fenfe. This idea was advanced by Bafter; yet it feemed to imply fuch an inverfion in the ordinary courfe of nature, that it gained little credit. Of late years the fame opinion has obtained the concurrence of the beft anatomifts. Cuvier is decidedly in favour of this conclufion, and, in addition to the reafons hitherto ftated in its fupport, obferves, that the internal membrane of the tracheæ appears well calculated to perform this office, being foft and moiftened; and that the infects in which the tracheæ enlarge, and form numerous or confiderable veficles, are thofe which feem to poffefs the moft perfect fenfe of fmell. Olivier endeavours to maintain that the palpi or feelers, and alfo the antennæ, are the olfactory organs in infects.

Eyes.—Moft infects have two eyes. Thefe are placed in the anterior part of the head, and vary very much in their external figure in different tribes. Some of the Linnæan infects of the apterous order have a greater number, the fcorpions have eight, and the fpiders from fix to eight, and there are befides other genera in which the eyes amount to more than two.

This pair of eyes in the infect race is of a compound kind, while thofe of the fcorpion and fpider are fimple, and in this refpect the difference is very remarkable. The compound eye is one of the moft extraordinary deviations from the ordinary courfe of nature in the conformation of the organ of fight; the fimple eyes approach much nearer thofe of other animals. By compound eyes we mean thofe kinds which are reticulated, and when magnified are found divided into a great number of compartments, and of thefe every genuine infect appears to poffefs two. Befides thefe eyes, many of the neuropterous and hymenopterous families have three fmall fhining convex points placed in the middle of the head, and called by entomologifts ftemmata, the utility of which has never been afcertained. The extreme minutenefs of thefe organs does not allow the comparative anatomift the means of diffecting them, but we ftill think they can be no other than organs of fight. Should this appear doubtful, becaufe we obferve them in thofe infects, which are befides furnifhed with a pair of eyes of the compound kind, it fhould be recollected that fcorpions and fpiders, as before-mentioned, have feveral more eyes than a pair; and if, on the other hand, the fimplicity of their ftructure be confidered as an argument againft this conclufion, let it be obferved that they poffefs every character in their form, appearance, fituation, and immoveability, which the only kind of eyes thefe creatures are furnifhed with are known to poffefs. We, indeed, conceive it very probable, that thofe three fhining points, called ftemmata, are truly organs of fight; and that, confequently, many infects which appear to have only two eyes, have in reality no lefs than five.

The compound eye in infects is fo very different from that of other animals, that it would be difficult to perfuade ourfelves of its being an organ of fight, had not experiments, purpofely made, demonftrated its ufe. If we cut out, or cover with an opake matter the eyes of a libellula, or dragon fly, it will ftrike againft walls in flight. The wafp is faid to afcend perpendicularly in the air till it completely difappears, when the compound eyes are treated in the fame manner, and to remain perfectly immoveable when both the compound eyes and the ftemmata are covered; in the firft cafe it feems to follow the direction of its fight upwards, in the other to be deprived entirely of the vifual organ, and uncertain whither to direct its flight.

The compound eyes are generally convex, and when viewed by the microfcope exhibit an innumerable multitude of hexagonal facets, flightly convex, and feparated from one another by fmall furrows, which frequently contain fine hairs, more or lefs long. Thefe facets give, to the naked eye, the appearance of net work, and amount to a greater or lefs number in different infects. Leeuwenhoek counted 3181 in the eye of a beetle, and in that of the common houfe fly about 8000.

Thefe facets form altogether a hard elaftic membrane, which, when freed from the fubftances that adhere behind, is very tranfparent. Each of thefe fmall furfaces may be confidered either as a cornea, or a cryftalline, for it is externally convex, and concave internally, but thicker in the middle than at the edges, and it is alfo the only tranfparent part in this fingular eye. Behind this tranfparent membrane is a fubftance, which varies greatly as to colour in different fpecies, and which fometimes forms, even in the fame eye, fpots or bands of different colours. Its confiftence is the fame as that of the pigment of the choroides; it entirely covers the pofterior part of the tranfparent facets, without leaving any aperture

aperture for the paſſage of the light. Behind this pigment we find ſome very ſhort white filaments, in the form of hexagonal priſms, ſituated cloſe to each other, like the ſtones of a pavement, and preciſely equal in number to the facets of the cornea; each penetrates into the hollow part of one of theſe facets, and is only ſeparated from it by the pigment mentioned above. If theſe filaments are nervous, we may conſider each as the retina of the ſurface behind which it is placed; but it will always, in the opinion of Cuvier, remain to be explained how the light can act on this retina through a coat of opake pigment. This multitude of filaments, perpendicular to the cornea, have behind them a membrane, which ſerves them all as the baſe, and which is conſequently nearly parallel to the cornea: this membrane is very fine, and of a blackiſh colour, which is not cauſed by a pigment, but extends to its moſt intimate texture; we obſerve in it very fine whitiſh lines, which are tracheæ, and which produce ſtill finer branches that penetrate between the hexagonal filaments as far as the cornea: this membrane by analogy Cuvier calls the choroides. A thin expanſion of the optic nerve is applied to the poſterior part of the choroides. This is the real nervous membrane, perfectly ſimilar to the retina in red-blooded animals; it appears that the white filaments, which form the particular retinæ of the different ocular ſurfaces, are productions of this general retina, which perforates the membrane named choroides by a multitude of ſmall and almoſt imperceptible holes. To obtain a diſtinct view of all theſe parts, it is neceſſary to cut off the head of an inſect which has the eyes of large ſize, and diſſect it behind, each part will then be removed in an order, the reverſe of that above deſcribed.

The conſtruction of theſe compound eyes is admirably adapted to the convenience of the inſect, for as the eyes of inſects are immoveable, they would have loſt ſight of many objects, if their eyes had been framed like thoſe of other animals, but by theſe means they can eaſily view ſurrounding objects. It ſeems a falſe concluſion that as each of the facets which compoſe the compound eye is a diſtinct organ of ſight, any ſingle object muſt appear multiplied as often as there are facets; it is, on the contrary, far from improbable, that as objects do not appear double to our eyes, but that the viſual organ is ſtrengthened, and many illuſive appearances are corrected by the uſe of both, ſo the numerous inlets to ſight in an inſect may increaſe their field of view, and be productive of other advantages, of which we are ignorant.

Stemmata: the three ſmooth, gloſſy, hemiſpherical dots, ſituated at the vertex of the head, and which, as juſt obſerved in ſpeaking of the eyes, are ſuppoſed to be organs of ſight. Theſe are moſt conſpicuous in the hymenopterous order of inſects.

An experiment made by abbé Catalan tends to confirm the truth of this conjecture. With the view of obſerving whether an inſect could ſee equally well with both the eyes and ſtemmata, he covered the reticular eye of a fly with fluid pitch, leaving the ſtemmata open; he then put it under a glaſs, where it ran up and down without ſtriking againſt any object, and when he lifted the glaſs, it flew away towards the window. He took another fly, and covered with pitch the ſtemmata, leaving the reticular eyes open, and found that with theſe it ſaw equally well as before. Laſtly, he took a third fly, and covered both the reticular eyes and the ſtemmata, and this he found completely blind; it walked ſlowly under the glaſs, and when removed would not venture to fly. Act. Erudit. A.D. 1682.

Antennæ are thoſe delicate moveable horns which appear on the fore part of the head in all perfect and genuine inſects; and which, in many inſtances, are very remarkable for their beauty and elegance of ſtructure. The antennæ are extremely diverſified in form, and vary conſiderably in their proportional dimenſions in different tribes; and for this reaſon are conſidered by entomologiſts of material conſequence in diſtinguiſhing the various orders, genera, and ſpecies. Theſe parts are always articulated, or conſiſt at leaſt of more than one joint, including the baſe, and moſt commonly are compoſed of a far greater number; few leſs than eight, ten, or twelve, and ſome amounting to twenty, or even more. This articulated ſtructure of the antennæ is of infinite utility to the inſect, as it is thereby enabled to move theſe organs in every direction their wants or wiſhes may require.

Antennæ are not entirely peculiar to inſects; the cruſtaceous animals poſſeſs the ſame organs, though in other reſpects they differ ſo eſſentially, (ſee article CANCER,) as do likewiſe ſome of the apterous order of Linnæan inſects, which modern naturaliſts exclude from this claſs. Nor will it be amiſs to obſerve that, even according to Linnæus, many of his apterous inſects are deſtitute of antennæ, and are conſequently inadmiſſible on this account, upon his own definition, into the ſyſtem of entomology. Spiders and ſcorpions are of the latter deſcription. The organs termed antennæ are eaſily diſtinguiſhed from the tentaculæ of vermes, by having a ſhelly covering, and from the palpi or feelers of inſects, the latter being more numerous, and ſituated at the mouth. The Linnæan and Fabrician entomologiſts admitting the cancer, and other cruſtacea among the inſect tribes, allow four, or in ſome caſes even ſix antennæ to this race, but as we refer theſe to another claſs, we apprehend that the number of antennæ in all genuine inſects invariably amounts only to two. Thoſe inſects which have attained their laſt ſtate, and are therefore denominated perfect, and which poſſeſs ſix legs, are always provided with two antennæ. It is true that the larvæ of many inſects are not furniſhed with theſe organs, yet they are ſtill genuine inſects, becauſe in their complete ſtate they poſſeſs them; ſpiders and ſcorpions on the contrary, with all their organs complete, have no antennæ. A very conſiderable number of inſects, even in the larva ſtate, are not deficient in theſe organs, and in many, though not in all, there is no difference whatever between the antennæ of the larva and perfect inſect. The genera blatta, gryllus, mantis, phaſma, cimex, and various others of the hemiptera order, are furniſhed with antennæ, which exactly reſemble thoſe of the ſame ſpecies in their perfect ſtate.

No writer, who has attentively regarded the ſtructure of the antennæ in inſects, has hitherto pretended to determine preciſely the purpoſe for which nature has deſigned them, and thoſe who have not very maturely conſidered them cannot poſſibly be competent to decide ſuch a doubtful circumſtance. We know of nothing analogous to theſe organs in larger animals whoſe manners we might be ſuppoſed to have a better acquaintance with, and it is not therefore by analogy that this point can be determined. Some naturaliſts conceive that they are appropriated to a feeling more delicate than our own, and that they are ſenſible to the leaſt motion or diſturbance in the ambient fluid, or that they are the organs of ſome ſenſe unknown to us, and of which we cannot conſequently form the leaſt conception. Some ſuppoſe they ſerve to ſound, and occaſionally to probe the earth on which they move, or that they are the organs of hearing, of feeling, or ſmelling, and by the means of which they diſtinguiſh their proper food. Each of theſe conjectures

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is liable to objection, and can be conſidered as an opinion merely, while the real purpoſes of theſe organs may perhaps for ever remain unknown.

Though it is difficult even to conceive the immediate object for which the Creator has aſſigned theſe organs to the inſect race, we muſt reſt perſuaded that they are intended to anſwer ſome very important deſtination in the economy of the animal, as the medullary nerves, ariſing directly from the brain, may be traced into theſe parts, and followed throughout their whole extent. In ſome inſects alſo, which have the antennæ ſmall. the palpi are obſerved to be very large, as if they were intended to anſwer the ſame purpoſe, or partake of the ſame ſenſe, as the antennæ, and thus, by their mutual aid, ſupply the deficiency of antennæ. This will in ſome degree account, perhaps, for the manner in which nature ſeems occaſionally to counterbalance the want of antennæ in the larvæ of certain kinds of inſects which have palpi, but no antennæ; others in the ſame ſtate have antennæ and no palpi. Many that are deſtitute of both the two firſt-mentioned kinds are thoſe chiefly which prey on inſects, and the latter ſuch as feed on plants.

The antennæ, nevertheleſs, appear to us to be rather connected with the organ of hearing, than either that of feeling or ſmelling. The palpi, we have little doubt, are the organs of feeling, both from their texture, and the manner in which inſects are oftentimes obſerved to make uſe of them in touching their aliments; and the organs of ſmelling in inſects, however ſingular it may be imagined, we conceive to be no other than the apertures diſpoſed on each ſide the thorax and body. By the organs of hearing, we do not mean to conſider them as external ears, but as being in ſome manner auxiliary to the organ of hearing, the ſeat of which we ſuſpect to be contiguous to the baſe of the antennæ, the ſpot in which the ſame organ has been diſcovered in the cray-fiſh. They may anſwer this and ſome other purpoſe likewiſe.

We have previouſly obſerved, that nothing can be diſtinctly inferred of the actual utility of the antennæ from analogy; nor do the purpoſes to which inſects appear ſometimes to appropriate them aſſiſt our concluſions in a ſatisfactory manner. Many inſects, when they walk, fly, or take their food, have the antennæ directed forward; others, on the contrary, carry them inclining backward, like the cerambyces; ſome kinds lay them along their back; and others, as the elater tribe, diſpoſe them on each ſide the thorax. The ſpheges and the ichneumons bear their antennæ directly before them, and continually agitate them, whether in flight, when ſtanding, or ſeizing on their prey. In others, the antennæ have little perceptible motion. Some inſects are ſaid to cover their eyes with their antennæ when they ſleep; the diminutive ſize, compared with the magnitude of the eyes in moſt inſects, will not permit us to believe that this is the principal object of their deſtination.

Notwithſtanding the direct connection of the antennæ with the brain, inſects, it has been affirmed, can undergo their partial privation, or total loſs, without experiencing any ſenſible injury; and hence it has been concluded they cannot be neceſſary to the life of the inſect. If the fact be true, the latter inference muſt ſurely be admitted, but this will not diſprove their utility: nor will it diſcountenance the idea that the antennæ are requiſite for ſome important end. We well know, that in the animal economy of larger beings, not only the medullary nerves may be in part deſtroyed, but even the animal be deprived of a portion of the brain itſelf, without ſuſtaining mortal injury. The antennæ of inſects may not be abſolutely neceſſary to the life of the inſect, but are certainly ſo to its well being, and to the perfect exerciſe of all its functions.

The antennæ of the male inſects generally differ from thoſe of the females. It is principally the antennæ of the former that are plumoſe, or furniſhed with teeth, or tufts of feathers, while thoſe of the female appear like a delicate thread, entirely ſmooth, or only ſlightly pectinated. This is obſervable throughout the moth tribe. In coleopterous inſects the males are often diſtinguiſhed by the ſuperior ſize and beauty of the antennæ from the other ſex. The antennæ are characterized by entomologiſts according to their ſtructure under different names. Linnæus deſcribes the following: 1, Setaceæ, thoſe which gradually become taper towards the extremity; 2, Filiformes, ſuch as are of an equal thickneſs throughout; 3, Moniliformes, are filiform like the preceding, but conſiſt of a ſeries of round knobs, like a neck-lace of beads; 4, Clavatæ, ſuch as gradually increaſe in thickneſs from the baſe, and form a club at the end; 5, Capitatæ, like clavatæ, increaſe in thickneſs towards their extremity, but are diſtinguiſhed from thoſe by the form of their laſt articulation, which is larger and more rounded than the others; 6, Fiſſiles are like the laſt, but are divided longitudinally into three or four plates or laminæ; 7, Perfoliatæ are alſo capitatæ, but have the head divided horizontally, the plates being connected by a kind of thread paſſing through their centre; 8, Pectinatæ are thoſe which have lateral appendages, like the teeth of a comb, or plume of a feather, as in the moth tribe. 9. Ariſtatæ, ſuch as have a lateral hair, which is either naked, or furniſhed with leſſer hairs, as in the muſca genus. Each of theſe is alſo diſtinguiſhed according to their length, as breviores, thoſe which are ſhorter than the body; longiores, thoſe which are longer than the body; and mediocres, ſuch as are of the ſame length with the body, all which varieties are conſpicuous in the Linnæan tribe of cerambyces.

The ſtructure of the antennæ in inſects is of ſuch vaſt importance in the definition of genera, ſpecies, and ſexual diſtinctions, that it is to be regretted we have not a more comprehenſive number of terms by which their particular forms might be minutely diſcriminated. Linnæus affords us ſome, the utility of which is univerſally allowed; others which he propoſes require ſome reviſal and modification; and among the immenſe number of inſects diſcovered ſince the time of Linnæus, the antennæ of many exhibit characters which cannot be expreſſed by any of thoſe his work preſents. Fabricius has others, but theſe, even in addition to thoſe of Linnæus, are not adequate to the purpoſe.

Organs of hearing at the baſe of the Antennæ.

The organs deſtined by nature for the conveyance of ſounds to the ſeat of the ſenſes in the inſect race have never been clearly aſcertained. This can be attributed only, perhaps, to their minuteneſs, which defies inveſtigation, except in ſome few of the larger kinds, and theſe even phyſiologiſts ſeem never to have examined. In the cray-fiſh the organs of hearing are exemplified by Fabricius and Scarpa. Theſe were diſcovered within the head, at the baſe of the antennæ, through the hollow tube of which it is ſuppoſed the ſound muſt be conveyed. Perhaps, from the analogy in certain reſpects, which this tribe of cruſtaceous animals bears to inſects, it may be imagined that the organs of hearing in both are ſimilar: this is very probable; but theſe two orders of creatures differ ſo eſſentially in ſeveral particulars, that we wiſh to expreſs ſuch an opinion with caution.

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In the cray-fiſh the labyrinth of theſe organs is very ſimple, reſembling a ſmall purſe, encloſed in a ſcaly cylinder open at both ends. The extremity by which this ſmall cylinder joins the baſe of the antennæ affords a paſſage for the nerves into the purſe. The oppoſite extremity is cloſed by an elaſtic membrane, which may be named tympanum, or, with more propriety, Cuvier thinks, feneſtra ovalis. The air, or water in which the animal lives, acts immediately on this membrane, the external part of which is obſervable at the lower ſurface of the baſe of the antennæ. That inſects are ſenſible of ſounds, and, conſequently, are furniſhed with organs of hearing, is demonſtrated by numberleſs obſervations.

Front: the anterior or fore part of the head, the ſpace between the eyes and the mouth.

Clypeus: ſhield of the head in coleopterous inſects, the part correſponding with the front of the head in the other orders. In the beetle kind it is advanced more or leſs upon, or over the mouth, and in ſome forms a ſort of cap, the rim of which extends ſo far over the head as to conceal the mouth beneath. The anterior edge of the clypeus is ſometimes miſtaken for the upper lip.

Vertex: the crown, or ſummit of the head.

Gula: that part which is oppoſed to the front of the head, uſually called the throat.

Trunk: the ſecond principal diviſion of which an inſect conſiſts, comprehending that portion which is ſituated between the head and the abdomen. The trunk includes the thorax, collar, ſternum, and ſcutel.

Thorax: a term indefinitely applied ſometimes to the whole trunk, the ſcutel excepted: in a ſtricter ſenſe it implies only the dorſal part of the trunk, and may be conſidered as expreſſive of that portion of the ſuperior ſurface which lies between the head and the baſe of the wings. Linnæus is not ſo explicit as could be wiſhed in his definition of the word thorax; according to this author, it is "the back part of the breaſt," and "upper part of the trunk between the head and ſcutel," yet it is evident, from the diſſimilar ſtructure in this part of the trunk in different inſects, that the definition requires rather more preciſion. It is not unuſual in the ſpecifical deſcriptions of inſects, both by Linnæus and Fabricius, to read of "thorax beneath," and "lower ſurface of the thorax," for the under ſurface of the trunk; though both endeavour to eſtabliſh it as a principle, that the word thorax applies to the back or upper ſurface of the trunk only. The appropriation of ſuitable terms, by which a thorax conſiſting of one, or of ſeveral pieces, may be diſcriminated from each other, is deſirable. In ſome the thorax is of a ſingle piece, as in the orders coleoptera and hemiptera; in that of lepidoptera it comprehends ſeveral ſegments, and a ſimilar ſtructure is ſtill more conſpicuous to view in the order hymenoptera. The firſt or anterior ſegment of the thorax in thoſe conſiſting of ſeveral pieces has been ſometimes called the collar; but in admitting this, we muſt by analogy define the coleopterous and hemipterous orders of inſects as having no thorax. This will be rendered plain, when we conſider that in the latter kinds of inſects the firſt pair of legs ariſes from what is uſually underſtood by the lower ſurface of the thorax; the interior ſegment in hymenopterous correſpond with the whole thorax in the former, for the firſt pair of legs ariſes from it exactly in the ſame manner. In the former the thorax of a ſingle piece is immediately ſucceeded behind by the ſcutel, while in the hymenoptera and lepidoptera a large plane of one or more joints intervene between this true thorax and the ſcutel; and it is to this laſt mentioned dorſal ſpace that the term thorax is aſſigned. Hence it is evident that the language of entomology in this point is not altogether conſiſtent; becauſe what we denominate the collar in hymenoptera, is the thorax in coleoptera, and in coleoptera we find nothing analogous to the thorax of the other order, except the collar.

The thorax in thoſe inſects, which have that part conſiſting of a ſingle piece, or the firſt ſegment in ſuch as are of a compound nature, have the firſt pair of legs ariſing from the lower ſurface, and it is in this part that the muſcles that move the head, as well as this pair of legs, are ſaid to be contained. The thorax in different kinds of inſects varies conſiderably in form, and affords very excellent generical and ſpecifical diſtinctions. Some are armed with ſpines, others denticulated, marginated, &c.

Pectus.—The breaſt is the third ſegment of the body, or that to which the four poſterior feet are attached, and which is longitudinally divided at the anterior part by the ſternum. The wings in lepidopterous, and moſt other inſects, have their origin or baſe in the ſuperior part of the breaſt. The wings and elytra in the coleoptera and hemiptera deviate a little from this, as they are placed more immediately on the back, than in a lateral poſition; the breaſt contains the muſcles that move the wings, and give action to the four poſterior legs. This part is capable of being compreſſed and dilated, the alternate motion of which is very evident in ſome inſects of the butterfly or moth kind, when held between the fingers. The power of compreſſion and dilatation is ſuppoſed to ariſe from the action of ſome very ſtrong muſcles, which ſeem to approximate the dorſal and ventral ſurfaces. They are four in number on each ſide, and differ very much in colour and texture from the other muſcles, being reddiſh yellow, and extremely looſe. It has been conjectured theſe muſcles may aſſiſt the motions of the organs of flight.

Sternum, or breaſt bone.—By this term entomologiſts define that portion of the middle part of the breaſt which is ſituated between the baſe of the four poſterior legs. This piece terminates inſects anteriorly in a ſomewhat acute point, in others it appears rather bilobate, and in the far greater ends obtuſely or in an obtuſe lobe. There are few inſects in which the ſternum is remarkable, either from its magnitude or figure. In ſome of the coleopterous tribes, as hydrophilus and dytiſcus, this part is moſt conſpicuous.

Scutel, or eſcutcheon (ſcutellum, Linn.) the lobe-like proceſs, ſituated immediately at the poſterior part of the thorax, in ſcutellate inſects. The ſcutel is not of the ſame form in all inſects, yet its general tendency is towards a ſub-triangular figure. In the coleopterous tribes it approaches neareſt to this form; its deviations incline more or leſs to heart-ſhaped, with the tip pointing backwards. The ſame figure prevails in ſome of the hemiptera order. In the neuroptera, hymenoptera, and diptera, the triangular contour is ſtill obſervable under various modifications, and moſt commonly with the poſterior tip rounded off. Sometimes, as in ſeveral of the hymenopterous inſects, the poſterior end is armed with ſpines, or denticulations; this is, however, not uſual, the ſcutel in the far greater number of inſects, whether terminating in a point, or rounded, is commonly unarmed. In point of ſize the ſcutel is more variable than in figure; in ſome it is ſo ſmall as almoſt to eſcape notice, merely forming a point at the extremity of the thorax, as we obſerve in certain kinds of the beetle tribe; in others it is very conſpicuous; ſometimes it is ſo large as to cover the middle of the back, and in others, as the ſcutellate kinds of cimices, and a few of the genus acrydium, it expands over the back, entirely concealing the wings and wing-caſes, and covering the margin of the abdomen.

Abdomen is the laſt principal diviſion, or poſterior part of the body, and is connected with the breaſt, either cloſely, or at a diſtance, by means of a fillet. The abdomen is compoſed of annular joints or ſegments, the number of which vary in different inſects. Each of theſe rings is pierced at the ſide with a ſingle pore, which in ſome kinds are of conſpicuous ſize, in others ſcarcely perceptible, and theſe are the orifices of the ſpiracles through which the inſects breathe. The upper part of the abdomen is called by entomologiſts tergum; the inferior, or belly, venter. The opening at the poſterior part of the abdomen is the vent, and the extremity in moſt inſects contains the organs of generation: there are exceptions to the latter.

The total movement of the abdomen is not very obvious, except in inſects which have that portion of the body pediculated, as in many of the hymenopterous genera. It has then a real joint, in which the firſt annulation is indented above, and receives a projecting proceſs from the breaſt on which it moves. This joint is rendered ſecure by elaſtic ligaments, which have a conſiderable degree of force. Some muſcles which ariſe within the breaſt are inſerted into the firſt ring, and determine the extent of its motions. The partial motion of the rings is produced by very ſimple muſcles, conſiſting of fibres which extend from the anterior edge of one ring to the poſterior edge of that which immediately precedes it. When the dorſal fibres contract, the ſuperior part of the abdomen being ſhortened, it turns up towards the back, but when the contraction takes place in the ventral or lateral fibres, the abdomen is inflected towards the belly, or directed towards one of the ſides. The extent of the motion, however, depends upon the number of the rings, and their mode of junction. In the coleoptera, for example, the rings only touch each other by their edges, and the motion is very limited, but in the hymenoptera they are ſo many ſmall hoops, which are incaſed one into another like the tubes of a teleſcope, ſo that ſcarcely half, and ſometimes not above one-third, of their extent appears viſible externally.

The form, connection, proportions, and appearance of the ſurface of the annulations of the abdomen, afford numberleſs ſpecifical diſtinctions; and ſo likewiſe do the appendices at the extremity of the abdomen.

The abdomen contains the inteſtines, the ovary, and part of the organs of reſpiration: it is affixed to the thorax, and in moſt inſects diſtinct from it, forming the poſterior part of the body. The abdomen is compoſed of rings or joints, by which means the inſect can lengthen or ſhorten it, or even move it in different directions. The upper part of the abdomen is called tergum, the under part venter, the vent is in the poſterior part.

Tail.—An appendage of any kind terminating the abdomen is uſually denominated the tail. Theſe appendages vary in figure conſiderably in different inſects, and many tribes are totally deſtitute of them. They are ſuppoſed to be deſtined to direct the motion of the inſect in flight, to ſerve for its defence, and for the depoſition of its eggs. In ſome inſects this tail is ſimple, (ſimplex,) and yet capable of being extended and withdrawn at pleaſure. In others elongated (elongata). Some are ſetaceous (ſetacea) or briſtle-ſhaped, as in the raphidia. Thoſe termed triſeta have three briſtle-ſhaped appendices, as in the ephemera. In ſome it is forked (furcata), as in podura. When it terminates in a pair of forceps it is called forcipata. In the blatta and others it is folioſa, or reſembling a leaf. In the panorpa it is furniſhed with a ſting, and is called telifera; this laſt may be more properly referred to the next.

Aculeus, ſting, an inſtrument with which inſects wound and inſtil a poiſon. The ſting generally proceeds from the under part of the laſt ring of the belly; in ſome it is ſharp and pointed, in others ſerrated or barbed. It is uſed by many inſects both as an offenſive and defenſive weapon: by others it is uſed only to pierce wood, or the bodies of animals, in order to depoſit their eggs. In waſps and bees the ſting is known to be retractile: in the ſcorpion fixed or immoveably connected to the laſt ſegment of the body. In ſome inſects it is the male only, and in others the female only, which nature has provided with this inſtrument; it is not frequently met with in both ſexes of the ſame ſpecies; and the far greater number of inſects have no ſuch organ.

Spiracles.—Theſe are the apparent orifices to the organs of reſpiration in inſects, and which are known to many entomologiſts by the name of ſtigmates. The ſpiracles are a ſeries of ſmall apertures diſpoſed along both ſides of the abdomen: ſome few appear on each ſide the thorax, the remainder on the abdominal rings, every one of which is pierced on each ſide with a ſingle aperture. Among the ancients it was generally believed that inſects had not the power of breathing, and this they concluded becauſe they have no reſpiratory organs, as in larger animals. The moderns are better informed; from the effects produced on inſects by the pneumatic machine it is demonſtrated, beyond diſpute, that they do reſpire, though not in the manner of other animals. An inſect placed in the receiver of this machine, upon the air being exhauſted, becomes ſuffocated, and dies in a very ſhort time; and the ſame reſult will be produced by cloſing the apertures of the ſpiracles with wax, oil, or other glutinous ſubjects, in a ſufficient degree to preclude the paſſages of air through theſe openings, a fact which in itſelf may be regarded as concluſive, that theſe are the true organs of reſpiration in inſects. They are alſo conſidered, and with much probability, as the organs of ſmell, as will be ſhewn hereafter.

Reſpiration being one of the moſt important actions in the life of every animal, it can be no matter of aſtoniſhment that great pains have been taken by naturaliſts to inveſtigate the organs of breathing in inſects; numberleſs facts contributed to prove its exiſtence, but this being accompliſhed by means unknown in the other tribes of animals, it became an object of the greater ſolicitude to explain the manner in which it was effected. Malpighi, Swammerdam, Reaumur, and Lyonet, are among the number of the earlieſt writers on this ſubject, and from their obſervations it appears, that in the caterpillar there are two air-veſſels, called tracheæ, which extend throughout the whole length of the inſect; from theſe proceed an infinite number of ramifications, which are diſperſed in various directions through the body; but the principal are thoſe which form a direct communication between the tracheal veſſels and the openings in the ſides of the body. Of theſe there are nine on each ſide placed nearly at equal diſtances, one extremity terminates in the orifice of the ſpiracle, and the other enters the principal tracheal veſſel diſpoſed neareſt, or on that ſide of the body. Theſe lateral or ſpiracular veſſels ſeem calculated for the reception of air; they are of a cartilaginous nature, and when cut preſerve their figure; they are conſtantly obſerved in a temperate ſtate of moiſture, and communicate in many inſects in the form of conſiderable veſicles, at their junction with the principal tracheæ.

Some writers have imagined, that though the air entered by the ſpiracles into the trachea, it did not come out by the ſame orifice, but was expired through a number of ſmall holes in the ſkin of the caterpillar, after being conveyed to them through the extremities of the finer ramifications of the tracheal veſſels. Others ſuppoſed, that the inſpiration and

and expiration of air through the ſpiracula, and that there was no expiration of air through the pores of the ſkin. Experiments were made to aſcertain the truth of theſe opinions, by plunging the caterpillars into water, or anointing them with fat and greaſy ſubſtances, either partially or entirely. The number of ſmall bubbles which are obſerved to cover the ſurface of their bodies when they are immerſed in water, is ſaid not to ariſe from the air included in them, and then proceeding from them, but to be formed by the air which is lodged near the ſurface of their bodies, in the ſame manner that it is about all other ſubſtances. To render the experiment more accurate, and prevent the air from adhering to the ſkin, before the caterpillars were plunged into water, they were bruſhed all over with a hair pencil, and after this, it is affirmed, that few air bubbles were found on their bodies when immerſed in water. The latter experiments were made chiefly by Bonnet, in order to aſcertain the truth of ſome opinions previouſly advanced by Reaumur.

A caterpillar, according to Bonnet, may be retained a conſiderable time under water, without deſtroying the principle of life, and will recover ſoon after being taken out of the water, when it has lain till all apparent ſigns of life have ceaſed. A caterpillar partially immerſed in water, or with two or three of the ſpiracles remaining in the open air, does not become torpid for a conſiderable time. One caterpillar lived eight days ſuſpended in water, with only two of its anterior ſpiracles in the air. During this time it was obſerved, that when the inſect moved itſelf, little ſtreams of bubbles iſſued from the ſpiracles on the left ſide; from this and other experiments, however, it appeared, that the anterior pair of ſpiracles, together with the poſterior pair, are of the greateſt uſe in reſpiration.

It has been remarked, that "when we conſider the great ſolidity of the caſes or cones of certain kinds of inſects, it is not eaſy to conceive how they can live ſeveral months under the earth in ſpaces ſo confined, and almoſt impervious to the air. If reſpiration was abſolutely neceſſary to their exiſtence, and indeed if they did reſpire, the ſame ſituation ſeems to preclude a continuance of the operation, as the air would ſoon be corrupted, and unfit for the offices of life."

But though it is difficult to aſcertain the reſpiration of ſome inſects at certain periods of exiſtence, except from its effects in preſerving life, which from analogy and collateral circumſtances we are aſſured muſt depend on this cauſe, there are others to whom reſpiration ſeems neceſſary in a very extraordinary degree. Many inſtances of this might be adduced; but in no tribe is this more clearly ſhewn than in thoſe of the aquatic kinds. There are a number of the latter which are obliged to keep their tails ſuſpended on the ſurface of the water for this reaſon, and in proof of which, if they be plunged entirely under water, they become agitated and uneaſy, firſt endeavouring to eſcape and riſe again to the air, or, if prevented, ſhortly fall to the bottom and die. Some aquatic beetles reſiſt the trial for a conſiderable time, while their larvæ can ſupport the privation of air only for a few minutes. A remarkable evidence of the ſame kind occurs in the larvæ of muſca pendula, which, though they live in the mud at the bottom of the water, have the power of extending the tube of the tail to a great length, in order to elevate it to the ſurface of the water; and the extremity of it is furniſhed with a tuft of fine hairs, which preſerves that part buoyant on the ſurface, while the creature remains in a ſtate of quieſcence. A ſimilar verticillated organ is placed at the tip of the tail in the larva of muſca chameleon, which alſo lives in the water; this is expanſile or retractile at the pleaſure of the inſect; when at reſt the expanded tail reſts upon the ſurface of the water, the remainder of the body being ſuſpended in that element with the head downwards, and when it is inclined to deſcend, it has only to retract or cloſe up the rays of the tail to effect its purpoſe; an expanſion of the tail will again raiſe the larva to the ſurface.

Upon anatomical examination, it has been found that the body of this laſt mentioned larva contains two large tracheal veſſels: theſe air-veſſels extend from the head to the tail, terminate in the reſpiring tubes, and receive the air from them. The larva quits the water when the time of its transformation approaches, and enters into the earth, where the ſkin hardens and forms a caſe, in which the pupa is formed: ſoon after the change, four tubes or horns are ſeen projecting from the caſe, which ſome ſuppoſe to be the organ for communicating air to the interior parts of the inſect: they are connected with little veſicles which are filled with air, and by which it is conveyed to the ſpiracles of the pupa. The larvæ of gnats, and various other little aquatic inſects of the ſame kind, are furniſhed with ſmall tubes that play on the ſurface of the water, and convey the air from thence into the body of the inſect.

Nothing can be more evident than that inſects do not reſpire by the mouth, like other animals. To determine the reſpiratory organs in inſects, and alſo to aſcertain in what manner this function of life is performed, has been an object of ſolicitude with many. The experiments made with this view are numerous and concluſive, the reſult demonſtrating, beyond diſpute, that the ſpiracles are the apertures through which the air is drawn into the body. This may be inferred from the writings of Swammerdam, Malpighi, Reaumur, Muſchenbröek, Degeer, and many others, who treat at large on this particular ſubject.

Theſe ſpiracles exiſt in every ſtage of life, in the larva and pupa as well as perfect ſtate. They are viſible externally as a ſmall knob of a roundiſh or oval form, ſlightly elevated and perforated in the middle: the aperture is uſually oblong or ſubovate, and is the orifice of the channel which communicates with the trachea, one of which is diſpoſed lengthwiſe on each ſide of the body.

The extreme tenacity with which many inſects retain life, while deprived of air, ſeems to indicate that they exiſt much longer without the benefit of this renovating fluid than moſt other animals; and that in certain caſes they may endure a temporary ſuſpenſion of the functions of reſpiration. But nevertheleſs every experiment tends to confirm the fact, that ſo far as reſpiration is neceſſary, it is performed only by means of theſe ſpiracles, the cloſing of which, to the total ſecluſion of the air, will at length deſtroy the vital principle.

Lyonet has obſerved, that although it is a general rule that every thing which lives reſpires, it is not perhaps without exceptions in inſects. Many give reaſon to doubt of their reſpiration, at leaſt in certain ſtages of their exiſtence. "I took, for inſtance," ſays he, "ſome of thoſe large cantharides of the willow, whoſe ſtrong ſmell, though not very diſagreeable, is felt at a conſiderable diſtance. I put them under a glaſs, where for a long time ſulphur had been burning on a piece of copper made red-hot, that the ſulphur might continue to burn in the midſt of its own vapours; and although there aroſe ſo thick a ſmoke that it almoſt hid the inſects from ſight, they ſupported theſe vapours for more than half an hour, without ſuffering, that I could perceive, the ſmalleſt injury." Inſects, we are aware, may live ſome time confined in this manner amidſt the vapours of burning ſulphur, but the inſtance adduced by Lyonet is ſtill remarkable, for we have known the ſame experiment tried with theſe cantharides, in the reſult of which the inſects died within

within the fpace of time mentioned by Lyonet; and if, inftead of fulphur, we employ camphor, the refpiratory powers ceafe, and life becomes extinguifhed in a fhorter period.

This author argues, that from the folidity of the greater number of the cones made by the pfeudo-caterpillars, and moft of the ichneumon flies, it cannot be conceived poffible how thefe infects fhould live feveral months under ground, in a place fo clofe and impenetrable to the air, if they were to breathe in it. "Neither," fays he, "would I maintain the refpiration of chryfalids; at leaft one experiment convinces me there are fome which do not breathe. I took the chryfalis of the fphinx liguftri, which being one of the largeft is the moft proper for experiments. It had, befides, the two anterior fpiracles fo open, that with a common magnifier I could fee into the fubftance of its body, and obferve a fmall vacuum between it and the cover. This made me hope, that if refpiration took place in the chryfalis this would give me certain proofs of it. Two or three months before the perfect infect iffued from its cover I dug it up, and covered feveral times, firft one and then two, and afterwards fucceffively, the whole of its fpiracles with foap water. At each time I obferved, for a confiderable fpace, with the glafs, the fpiracles thus covered, to fee if any bubbles of air were formed above, which would naturally have happened, had thefe fpiracles ferved as conduits to the air in refpiration; but with all my attention I could perceive none. Some days afterwards I repeated the fame experiment, in a manner to me ftill more decifive. Inftead of covering the fpiracles with foap-water, I covered each with a little bubble of air, taken from the froth of the fame water, that the air might enter and go out more freely. But my curiofity was not more gratified: thefe bubbles, which ought to have rifen or funk at each expiration or infpiration of the chryfalis, preferved conftantly the fame appearance, till their pellicle becoming dry, they burft. When the perfect infect had iffued from this chryfalis, I took it up inftantly, wafhed the infide of it, and obferved at the fpiracles little bundles, compofed of a great number of very white threads, of which the longeft were about two lines in length. Thefe appeared to me the exuvia of the pulmonary organs. I blowed on each of the fpiracles with all my force, by means of a very flender tube, but my efforts could neither fwell nor move any of thofe fragments of the veffels which were attached to them internally; but this muft neceffarily have happened, had the communication of the external air by thefe fpiracles in the bronchiæ remained open, or had the infect, when inclofed in its chryfalis, been able to breathe through them. It may be inferred from this, that the chryfalis of fphinx liguftri lives for fome time without refpiration, and that its two anterior fpiracles ferve only to facilitate the evaporation of the fuperabundant humours, and to permit the external air to fupply their place." Lyonet, however, admits, that it is not on the fingle experiment here related that the knowledge of the refpiration in infects is founded; and that this experiment does not appear decifive. We have unequivocal proofs of the refpiration of infects; a fact demonftrated beyond all doubt in numbers of the aquatic kind, and as to lungs, he fays, we may affure ourfelves that infects poffefs them without being at the trouble of diffection. The fpiracles are called ftigmata by the modern naturalifts; ftigmates of the French.

Members.

Legs.—In all infects that are furnifhed with wings the pedes or legs amount to fix, and never exceed that number; and the fame is obfervable of the true feet in the larvæ of thofe infects; the latter have fpurious feet to a greater amount, but the true feet do not exceed fix. The apterous tribe in this, as in other particulars, afford exceptions: thofe of the pediculus, pulex, lepifma, podura, and acarus genera have only fix legs, and thefe are attached to the body in the fame manner as in winged infects: the fcorpio, aranea, and phalangium genera have eight; the cancer, if admitted, have as many; and in the onifcus, julus, and fcolopendra, they are far more numerous, varying from ten or twelve to twenty, fifty, or even thrice that number.

The leg of an infect may be divided into four, or, more correctly, into five parts; coxa, the firft joint, or haunch, at the bafe; femur, the thigh; tibia, the fhank; tarfus, the foot; and unguis, the claw. Each of thefe parts is enveloped in a hard cafe of a horny fubftance, and varies in fhape in different infects; the form of the feet in all the kinds being admirably adapted to their mode of life, and convenience of their motion. Some of thefe are diftinguifhed by particular terms, as, curforii, thofe formed for running (and which are the moft numerous); faltatorii, thofe conftructed for leaping; natatorii, thofe employed in fwimming, &c. From the different conformations of thefe limbs, it is eafy to recognize, even in the dead infect, the mode of life which the fpecies is deftined by nature to purfue. Thofe which have the legs adapted for running or walking have them long and cylindrical; the thighs of the leapers are remarkably large and thick, with the fhank long and commonly arched, by which means they poffefs great ftrength and power for leaping: the legs are broad, ferrated, and fharp at the edge, in thofe accuftomed to dig in the earth; and fuch as are of the aquatic kind have the legs, efpecially the pofterior pair, long, flat, and ciliated, or fringed at the edge with hair. The leapers are well exemplified in the faltatorial kinds of curculio; and the fwimmers in the genera hydrophilus and dytifcus.

The coxa, or fmall joint at the bafe, connects the leg to the body, and moves in a correfponding cavity of the collar or thorax in the firft pair, or breaft in the two pofterior ones. This part varies in form: in the cerambyx coccinella, and other tribes in which the feet ferve for walking only, its fhape is globular: fuch as require that the feet fhould have a lateral motion, and which is neceffary to thofe that dig into the earth, have the coxa broad and flat; this is alfo obfervable in fome of the aquatic beetles; in the dytifcus, the coxa of the pofterior legs is confolidated with the trunk, and immoveable; and in the blatta, lepifma, and others which walk very rapidly, it is compreffed into a lamellate form.

There is more diverfity in the form of the thigh than the coxa to which it is united. The articulation of thefe two parts is internal, and is produced in fuch a manner, that when the animal is in a ftate of repofe, it is parallel to the inferior furface of the body. It is limited to a forward and backward motion, with refpect to the firft piece. The nature and extent of the motions of the thigh appear to determine its form. In thofe infects which walk much and fly little, as the carabus, cicindela, &c., the thigh has two little prominences at the bafe, which appear to be intended for removing the mufcles from the axis of the articulation. Thofe which require ftrong mufcles adapted to leaping have the thigh not only thick but greatly elongated, as in the gryllus and locufta tribes, the pulices, or fleas, &c. And in the fcarabæi, fcarites, and other coleoptera, and alfo in the mole cricket (acheta gryllotalpa), all which burrow in the earth, the thigh is moved with much force, and has an articulated furface correfponding to the flat part of the coxa on which it refts. This part is fometimes fpinous.

Tibia, or fhank, is the third joint of the legs, and moves in

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an angle, according to the direction of the thighs. The figure of this part depends effentially on the ufes to which the habits of the infect require it to be applied; in the natatorial kinds it is ufually flat and ciliated, at leaft the tibia of the pofterior pair, and in many others, as in a variety of the burrowing kinds of beetles, it is ferrated. In the mantis genus, to which fhanks of the anterior pair of legs ferve as weapons of defence, they are broad, flat, and acute at the edge, and thefe they wield with dexterity in the manner of a fabre. The fhank is more frequently ferrated or fpinous than the thighs.

The tarfus, or foot, is the fourth joint, or laft portion of the leg, except the claw. This part confifts in general of five joints: this is ufually the number in the coleoptera, hymenoptera, and diptera; in fome of thefe, however, and alfo in the hemiptera, there are only four articulations in this part of the leg, as we obferve in cerambyx, gryllus, and others; in libellula, forficula, &c. three: in the anterior feet of mantis and nepa only one; and in thofe of the nymphales family of butterflies none. The figure of the tarfus is more variable than any other portion of the leg, and is in a moft fingular manner adapted to the infect's mode of life. The articulations in fuch as walk on the furface of the earth are flender, thofe which burrow in the earth have them more robuft. Many of thofe which inhabit waters have them flat and ciliated at the edges, as in the hydrophilus. Others are furnifhed with briftly tufts, or vafcular flefhy tubercles, which enable them to move with fecurity on fmooth and flippery bodies in any direction; an admirable example of this prefents itfelf in the common houfe fly, which "treads the ceiling, an inverted floor," with the fame facility that other infects walk on the furface of the ground. An occafional difference in the number and form of the joints of the tarfus is fometimes obferved in the two fexes of the fame fpecies. The motion of each joint of the tarfus is performed in a fingle plane, and is directed by two mufcles in each joint, one of which is fmall, and placed on the dorfal furface, the other larger, and fituated beneath.

Unguis, or claw, the termination of the tarfus; in the greater number of infects there are two claws attached to each tarfus: fome have only one, and in others furnifhed with two, there is an intermediate procefs forming by this means three. An appearance fimilar to this is feen in the legs of the lucanus, but this, on minute examination, is found to be a diftinct joint alfo, armed with a pair of claws, precifely refembling thofe which, more obvioufly from their fize, appear to terminate the tarfi. It is confiderably fmaller, but as perfectly well defined.

Reaumur, Weifs, Borelli, and Cuvier, have publifhed fome curious remarks on the laws of motion obferved in the legs of infects, fome of which are very interefting. The relative proportion of the feet feems to determine, in a certain degree, the particular manner in which each infect moves either in walking or leaping. When, for example, the legs are all equal, the movement is uniform, but when fhort it is flow, and when long, it moves with rapidity. Thofe infects, therefore, which have the legs long, as in the phalangium, and fome others, run very quickly: and, on the contrary, the acarus, pediculus, and thofe others, which have the legs fhort, are remarkable for the flownefs of their pace. When the anterior feet are longeft, as in certain cerambyces, their fpeed is retarded when moving on even ground, though, in climbing, this length of the anterior legs is an advantage. When the pofterior feet are longeft, they ufually afford the infect the ability of leaping, as in the locuft, acheta, and other families; but fuch a ftructure impedes its fpeed in walking; and does not always enable it to leap; the infects of the leucopfis and chalcis genus, though their pofterior thighs are very large and thick, are fuppofed to be incapable of this action. The latter inability is attributed to the great curvature of the legs, thofe infects which are truly of the faltatorial kind, as in the gryllus genus, being remarkably ftraight.

Alæ, or *wings*.—Wings, the organs appropriated to flight. Thefe in different infects vary from two to four, and are attached to the lateral part of the breaft, clofe to the lower margin of the thorax. They are placed to an equal amount, and in a correfponding fituation on both fides of the infect, whether the number be two or four. Thofe infects which are furnifhed with only one pair of wings, have both of an uniform appearance and fize. Such as have two pair moft frequently differ, the firft being larger than thofe behind: there is alfo a difference in fhape, and very commonly a confiderable variation in the fpots, markings, and other particulars, notwithftanding the prevailing hues in all the wings may be the fame. In general, the pofterior pair is paler, and the marks obfcure.

The wing properly fo denominated fhould be diftinguifhed from the elytra or wing-cafes, thofe hard fhelly coverings of the true wings in the alated kinds of coleoptera. Thefe wing-cafes, or fheaths, are often confounded with the wings; but they are really not wings from their ftructure or fubftance, nor do they anfwer the purpofe of flight: they merely open to afford the true wing, concealed beneath, the power of expanfion and motion, and clofe down upon the wing, when the infect is at reft, to preferve it from injury. Of this we have fpoken more largely in defcribing the elytra. The femi-cruftaceous wings of the hemipterous orders partake of an intermediate character between the wing-cafes and wings, as already noticed in its proper fection. The wings and elytra in fome infects, and the wings and hemelytrous wings in others, are fo intimately connected, that we conceived it requifite, in order to avoid mifconception, to advert again to this circumftance.

A fkeleton of nerves, more or lefs numerous, and differing exceedingly in difpofition, placed between two thin and clofely united membranes, conftitute the true wing in infects. This conformation is very clearly exemplified in that defcription of wings which is ufually termed tranfparent, as in the common houfe-fly and the bee. The true wing, by means of which the infect is enabled to fly, is always conftructed in this manner, whatever may be its appearance externally, arifing from a fuperficial covering of down, feathers, hair, or any other caufe. The variety in the form and ftructure of the wings, in the number, figure, and difpofition of the nerves, or the colours with which they are adorned, is infinite. The diverfity in the difpofition of the nerves is evident from a comparifon of the fimply conftructed wing of the common houfe-fly (mufca domeftica) with the complex wing of the panorpa, or the ephemera, or the wing of the forficula (earwig), which confifts of a feries of fingle nerves, with the elaborately wrought lattice-work of the wing of the libellula. The whole of the lepidoptera tribe exhibit the fuperficial coating of feathers, down, or hairs; and upon the removal of thefe, the wings are found conftructed exactly in the fame manner as the tranfparent wings of the other tribes. A variation in the form of the wing, as well as its texture, is manifeft throughout all the infect tribes of the winged kind. Thofe of the coleoptera have two membranous wings, which fold upon each other, forming a plait, or double at their external margin; which fold is accommodated by a peculiar joint in the main rib of the wing, and the peculiar difpofition of the nerves in the middle of the wing contiguous. In the hemiptera

miptera the wings generally fold longitudinally, without any tranfverfe double, fo that in expanfion. thefe parts open fomewhat like a fan: the forficula is an exception in this order, the wing in this genus being doubled acrofs as in the coleoptera. The wings of the lepidoptera are neither doubled acrofs nor folded longitudinally; they are entirely flat, and incapable of contraction and dilatation. In the papilio genus they are endowed with the power of erection, which is not the cafe in the phalæna genus, though occafionally obferved among the fphinges; the phalænæ have the lower wings concealed under the anterior pair, the latter being laid in a flat pofition over them. The wings of the lepidoptera are downy, and often decorated with very beautiful colours difpofed in the moft pleafing and varied manner. The neuroptera in general have the wings flat; this is not invariable: they are conftantly membranaceous, and reticulated with nerves. In the hymenoptera the wings are membranaceous, generally flat, but fometimes folded, when the infect fettles, as in the wafp genus. The dipterous order cannot be confounded with the preceding, as they have only two wings, without any wing-cafes: they are membranaceous as in the former.

Infects of the dipterous family, bees, and various kinds of hymenoptera, and many others, poffefs the powers of flying in a more perfect degree than any clafs of animals befides; furpaffing in this refpect even the bird tribe. All infects that are furnifhed with wings have not an equal celerity of motion in the air; the movements of the wings in fome infects is more circumfcribed than in others. The mufcles that move the wings are not yet very well afcertained: they are faid to be fituated in the breaft, and to be of two kinds; the firft of thefe are fmall and fhort, and are intended to extend or fold the wings, at the fame time that they move them to and fro from the body; the others, which are fomewhat longer, are calculated to produce thefe motions of elevation and depreffion which the wings perform, very ftriking examples of which are found in the two genera papilio and libellula. The wing-cafes of the coleoptera are not moved, it appears, by the pectoral mufcles like the wings.

The dipterous infects, when flying, emit a loud buzzing found, occafioned, as it is believed, by the wings and balancers ftriking againft each other. The noife of the cricket and locuft is produced by the friction of the wings, or bafe of the wing-cafes againft the pofterior edge of the thorax; and which is obferved likewife to be the cafe with the cerambyx, leptura, and various other infects.

In all infects of the winged kind thefe organs prefent the greateft diverfity, and afford characters both of genera and fpecies lefs liable to fluctuation than common obfervers would conceive. The number, figure, conftruction, proportion, confiftence, and texture of the wings have enabled naturalifts to diftribute infects into principal families with confiderable precifion; and their minor peculiarities of fpots, marks, and colours, have furnifhed fubordinate characters of the utmoft utility in defining fpecies. Linnæus derived much affiftance from an attention to thefe parts; later writers have in many inftances regarded them more clofely; and in the further progrefs of the fcience, we are perfuaded thefe parts may be confulted with much greater advantage ftill.

There are many terms at prefent in ufe, intended to defcribe the different kinds of wings, the principal of which fhould be underftood by the ftudent in entomology.

The wing in all infects is diftinguifhed, with refpect to its furfaces, into fuperior and inferior; that above is denominated the fuperior, and that beneath the inferior. In the defcription of wings, the terms anterior, pofterior, interior, and exterior parts, and fometimes the difk, occur very frequently. The anterior part or margin is that next the head; the pofterior, that towards the vent; its exterior, that towards the outer edge; and the interior, that next the abdomen: the difk is the centre of the wing. Thefe terms are not always applied with precifion by entomologifts: the bafe of the wing, next the point of connection to the breaft, is fometimes called the anterior part; and in this cafe, every other part varies its name in a relative proportion: and this appears to be a correct method of defcribing the parts of a wing in its natural ftate, while the infect is at reft, with the wings down; but it applies only to thofe which difpofe their wings longitudinally: it would be altogether inapplicable in defcribing a papilio, in which the wings are expanded and ftretched forward; or in the libellula, which refts with the wings in the fame pofition. The anterior margin of a wing is, therefore, generally underftood as implying the coftal edge, and which is fo named becaufe it is formed by the main rib that extends from the bafe to the tip of the wing.

The wings are called plicatiles, when they are folded at the time the infect is at reft; planæ, when ftretched out their whole length without folds, and incapable, from the ftructure of their nerves, to be folded up; erectæ, fuch as have an erect pofition when the infect is at reft, the fuperior furfaces being brought in contact above the back, and the extremities oftentimes meeting, as in the butterfly tribe; patentes, thofe like the geometra family of moths, and moft of the libellula, which have the wings expanded horizontally when at reft; incumbentes, fuch as cover in an horizontal manner the fuperior part of the abdomen, when the infect is at reft. Thefe differ from deflexæ, in having the outer edges declining towards the fides, like the ridge of a houfe; reverfæ are alfo deflexæ, with this addition, that the edge of the inferior wings projects from under the anterior part of the fuperior ones; dentatæ are thofe with the wings indented or fcolloped; caudatæ, thofe in which one or more of the nerves of the pofterior wings extends beyond the margin, and forms a procefs, fuch as occurs in the equites family of papilio, and the genus hefperia, and in a far more remarkable manner in phalæna argus; reticulatæ, thofe in which the veins or membranes of the wing form a kind of lattice-work, as in the genus libellula.

The colours (colores) are named in terms agreeably to their common acceptation; but according to the various forms of the fpots, bands, ftreaks, &c. in which they appear on the wings, they have various fignificant appellations. Maculæ are fpots; punctæ, dots; fafciæ, bands; ftrigæ, ftreaks; and lineæ, lines. Ocellus is a round fpot, containing a fmaller fpot of a different colour in its centre. Stigmata is a term in the Linnæan language, introduced to fignify a fpot or anaftomofis in the middle of the wing, near the anterior margin: this is confpicuous in moft of the hymenoptera and neuroptera. Stigmates is a term alfo applied to the fingle or double kidney-fhaped fpot fituated in the middle of the anterior wings in many of the moth tribe, in the noctua family, and in fome of the bombyces. Several modern naturalifts call the refpiratory fpiracles at the fides of the body in infects ftigmates, the application of which may create confufion; ftigmata, and ftigma, ought for this reafon to be admitted in the fenfe Linnæus intended: the fpiracles bear already a name fufficiently indicative of their ufe and appearance, and do not require this alteration. Moft of thefe terms apply only to the lepidoptera tribe, in the markings of whofe wings the moft beautiful colouring prevails.

Halteres,

Halteres, poifers, or balancers, appendages peculiar to infects of the diptera order, and which, with fufficient reafon, are deemed an effential character of that tribe. Thefe poifers are two fhort, moveable, clavated filaments, placed one contiguous to the origin of each wing. They feldom exceed one-tenth the length of the wing, though in certain genera they are rather longer. The capital, or head, in which the filament terminates is either roundifh, oval, truncated at the end, or compreffed at the fides: in fome infects its fituation is directly under a fmall, arched, filmy fcale, which alfo varies in fize and form; and in feveral families is entirely wanting.

The exact purpofe to which nature has deftined thefe organs has not been hitherto afcertained in a very fatisfactory manner. The moft prevalent, and perhaps in fome meafure the moft confiftent, opinion feems to be, that they balance or counterpoife with the action of the wings, when the infect is in flight, in the fame manner as rope-dancers exercife a pole to preferve their equilibrium. The diminutivenefs of their fize is a plaufible objection to this idea. Others confider thefe as the organs of that vibratory found which dipterous infects emit in flight: they compare the filmy fcale to a kind of tambour, and liken the balancer to a drum-ftick, which ftriking repeatedly upon it, they conceive muft occafion this noife. In the conformation of the drum-like organs under the breaft of fome fpecies of tettigoniæ, this conception is fully realized; a found is actually occafioned by fimilar means. (Vide Donov. Inf. China.) But with regard to the diptera, it is apprehended the founds they emit in flight cannot be traced to this caufe: in fome we know it cannot, for the beft of all poffible reafons, namely, that though, like others of the fame tribe, they have balancers, they have no fcale to ftrike with them. It fhould be obferved alfo, that this buzzing found is obfervable in a vaft number of infects which have no poifers or balancers, fuch as wafps and bees. The two genera, afilus and bombylius, have no fcale, and yet the noife perceptible in their flight is louder than in moft of thofe which have both fcale and poifers, as in the mufcæ, for example. Nor does this noife iffue from the poifer, either by ftriking on the fcale, or by any other means, as muft be admitted, fince it is known that if the poifers, or both poifers and fcales, be cut off, the fame found continues to be heard from the mutilated infects as before.

The motion of thefe poifers, when the infect flies, is very lively: they are longeft in the tipula, diopfis, and afilus; in mufca, fcarcely apparent, and accompanied by a fcale of large fize.

Elytra, or wing-cafes, appertain to the coleopterous tribe: thefe are two in number, of a fubftance refembling leather, for the moft part moveable, and opening by a longitudinal future along the middle of the back. The elytra are extended or raifed up when the infect is in flight. They do not appear to affift the infect in its flight; the mufcles, by which they are connected to the body, have not their feat in the breaft, like thofe of the true wings; and its movement in the air is accomplifhed by means of the latter, which are tranfparent, folded between the body and elytra when at reft, and expanded when the infect flies. Some have the elytra united, and may with more propriety be named elytron, for it confifts only of a fingle piece marked with a longitudinal line fuperficially, inftead of being divided by a future; this is lifted up, or rather, the abdomen depreffed downwards, to admit the paffage of the wings laterally, when the infect is preparing for flight. Others furnifhed with elytra, or wing-cafes, feem to render the term for thefe parts exceptionable; for in reality they have no wings beneath them: the number of thefe, however, is not confiderable, and they cannot employ their elytra as organs of flight.

The fuperior furface of the wing-cafes is more or lefs convex, and the lower furface correfpondently concave: the texture in fome, as in fome of the curculio and bupreftis, fo hard, that it is pierced with difficulty by means of a ftrong pin; in others fo flexible, that they fpring into their proper form immediately after being bent double. The proportions of the elytra, compared with the body, are various, their form diffimilar, and the diverfity of their furface, arifing from dots raifed or depreffed, protuberances, flutings, colours, and other circumftances, endlefs. Thefe differences in the elytra furnifh fome excellent generical diftinctions, and are ftill more extenfively ufeful in conftituting the characters of fpecies. When the wing-cafes are fhorter than the abdomen they are termed abbreviata, unlefs they terminate in a tranfverfe line, when they are called truncata; faftigiata, when of equal or greater length than the abdomen, and terminating in a tranfverfe line; and ferrata, when the exterior margin towards the apex is notched or ferrated, as in fome of the bupreftis genus. The appearance of the furface is varioufly diftinguifhed; fpinofa is the term implying that the furface is covered with fharp points or fpines; fcabra, rough; ftriata, marked with flender furrows longitudinally; porcata, with elevated longitudinal ridges; fulcata, with concave ridges, &c.

The want of appropriate terms for thofe kinds of wing-covers, which partake of a middle texture between the elytra and the wings; and alfo for thofe in which the characters of both are united, muft be obvious in the prefent ftate of entomology. To the firft of thefe no fuitable name has been given: the French "ètius molle," and "ètius prefque membranaceux," are not fufficiently expreffive; the firft is deficient in precifion, and in the other there is too much latitude. Linnæus once propofed the term hemelytra, by which he intended to defignate both kinds, whether, as in the grylli, thofe parts were of an intermediate fubftance between leather and membrane; or, as in cimices and nepæ, one half was coriaceous, and the remainder membranaceous. The term, in this general fenfe, could not be ftrictly proper; it was, notwithftanding, preferable to that of elytra, admitting the latter to be rightly applied to the wing-cafes of the coleoptera; and we are therefore the more furprifed it was not afterwards adopted by that naturalift, or fome other fubftituted. So lately as the tenth edition of the Linnæan Syftema, the word elytra is employed indifcriminately for the hard and ftubborn wing-cafes of beetles, the foft wing-covers of the blatta, and the membranaceous reticulated wing-covers of the gryllus, all which genera were included at that time in coleoptera; and by an overfight equally extraordinary, the half-coriaceous wing-covers of the cimices, the nepæ, and notonectæ, were then confounded with the delicate covers of the aphis, thrips, and chermes, under the indifcriminate title of wings. The diftinction of coleoptera and hemiptera is rendered rather more clear in the laft edition of that work, the blattæ and grylli being removed from the former to the latter order; yet the application of the word elytra to the wing-cafes of the hemiptera is not by that means rendered lefs improper. The difference in the conformation and confiftence of the wing-covers in the two tribes is too evident to leave this a matter of doubt. But cuftom has fo far fanctioned this impropriety, that our beft entomologifts to this period defcribe all thefe kinds of wing-covers under the name of elytra. Fabricius has not even attempted to correct this error in the Linnæan phrafeology; he adopts the fame term.

Among the principal differences in the form and texture of the elytra, fome, at leaft, are very remarkable. In the beetle, or coleoptera tribes, thefe parts are coriaceous, very hard throughout, convex in form, and divided by a ftraight future. Thofe of the cimex genus have the upper half only of a coriaceous texture, the lower half being foft and membranaceous, and the latter portion of one elytron is folded acrofs the correfponding part of the other when the infect is at reft. The coriaceous half of the elytra in many fpecies is as hard and tough in texture as the entire elytra in the coleoptera, and the membranaceous part as foft as in the hymenoptera and diptera. In the genera blatta, forficula, acheta, and others, the elytra is of an uniform fubftance throughout, fomewhat refembling parchment; a fimilar texture prevails in the elytra of nepa, notonecta, and naucoris genera, but rather like the cimices, there is a diftinction between the upper and lower portions, the firft being of a firmer texture, and thicker than the other part. The fulgora genus, like the gryllus, affords examples of another kind, thick, membranaceous, and ftrongly reticulated elytra, divided in the middle by a longitudinal future. In the tettigonia, another of the hemipterous genera, the elytra are often perfectly membranaceous and tranfparent in texture, though not in form refembling thofe of the hymenoptera and diptera; yet thefe are called elytra, and fo likewife are the weaker and more flexible tranfparent anterior wings of the aphis, thrips, and chermes, for thefe two are included in the order hemiptera! From a due confideration of thefe decided differences, we cannot hefitate to admit that the term elytra is not applicable to all. In a treatife of this kind it might, perhaps, create confufion to introduce any other terms than thofe in common ufe; we only intimate our perfuafion, that reformation in the language of entomology is neceffary. In the formation of any new fyftem, and which in the prefent ftate of fcience appears requifite, we may reafonably hope to fee thefe and fimilar objections obviated.

In conclufion of thefe remarks, it may be mentioned that nature has herfelf pointed out certain difcriminating characters in thofe parts called the elytra which do not feem to have been fufficiently attended to, and which not only relate to their figure and appearance, but likewife to their utility, or the benefit the infects derive from thefe organs. The wing-covers in the coleoptera do not, it is generally believed, in the leaft degree, affift the infect in flying: in the cimices, and others which have thofe parts of a more flexible texture, they do not materially aid its celerity of motion in the air; but in thofe which have the wing-covers completely fupple, they concur immediately to its velocity in flight.

Sexes of Infects.

The fame difference of fex exifts throughout the infect race as in moft other animals. The fexes cannot be afcertained in the larva and pupa ftate, except in fome few inftances; but when they arrive at their laft ftate, both kinds poffefs permanent characters, by which they may be eafily determined: thefe confift in a comparative difference in their fize, and vivacity of colour, form of the wings, bulk of the abdomen, fhape and dimenfion of the antennæ, and various other external peculiarities.

In moft infects the male is fmaller than the female, their comparative difference varies confiderably in different fpecies. In the lepidopterous tribe the female is only perceptibly larger than the other fex in general; in the ant it is fix times larger than the male: in the coccus twelve or fifteen times, and in the termes the female is at leaft two hundred times larger than the male. This latter fex is commonly decorated with colours more lively and brilliant than the females, a diftinction obfervable in a very remarkable degree in many of the butterfly tribe, the males of which are very beautiful, and the females obfcure. There is alfo fome difference in colour between the two fexes in fome coleopterous infects.

Many of the larger tribes of beetles (geotrupes) prefent a wide diffimilarity in the conformation of the two fexes: in the males the head is embellifhed with one, two, or more diftinct and prominent horns, and which, in a number of fpecies, are very confiderable in fize; thefe are entirely peculiar to the males; the head of the female has only a few flight protuberances inftead of horns, and is fometimes even deftitute of them.

In the moth tribe the antennæ of the male are almoft invariably larger or more deeply pectinated than in the female, and this difference may be traced from the broad feather antennæ of the largeft bombyces, to the fetaceous antennæ of the noctuæ; however flightly the antennæ of the male appear pectinated, thofe of the female will be found ftill lefs fo. The abdomen in this order is alfo fmaller than that of the female. The colours of the wings alfo differ amazingly in the two fexes, of which phalæna humuli (Linn.) affords a very ftriking example, the wings of the male being of a beautiful fnowy white; that of the female bright yellowifh, with orange fpots.

Another diftinction, but which is not a general character, confifts in the female being apterous, or without wings, the male being furnifhed with thofe organs of flight. Among the coleoptera we find the lampyris of this kind; in the hemiptera the blatta; among the moth tribe, phalæna antiqua, gonoftigma, brumata, &c. Thefe winglefs females are indeed fo much unlike the other fex, that no one unacquainted with infects could believe them to be of the fame fpecies. The females of thefe lepidopterous infects are not entirely apterous; they have four very minute wings attached to the thorax, in the fame place as is occupied by the bafe of the wings in the other fex, otherwife they refemble an apterous infect. In the aphis tribe the male has fometimes wings, and is fometimes without; and the female, it is faid, differs in the fame manner.

Thefe are the principal external characters, by means of which the two fexes in infects may be difcriminated.

Generation.

That general law of nature which prevails among the larger tribes of animated beings, and ordains an intercourfe of the two fexes as indifpenfable to the production of their young, does not regulate the multiplication of all infects: there are fome fingular deviations to the contrary. The doctrine held by the ancient fages of Egypt, that in certain infects both fexes are united, is perhaps inadmiffible: we ought not to fpeak with too much confidence on this fubject, notwithftanding the affurance of Linnæus, that there are no hermaphrodite infects. The obfervations of naturalifts leave us in no uncertainty with refpect to another order of beings, namely, thofe which belong to neither fex; and indeed the exiftence of thefe is demonftrated daily in every hive of bees.

The myfteries of generation are only in part unveiled to the philofophical enquirer. Some leading points appear equivocal, and remain inexplicable. This is the cafe with larger animals, where we have external circumftances to direct our judgment. With refpect to infects, in particular, the hiftory of their generation, in certain inftances, at leaft, is more obfcure. Many of them, like the larger animals, produce their young in confequence of an immediate union of of the fexes. But among the numerous families which compofe this extenfive clafs of creatures, there are fome deviations from this ordinary courfe of nature, and thefe partaking of incidents fo remarkable, that no pofitive and uniform conclufion of their mode of increafe can be laid down. The notions entertained by fome philofophers in the middle ages, that infects are the offspring of corruption and putridity, have no foundation in reafon or analogy. It is impoffible to conceive that organized bodies, poffeffed of life, and endowed with fenfibility, can owe their origin to chance. But beyond this we are authorized in the belief of circumftances, that militate very ftrongly againft eftablifhed opinions. The courfe of generation and mode of increafe, obferved in certain tribes of infects, have no parallel among thofe of the larger kinds of animated beings: we need only mention a few particulars of the aphides in fupport of this.

Of the aphis genus there are not lefs than feventy fpecies known, and the females of every one of thefe, fo far as it has been poffible to inveftigate their manners, are capable of producing their young without the concurrence of the male fex! A female aphis, brought up in the moft perfect feclufion from the very inftant of its production from the egg, will in the courfe of a few days be found in the midft of a numerous family of females only, brought forth alive. An individual taken from thefe, or even felected at the moment of its birth from the brood, and kept alone, will in a fhort time produce another brood, and in like manner a repetition of the fame experiment will be again attended with the fame refults.

It would be only a natural inference drawn from the above mentioned circumftances, that in the fame individual of this kind the two fexes muft be united. This we know is not without example in the inferior order of animals, the greater part (we fhall not fay the whole) of the vermes tribe being probably of this defcription. Such is not apparently the cafe however with regard to the aphis; the real truth appears ftill more aftonifhing. To render thefe fertile, the intervention of the male feems to be requifite in autumn, and hence the power of impregnation devolves down to the tenth, or, as fome naturalifts affirm, to the twenty-feventh generation. The eggs of the firft, or parent brood, are laid in autumn, thefe hatch in the enfuing fpring, and this fertile produce perpetuate the race through many generations till the autumn following; every brood, after thofe hatched in fpring from the egg, being viviparous.

The generality of vermes are believed to unite the two fexes in the fame individual, and thus poffefs the power of felf-production. Later obfervations feem to prove, that moft animals of this tribe have both male and female organs, but that the union of two individuals are ftill requifite, each performing at the fame time the office of male and female, and by this reciprocity of their functions both become fertile. Among the cancri, which Linnæus confiders of the infect race, we are affured fome monftrous lufi have been obferved, in which the organs of both fexes were apparent; but probably thefe might not poffefs the ability to perpetuate their natural race. Thefe we pafs over therefore for the prefent as irrelevant. There is no infect, perhaps, fuch accidents excepted, in which the two fexes are united. We advance even this with caution, becaufe there is reafon to imagine the contrary in certain inftances. From our own obfervation we are perfuaded that fome few at leaft of the fuppofed vermes are the larvæ of genuine infects. Let us for a moment imagine thefe larvæ to be really vermes! And let us farther conceive that thefe larvæ, like the true vermes, are of the hermaphrodite kind! What an extraordinary deviation from the ufual courfe of nature would fuch a prodigy prefent!

Here, however, be it explicitly underftood, that we do not affert the latter part of this obfervation as abfolutely certain. Such an affertion is countenanced by no opinion except our own, and fuch opinion ought not to be advanced without being at the fame time fupported by argument and proof, the production of which would extend the limits of our obfervations very far beyond our prefent defign. It is only our wifh to intimate at this time, that there are certain animals of the fuppofed vermes, and which are defcribed by Linnæus and others as appertaining to this clafs, which are in reality the larvæ of infects; and that we are not without fufpicion that fome of thefe larvæ are fertile, and produce an increafe in a manner not very clearly known, before they affume their final form. Among the fuppofed vermes of the marine kind, the larvæ of certain coleopteræ will perhaps be recognized. Thefe are fimply larvæ, and apparently deftitute of any fexual functions till they arrive at their laft ftate. Some of the frefh water larvæ, miftaken for vermes, are in all probability of the fame defcription. But have we fufficiently examined the inteftinal vermes? Are any of thofe peculiar to different animals, or man, capable of producing young vermes, like themfelves, and afterwards becoming infects? One fact may be important, and we ftate it upon the teftimony of our own knowledge, that certain kinds of thefe fuppofed vermes, which infeft the human race to the deftruction of thoufands in the age of infancy, are really no other than the larvæ of infects.

Linnæus affirms that no infect can form an union with the oppofite fex, or propagate its kind till it arrives at the laft ftate, and offers this as a proof that gryllus pedeftris is not a pupa which its appearance implies, becaufe it is found connected with the female. This obfervation of Linnæus is pretty generally correct, and it may be further added, that in the different ftates, prior to the perfect condition, there are no fexual organs, or at leaft none that are developed. This is the fact with regard to moft infects, certainly not to all. Among the cimices there can be no doubt in our own mind from actual obfervation, that the femi-nymphs of certain fpecies do unite with their mates, and afterwards become winged infects. We are not without fufpicion that many of the grylli, like the pedeftris, poffefs the fame faculty, and are afterwards furnifhed with wings.

With refpect to the infects of neither fex, or neuters, it fhould be obferved that thofe appertain to fpecies in which there are the two diftinct fexes befides, as in the bee tribe. It is chiefly among the hymenopterous infects that we meet with thefe neuters; the formicæ afford examples of other infects of the fame kind, and it is believed there are likewife neuters among the coleoptera. They are called neuters becaufe they are of no apparent fex. Some have pretended that they are no other than females, in which the fexual parts are not yet developed. This cannot, however, be the fact; neither can they be of the male fex under the fame difguife, becaufe they are conftantly diffimilar in their characters from both, and could fcarcely be fuppofed, from their appearance in many inftances, to belong to the fame fpecies they really do, had not this been afcertained by their production from the fame brood with the two diftinct fexes.

Of infects in general it may be obferved, that the males and females of the fame fpecies are not unerringly faithful; they deviate occafionally from the path appointed by nature. This is moft obfervable in the coccinella genus. Thefe hybrid infects are conceived to be unfruitful; they refemble the

the female in form, but in point of colours and fpots have fome refemblance to the male parent.

There is an accordance in the ftructure and fituation of the fexual organs in infects, whether male or female, with thofe of larger animals, and their union is accomplifhed in the fame manner. Thefe organs are ufually placed at the extremity of the abdomen. This is not conftantly the cafe; there are infects, and among thofe the fpiders, which have the male organs placed at the tip of the feelers, one at the extremity of each; every individual of thefe creatures being furnifhed with two. The female organ is beneath the abdomen. Another fingularity is obfervable in the libellulæ (dragon flies), the males of which have the fexual organ fituated under the breaft, while that of the female is at the extremity of the abdomen. When in union they are feen flying in the air, the female under the male with her flender body incurvated, and the tip of the abdomen bent under his breaft.

Except at the period of their amours the fexual organs of infects are not perceptible, thofe of the male at other times are drawn within the body. Their union in fome fpecies continues for a fhort time only; others remain in this ftate for hours, or even days together.

Transformation of Infects.

Moft animals retain during life the form which they receive at their birth. Infects are diftinguifhed from thefe by the wonderful changes they undergo. The exiftence of an infect partakes of two, three, or four diftinct ftates, and in each of thefe differs moft effentially in appearance, organization, and manners of living.

The ancients were not unacquainted with the fingular metamorphofes of infects. Ovid has drawn many beautiful fables from this fource. The fongs of Anacreon afford certain paffages to the fame effect; and we might alfo mention others. An inquiry into the knowledge of the ancients in this refpect might be interefting; but we cannot now purfue the inveftigation, as it would lead to digreffions the limits of this article will not allow. Our ideas have been offered at fome length in another place. (Donov. Hift. Inf. China.) We fhall only obferve for the prefent, that they were not unacquainted with the metamorphofes which certain infects undergo. Their poets wantonly intermingled fable with truth, to improve their allegories; but their hiftorians were more correct, and feldom formed erroneous conclufions, unlefs deceived by fpecious appearances. In the fixteenth century, with the revival of learning and philofophical difcuffion, and from that period to the prefent, this fubject has engroffed much attention. The labours of Swammerdam, Goedart, Merian, Malpighi, and others, contributed materially to its advancement in the firft inftance. Their difcoveries induced others to regard the transformations of thefe curious creatures with attention; and hence, in the courfe of years, their hiftory became pretty generally underftood. Thofe who afterwards contributed moft effentially to the improvement of this branch of entomological knowledge were Reaumur and Degeer. In the progrefs of time, other valuable works appeared in elucidation of the fame fubject. The moft ufeful of thefe, perhaps, to the general reader, are thofe denominated "Entomologi Topographici," or fuch as relate to the infects, with their transformations peculiar to, or inhabitants of particular countries. Among the number of thefe may be mentioned the two works of Merian, "Erucarum ortus, Alimentum et Paradoxa Metamorphofis," and "Infecta Surinamenfia." "Hiftoire abregée des Infectes, qui fe trouvent aux Environs de Paris," by Geoffroy; "Naauwkeurige Waarneemingen," &c. of Admiral; Roefel's "Infecten Beluftigung;" Abbot's "North American Infects," by Smith; and Donovan's "Infects of Great Britain."

The changes through which the greater number of infects pafs are from the egg to the larva, from the larva to the pupa, and from the pupa to the laft or perfect ftate. Exceptions occur to this: for fome infects are viviparous; the number of thefe is not confiderable: and there are others of the apterous or winglefs kind, which undergo no change, iffuing from the egg in the perfect form.

Of the Egg State.

The egg, containing the infect in its fmalleft fize, is expelled from the ovary as in oviparous animals. They are contained and arranged in the body of the infect, in veffels which vary in number and figure, in different fpecies. The fame variety is found in the eggs: fome are round, others oval, fome cylindrical, and others nearly fquare. The fhells of fome are hard and fmooth, while others are foft and flexible. It is a general matter of obfervation, that eggs do not increafe in fize after they are laid: among infects we find, however, one exception to this rule, for the eggs of a fpecies of tenthredo are known to become larger after being depofited. The fhell is membranaceous, which admits of this dilatation.

The eggs of infects are of various colours; fome are found of almoft every fhade of yellow, green, and brown, a few are red, and others black. Green and greenifh are not unufual, and they are fometimes fpeckled with darker colours, like thofe of birds. Some are fmooth, and others befet in a pleafing manner with little raifed dots.

Infects are inftructed by nature to depofit their eggs in fituations where their young ones will find the nourifhment moft convenient for them. Some depofit their eggs in the oak-leaf, producing there the red-gall; others chufe the leaf of the poplar, which fwells into a red bladder: to a fimilar caufe we are indebted for the knob, which is often feen on the willow leaf, and the three-pointed protuberances upon the termination of the juniper branches. The leaves of the veronica and ceraftium are drawn into a globular head, by the eggs of an infect lodged in them. The phalæna neuftria glues its eggs with great fymmetry in rings round the fmaller twigs of trees; others affix them to the furface of leaves; and again, others lodge them in the crevices of trees.

The gnat, the ephemera, phryganea, and libellula, hover over the water all day to drop their eggs: thefe hatch in the water, and continue there while in the larva and pupa form, quitting the water only when they attain the winged ftate. The mafs formed by the eggs of the gnat refembles a little veffel, and floats on the furface. This infect depofits only one egg at a time; the firft is retained by means of the legs, when dropped, till a fecond is depofited next to it, then a third, fourth, and further number, till the mafs becomes capable, from its fymmetry, to fupport itfelf upright. Many moths cover their eggs with a thick bed of hair or down, collected from their own body; others cover them with a glutinous fubftance, which, when hard, protects them from the ill effects of moifture, rain, and cold. The folitary bees and wafps prepare nefts in the earth, hollow trees, or cavities in old walls, wherein they place a quantity of food for the fupport of the young brood, when they break from the egg. Some of the fpiders carry the eggs on their back in a fmall filky bag. The ants are known to conftruct nefts in the earth, in which their eggs are placed

placed with the utmoſt care. Some depoſit their eggs in the larvæ of other inſects, chiefly thoſe of the moth and butterfly kind; and having paſſed through all their changes in their bodies, become what is termed the ichneumon fly. In the Lapland Alps there is an inſect called the rein-deer gad-fly (oeſtrus tarandi), the attacks of which are greatly dreaded by the rein-deer. It hovers all day over theſe animals, who betray every mark of fear; their legs tremble under them; they prick up their ears, and ruſh to the mountains covered with ice and ſnow, to eſcape from the fly, but often in vain; for the inſect follows, and generally finds means to lodge its egg in the back of the deer. The worm hatching penetrates the ſkin, and remains under it in ſecurity during the winter; in the year following it falls out, changed to a pupa, and becomes a winged inſect. The oeſtrus bovis is an equal terror to oxen; the hippoboſca equina to horſes; and oeſtrus ovis to ſheep: the latter inſinuates its eggs into the head of thoſe uſeful animals, through the naſal organs.

The neſt formed by the female of hydrophilus piceus, for the preſervation of their eggs, is altogether remarkable, and is deſcribed with much minuteſs by Lyonet. This neſt is whitiſh, its figure an oblate-ſpheroid, three-fourths of an inch in length, and its breadth two-thirds of its length; on the upper ſurface it is terminated by a lengthened horn-like proceſs, an inch long, ending in a point, and of a browniſh colour. In this neſt the eggs are depoſited, and left floating on the water till in due time they hatch, and the larvæ deſert the little bark contrived for their preſervation in the ſtate preceding, committing themſelves to the water. Theſe coques generally float among reeds and duck-weed. The purpoſe of the conical projection is ſuppoſed to be that of ſuſtaining the caſe in an upright poſition, when aſſailed by the wind: but this is mere conjecture; we may have yet to learn its actual deſtination. Another aquatic inſect, (one of the nepa genus,) that inhabits the waters of China, exhibits a far more extraordinary inſtance of the parental care which the inſect race evince for the preſervation of their eggs. This diminutive creature, ſcarcely an inch long, and of a ſubrotund figure, with the upper and lower ſurfaces flattened, is ſeen at particular ſeaſons bearing a large cluſter of eggs on its back, which, though diſpoſed as compactly as poſſible, by being placed on one end, and having the ſides touching each other, cover no inconſiderable portion of the whole ſurface of the diſk. In this manner they are conveyed by the inſect, wherever it goes, till the larvæ hatch, and drop inſtinctively into the water; when the parent inſect caſts off the exuvia of the nidus, and reſumes its former appearance. (Donov. Inſ. China.)

Of all the productions of nature inſects are ſuppoſed to be the moſt numerous and fertile. With the exception of fiſhes and cruſtacea, they are apparently the moſt prolific. Lyonet has offered a curious eſtimate of the increaſe of inſects, taken from their eggs. From a brood of 350 eggs, which he obtained from a ſingle moth, he ſelected 80. Theſe, when arrived at their perfect ſtate, produced 15 females; and hence he deduces the following concluſion. If 80 eggs give 15 females, the whole breed of 250 would have produced 65. Theſe 65, if equally fertile, would have produced 22,750 caterpillars, among which there would have been 4265 females. Theſe, in the third generation, by the ſame mode of calculation, muſt amount to 1,492,750 caterpillars. The number would have been ſtill greater, if in the firſt inſtances a larger number of females had been ſelected.

Of the Larva State.

Coleoptera.—The larva of all the coleopterous tribes of inſects is produced from an egg, in which the growth of the creature in an embryo or infant ſtate may be eaſily traced ſome time previouſly to its birth. They are either of a heavy, ſlothful, and voracious diſpoſition, as may be obſerved moſt commonly of thoſe which paſs their lives under ground, in putreſcent ſubſtances, or the trunks of trees; or briſk and active, like the generality of thoſe in the ſucceeding or hemipterous order. Among the coleopterous larvæ of lively manners we muſt rank ſome of the terreſtrial kinds, which, though they live in the earth, are always found cloſe to the ſurface, and affect particular ſoils; and thoſe of ſands, in maritime ſituations eſpecially: to theſe we ſhould add the inhabitants of the watery element, or thoſe which, in the ſtate of larva, are of the aquatic kind; and in ſhort, all that are carnivorous: theſe being more remarkable for their activity than ſuch as are deſtined by nature to feed on plants only. A ſuccinct account of the larvæ belonging to a few of the principal genera, and a conciſe deſcription of their manners, will be ſufficient to afford an accurate idea of the modes of life purſued by the larvæ of coleopterous inſects in general.

We know nothing from actual obſervation of the larvæ, from which the larger kinds of extra European beetles are produced: the transformations of the ſpecies hercules, alcides, actæon, atlas, and goliathus, and a hoſt of other gigantic animals of the ſame kind, (the largeſt of the inſect race,) remain at preſent in obſcurity. Yet we are at no loſs to conceive what the appearance of ſuch inſects in the larva ſtate muſt really be, ſo far as we already know their affinities; becauſe, from analogy, we can conclude they muſt be ſimilar, or at leaſt, generally ſpeaking, we may preſume with ſafety they differ only in ſome ſlight degree. The transformations of the ſpecies naſicornis, a native of Europe, an inſect of large ſize, and from its conformation poſſeſſing habits ſimilar to ſome natural family of exotic beetles, will, for example, aſſiſt our concluſions as to thoſe reſembling it; and, in like manner, the transformations of other extra European kinds may be determined with ſome preciſion, from the known changes of thoſe inſects naturally allied to it, or, in other words, of the ſame natural family.

Scarabæus naſicornis, or, as it is ſometimes called, the rhinoceros beetle, from the conſpicuous horn placed erect on the head of the male, reſembles an extenſive family of ſcarabæi, the inhabitants of Aſia and Africa. The larva is hatched from an egg of a roundiſh form. The body is like that of a thick and ſomewhat broadiſh annulated worm, of a pale yellowiſh-white colour, flattiſh on the belly, and with the ſkin much wrinkled. The lateral breathing ſpiracles are very diſtinct, the head is hard and ſcaly, and armed with powerful jaws; and the three anterior rings of the body are furniſhed each with a pair of ſcaly jointed feet. It is found in the earth and in hollow trees, and ſeveral times caſts its ſkin before it changes into the pupa ſtate. The larva of the cock chafer, another of the ſcarabæi, (melolontha, Fabr.) reſembles this, except in being ſmaller: like the reſt of its family it ſpends the greater part of the time, while it remains in the larva form, in the earth, where it ſubſiſts on the roots of plants. It is two, and ſometimes three years in paſſing from the egg to the perfect ſtate.

The ſtag beetles, (lucanus,) in the larva ſtate, bear a ſtrong ſimilarity with the preceding; they reſide chiefly in rotten wood. The larvæ of ſome cerambyces reſemble theſe in being ſoft, and in having the head and feet ſcaly. It is the

the larva of an infect of this genus (C. damicornis) which is eaten, and confidered as a delicacy in the Weft Indies. The fpecies is a native of this and other parts of America, and it is credibly affirmed, on the beft authority, that fome people of fortune in the Weft Indies keep negroes for the fole purpofe of going into the woods in queft of them, and fcooping them out of the trees. Their general length is about three inches and a half, and their thicknefs that of the little finger. Dr. Browne, in his hiftory of Jamaica, particularly defcribes this infect; he informs us it is chiefly found on the plumb and filk cotton trees; that they are commonly called macaccos, or macokkos; and that the mode of drefsing them, after opening and wafhing, is to broil them carefully over a charcoal fire. The epicures of thefe tranf-Atlantic regions only imitate the epicures of antiquity: they alfo efteemed the larvæ of the beetle tribe as a delicacy, and introduced them to their tables.

Many fpecies of that elegant tribe of beetles, the curculiones, are the offspring of larvæ, bearing fome refemblance to the former: their body is covered with a wrinkled fkin, their head with a fcaly covering, and the three anterior rings of the body furnifhed each with a pair of feet. Thefe infeft plants of various kinds; fome fubfifting on the flowers, others the leaves, the roots, feeds, &c. One of thefe, the larva of curculio palmarum, deferves notice for the fame reafon as that of cerambyx damicornis. This larva is about two inches long, and of an oval fhape. It lives in vaft numbers in the middle of the trunk of the young palm trees, and feeds on its juices. Thefe trees are fometimes cut down, when about the height of a man, and the tendereft part of them eaten; the worms are alfo taken care of, being confidered as highly agreeable food when roafted.

The larvæ of the coccinellæ have the body long, annulated, and furnifhed with fix feet; they run brifkly over plants, and feed chiefly on plant lice. The larvæ of the genus caffida are generally found under the leaves of plants on which they feed, to which they adhere by means of their lateral fpines, and a briftle at the end of their tail. They form a kind of umbrella with their excrement, under which they are fheltered from the fun and rain. The larvæ of the cicindelæ are foft and white, long fix-footed, and have a brown fcaly head. Thefe creatures employ great addrefs to entrap their prey: like the lion ant, in fome degree, the larva lurks in a round perpendicular hole in the ground, with its head at the entrance, to draw in and devour whatever infects come within reach. The larvæ of dermeftes live in leather, fur, and other fimilar fubftances, to which they do confiderable mifchief. The larva of the ptini infinuates itfelf into wood, and deftroys it.

That fimilarity in exterior characters, which we obferve fo prevalent in the perfect ftate of all coleopterous infects, whether of the terreftrial or aquatic kinds, is not apparent in the larvæ of thofe two natural tribes: they are in this ftate altogether remote, and have no greater analogy in their conformation than in their manners of life, or the elements in which they exift.

The larvæ of the dytifci conftitute a link of beings clofely allied to fome of the neuroptera; and this refemblance is fo remarkable, that certain fpecies of dytifci and hydrophili in that ftate differ more from each other than they difagree with the larvæ of the libellula; thefe latter prefenting creatures of an intermediate character, and which, to an ordinary obferver, would feem to unite them. Thus, the larva of libellula grandis more clofely correfponds with thofe of dytifcus marginalis or punctulatus, than the latter with dytifcus caraboides; and in external afpect the affinity of the larva of dytifcus caraboides may be even ftronger towards that of ephemera marginata or hemerobius lutarius, than to either of the former. There is certainly a difference between thefe in the ftructure of the jaws, &c.; but we fpeak only of thofe obvious characters and general appearances which firft excite attention.

Dytifcus marginalis, the fpecies before mentioned, is common in many ftagnant waters; and, from refembling the fhrimp in fome diftant degree, bears the name of fquilla aquatica in the writings of Mouffet and Aldrovandus. It meafures, when full grown, about two inches and a half in length, and is of a pale yellowifh-brown colour, and very tranfparent. The head is large, fomewhat flattened, and furnifhed in front with a pair of very ftrong curved forceps, which, when magnified, are found to be perforated at the tip: thefe are the inftruments with which it feizes upon its prey, and fucks its animal juices. The legs are flender and fmall in proportion to the body; the tail terminates in a trifurcated procefs, ciliated at the margin. This larva is a fierce deftructive creature, and not only commits vaft depredations among the weaker kinds of water infects, but preys alfo on the fry of fifhes, and is for this reafon highly injurious in fifh-ponds. It is fuppofed, like fome others of the fame genus, to remain two years in the ftate of larva. Dytifcus cinereus is produced from a larva fomewhat fimilar, but remarkable for the length of the legs: its habits are the fame. Caraboides is an hydrophilus, having the antennæ clavated inftead of filiform; the body of the larva is fhaped like the former, but on each fide is a fingle feries of plumofe branchiæ, or breathing organs, like thofe obfervable in the larvæ of ephemera marginata. In the firft ftages of growth this larva is fufcous; when full grown, the pofterior part is greyifh and rather pellucid. The gyrinus is another aquatic genus, and, from its form in the perfect ftate refembling the dytifci, has been fuppofed fimilar in that of larva; an argument, as already fhewn, not always admiffible. From the reprefentations given by fome authors, it is not unlike that of H. caraboides, in the fpecies natator, only of a more elongated form, and having four ciliated appendages at the pofterior end.

Hemiptera.—The larvæ of all hemipterous at prefent known are furnifhed with fix legs, antennæ, and organs of the mouth, as in the perfect infect from which they originate; and agree with them in moft other refpects, except in being entirely deftitute of wings. The larvæ of the mantes are carnivorous; thofe of the grylli feed on plants and farinaceous matter; the nepæ are aquatic, and fubfift on water infects; the cimices, inhabitants of the land, and a moft extenfive tribe, are entirely carnivorous, and like that odious and well-known infect of the fame genus, (the common bug,) derive their fuftenance from the blood and juices, extracted by means of their probofcis, from the bodies of other animals, thofe of the largeft kinds, and man not excepted.

Lepidoptera.—The caterpillars of the butterfly, fphinx, and moth tribes form a very numerous feries; and thefe, from a variety of concurrent circumftances, have been more particularly obferved than any others. The greater part of thofe lepidopterous infects which come forth in the fpring or fummer perifh or difappear at the approach of winter. There are few, the period of whofe life exceeds that of a year. Some furvive the rigours of winter from being concealed under ground, and others remain hid in the bark of trees, or in the chinks of old walls, but the proportion of thofe which out-live the inclemency of the winter feafon is very inconfiderable, unlefs it be thofe in the egg ftate. Thofe which

which are hatched in the autumn, and live under ground or in other places of fecurity during winter, ufually come forth in the fpring, take proper nourifhment, and undergo their feveral changes to the perfect ftate. The eggs, which have been carefully depofited by the parent fly in thofe places where they could remain in the greateft fafety, are alfo hatched in general by the genial influence of the fpring, and the infant brood called into life and action.

All caterpillars are hatched from the egg, and when they firft proceed from it are generally fmall and feeble, but grow in ftrength as they increafe in fize. The body of the caterpillar confifts of twelve rings; the head is connected with the firft, and is hard and cruftaceous. No caterpillar of the moth or butterfly has lefs than eight, or more than fixteen; thofe which have more than fixteen belong to fome other order of infects. The fix anterior feet, or thofe next the head, are hard and fcaly, pointed and fixed to the firft three rings of the body, and are in number and texture the fame in all lepidopterous larvæ. The pofterior feet are foft, flexible, or membranaceous; they vary both in figure and number, and are obfervable only in the caterpillar ftate, the perfect infect having only fix feet, the rudiments of which are the fix anterior fcaly feet before-mentioned. Thefe fpurious feet are either fmooth or hairy, foft to the touch, or hard, like fhagreen. On each fide of the body are nine fmall oval apertures, which are confidered as the organs of refpiration, and are called fpiracles. The head is covered with a fhelly fubftance, and on each fide are five or fix fmall black fpots, which are fuppofed to be the eyes. Some caterpillars grow to a very large fize.

The caterpillar, whofe life is one continued fucceffion of changes, often moults its fkin before it attains its full growth. Thefe are the more fingular, becaufe when it moults it is not fimply the fkin that is changed; for we find in the exuvia the fkull, jaws, and all the exterior parts, both fcaly and membranaceous, which compofe its upper and under lip; its antennæ, palpi, and even thofe cruftaceous pieces within the head, which ferve as a fixed bafis to a number of mufcles; we alfo find in the exuvia the fpiracles, the claws, and fheaths of the anterior legs, and in general the traces of all that is vifible in the external figure of the caterpillar.

The change in the caterpillar is effected by the creature withdrawing itfelf from the outer fkin as from a fheath, when it finds itfelf incommoded from being confined within a narrow compafs. But to accomplifh this change is the work of fome labour and time. Thofe caterpillars who live in fociety, and have a kind of neft or habitation, retire there to change their fkin, fixing the hooks of the feet, during the operation, firmly in the web of their neft. Some of the folitary fpecies fpin at this time a flender web, to which they affix themfelves. A day or two before the critical moment approaches, the infect ceafes to eat, and lofes its ufual activity; in proportion as the time of its change approaches, the colour of the caterpillar declines in vigour, the fkin hardens and becomes withered, and is foon incapable of receiving thofe circulating juices by which it was heretofore nourifhed and fupported. The infect is now feen at intervals with its back elevated, or with the body ftretched to the utmoft extent: fometimes raifing its head, moving it from one fide to another, and then letting it fall again. Near the change the fecond and third rings are feen confiderably fwollen. By thefe internal efforts, the old parts are ftretched and diftended as much as poffible, an operation attended with difficulty, as the new parts are all weak and tender. However, by repeated exertions, all the veffels which conveyed nourifhment to the exterior fkin are difengaged, and ceafe to act, and a flit is made on the back, generally beginning at the fecond or third ring. The new fkin may now be juft perceived, being diftinguifhed by its frefhnefs and brightnefs of colour. The caterpillar then preffes the body like a wedge into this opening, by which means it is foon torn down from the firft to the fourth ring: this renders it large enough for the caterpillar to pafs through.

The caterpillar generally fafts a whole day after each moulting, for it is neceffary that the parts fhould acquire a certain degree of confiftency before its organs can perform their ordinary functions. Many perifh under this operation. The caterpillar always appears much larger after it has quitted the exuvia than before; for the body had grown under the old fkin till it was become too large for it, and the parts being foft they were much compreffed, but as foon as this fkin is caft off, the parts diftend, and with them the new fkin, which is yet of a flexible and tender texture, fo that their increafe in fize at each moulting is confiderable. Some caterpillars in changing their fkin alter very much in colour and appearance, fometimes the fkin from being fmooth becomes covered with hair, or fpines, or tubercles, and others that are in one ftage hairy, have the fkin fmooth in the next. No fex is developed in the caterpillar ftate.

The caterpillars of lepidopterous infects feem deftitute of all means of defence, and are the prey of birds and other voracious creatures. Nature has not, however, left the whole tribe in this defencelefs ftate, fome kinds are armed with ftrong and powerful fpines difpofed in a verticillate manner round the annulations of the body, and which, if they be infufficient to annoy others, ferve at leaft, in fome meafure, as the means of felf protection. There are others, chiefly the inhabitants of the warmer climates, whofe bodies prefent an armament of fpines not unlike that of the hedgehog or porcupine, and thefe placed in fuch a formidable manner, as muft either forbid the approach of other fmall creatures, or punifh their temerity. Some few of the North American fpecies are of this defcription. In others, we fee the rings tuberculated, and every tubercle befet with ramofe fpines, the branches of which intertexting with each other, form an almoft impenetrable net-work of fpines. Others again are thickly clothed with fpines and hair intermingled, which may be fufficient to guard them againft the attack of fome of their inferior enemies. Some fpecies with the body covered only with a thin fkin, and therefore apparently expofed to the annoyance of every other, has the jaws fo powerful, and the difpofition fo ravenous and fierce, that they conftantly attack, and moft commonly with fuccefs, the larva of other fpecies much larger than itfelf. At the extremity of the body in the larva of the fphinges, is a remarkable recurvate fpine or horn, formidable in appearance, but harmlefs in its nature, and which is vulgarly fuppofed to be its weapon of defence. Thefe infects, or at leaft fome of them, are not, however, without the means of annoyance, for it appears they poffefs the ability of difcharging from their mouth or vent a fœtid liquor, the fcent of which, fhould it fall on the fkin, cannot eafily be removed even by wafhing, and which may be fuppofed powerful enough to repel other infects. This ability in the fphinx tribe of caterpillars is admitted on the authority of fome credible authors; the like circumftance is more commonly obferved in the larvæ of fome fpecies of tenthredo.

The caterpillars of many infects of the butterfly tribe feed clofe to the ground, or under the furface, fubfifting on the lower parts or roots of plants; and for this reafon many kinds are feldom feen, and others remain unknown. The larvæ of the fphinx kind live chiefly on the leaves. Thofe of the fefia genus are ufually denominated internal feeders, or fuch as refide in hollow cavities, which they form

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in the trunks or branches of trees, the fubftance of which alfo affords them nourifhment. Many of the moth tribe are of the fame kind, and have the fame habits; others eat the leaves of different plants, and a few of the fmaller forts feed on woollen, paper, and other fubftances, not of a vegetable nature. Some of the lepidopterous caterpillars are folitary, others live in fociety.

Neuroptera.—The larvæ of neuropterous infects are carnivorous, and in the vivacity of their manners exhibit a very ftriking contraft with thofe of the generality of infects. They are nearly all of the aquatic kind, paffing their whole life, till they affume the winged ftate, in the water; and are diftinguifhed for the peculiar addrefs with which they conftantly wage war, not only againft every other diminutive inhabitant of their natural element, but alfo againft each other. Thefe larvæ are hexapode, or furnifhed with fix feet of a fcaly nature, and having the head protected by a fimilar fubftance.

The libellulæ, or dragon-flies, form an interefting genus of the neuroptera order, and the habits of their larvæ illuftrate, in the ftrongeft manner, the nature of thefe aquatic creatures. The egg, when depofited by the parent in the water, finks to the bottom, and remains there till the young infect has acquired fufficient maturity and ftrength to burft from its confinement. The larva, at firft fmall, increafes to nearly half the fize of the perfect fly, by changing its fkin at different intervals like the caterpillars of moths and butterflies. The appearance of the little cafes containing the rudiments of the wings, at the lower margin of the thorax, denotes its change to the ftate of pupa. The head of this larva is exceedingly fingular, being covered with a mafk extending over the whole of the fore part of the head, with cavities in the interior furface to fuit the different prominences of the face to which it is fitted with perfect neatnefs. Its form is triangular, growing fmaller towards the bottom: in the latter part there is a knuckle which fits a cavity near the neck, and on this part it turns as on a pivot. The upper part of this mafk is divided into two pieces, which the infect can open or clofe at pleafure, and it can alfo let down the whole mafk, fhould occafion require. The inner edges of thefe two pieces are toothed like a faw, and ferve the animal as a pair of forceps to feize and retain its prey. This is the general principle on which thefe projecting forceps are conftructed in the larva of the libellulæ; they differ in fhape in the feveral fpecies, but uniformly act in a fimilar manner.

Thefe animals generally live and feed at the bottom of water, fwimming only occafionally. Their motion in the water can fcarcely be called fwimming, it is accomplifhed by fudden jerks repeated at intervals. This motion is not occafioned by their legs, which at this time are kept immoveable and clofe to the body: it is by forcing out a ftream of water from the tail that the body is carried forward, as may be eafily perceived by placing them in a flat veffel, in which there is only juft water enough to cover the bottom. Here the action of the water fquirted from their tail will be very vifible; it will occafion a fmall current, and give a fenfible motion to any light bodies that are lying on the furface. This action can only be effected at intervals, becaufe after each ejaculation the infect is obliged to take a frefh fupply of water. The larva will fometimes turn its tail above the furface of the water, and force out a fmall ftream, as from a little fountain, and with confiderable force.

The larvæ of the ephemeræ, another of the neuropterous tribes, differ in various particulars from thofe of all other infects: its length, in the larger fpecies, about an inch; the form rather long, and fub-cylindrical, tapering a little towards the tail: the head is furnifhed with antennæ, trunk with fix legs, abdomen with feveral finny plumes each fide, and the tail with three long proceffes. They live in the water, where earth and clay, it is affirmed, form their principal nourifhment for the fpace of two or three years, the time they confume in preparing for their metamorphofis, and which is accomplifhed in a few moments. The larva, when ready to quit that ftate, arifes to the furface of the water, and inftantly cafting off its fkin becomes a pupa. This is furnifhed with a kind of wings, by the affiftance of which it efcapes to the fhore, and there fettling, in the fame moment, quits a fecond fkin, and becomes the perfect fly. In this ftate, which has been fo long preparing, the pleafures it enjoys muft be very fenfible, if they are lively in proportion to the fhortnefs of their duration, the infect celebrating its nuptials, producing the fruit of them, and dying within the fpace of a few hours; the vital principle, though fo evanefcent in the complete infect, is extremely tenacious in the larva.

The phryganeæ, a genus of this order, very much refembling, in general appearance, certain families of the moth kind, are the offspring of aquatic infects, not much unlike the larvæ above defcribed; only that inftead of inhabiting the waters in a defencelefs ftate, they conftantly live in fmall cylindrical cafes of their own conftruction, which they drag after them in the water wherever they go. Thefe cafes are tubular and open at both ends: externally they are formed with fmall bits of reed, gravel, fmall fhells, and other fubftances curioufly cemented together, and lined with fine filk. The animal never quits its habitation till it becomes too fmall for its body, when it conftructs another. Like the hermit crab, when it is defirous of moving from one place to another, the animal advances the fore-part of the body out at one end of the tube, fo as to admit the free ufe of its legs, which are fix in number, and placed contiguous to the head, and by this means it is able to crawl or walk with perfect facility at the bottom of the water. The body in moft fpecies is fmooth, and the back ufually furnifhed with a tubercle, which prevents the cafe from flipping too forward while the animal is feeding, and which ferves alfo to retain the cafe more firmly to the pofterior part of the body in the action of walking. Thefe, in common with other aquatic larvæ, are frequently ufed by anglers as bait, and are called cadew-worm, ftone bait, or cod bait, and in the perfect ftate is known by the name of fpring fly. The larvæ of the phryganeæ prefer running waters.

Thofe above-mentioned are the larvæ of the amphibious kinds of neuropterous infects; there are others which live only on land, and differ much from thefe both in appearance and mode of life. Thofe of the myrmeleon, panopa, hemerobius, and raphidia, are of the terreftrial order. They are carnivorous as well as the aquatic kinds, preying on other infects. The moft extraordinary of thefe in their manners of life are fuch as have been denominated by naturalifts the lion-ants, or lion-pifmires (the myrmeleon of Latin writers). Of this genus there is nearly a dozen fpecies, or, indeed, if we include the afcalphi which Fabricius removes from that genus, there are altogether fixteen fpecies at prefent known. The larvæ of this family prey with the moft favage ferocity on all the fmaller kinds of infects: it is not, indeed, this difpofition, fo common to all carnivorous larvæ, that renders them remarkable, but the extraordinary and peculiar contrivances they adopt to enfnare their prey. We are beft acquainted with the hiftory of the fpecies formicarius, the formica-leo of Linnæus, and this may ferve as an example of the genus, the habits of which, fo far as we are acquainted with them, being alike in all, with this difference, however, in their predatory powers, that formicarius

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is one of the fmaller kinds, and lefs capable, from its inferiority in ftrength and fize, to commit devaftation, than moft of the extra European fpecies, thofe of Africa efpecially.

Myrmeleon formicarius is found in France, Spain, and Germany, and is an inhabitant of fandy places. The egg is depofited by the parent infect in the fand, and this hatching produces a larva of an ovate form, armed with a long and powerful pair of jaws. The larva, as foon as produced, begins to exercife its talent of preparing a pitfall in the fand, by turning itfelf rapidly round, and which, when formed, is fomewhat funnel-fhaped, or rather concave, with a very fmall aperture in the centre under which the animal conceals itfelf with only its pincers advanced through the hole, ready to feize on any infect that may unwarily fall into the hollow. Sometimes the whole head is protruded through the hole, but when it lies in wait the body is always concealed under the fand. From the ftructure of this trap, fuch infects as crawl to the edge or fides are almoft fure to fall in, and be devoured by the larva. But fhould the fides of the pit not give way, or the unfortunate infect appear to be able to make its efcape, its mercilefs enemy immediately difcharges from its head fhowers of fand, the repeated force of which is irrefiftible; the infect falls within reach of the larva, who, after fucking out its juices through the tubular forceps, by a fudden exertion throws the remains of its carcafe out of the hollow to a confiderable diftance, and again, after repairing its den, renews its vigilance for prey. As the larva increafes in fize, it enlarges this cavity; at firft it is only a flight depreffion in the fands half an inch in diameter, in its next ftage it is increafed to twice that diameter, and when the larva attains its full fize is between two and three inches acrofs. In the preparation or enlargement of its pit, when it grows to its full fize, it fhews much addrefs: its operation commences by tracing an exterior circle of the intended circumference of the cavity, and continuing its motion in a fpiral direction till it reaches the centre, thus marking each revolution in the faud like the impreffion of a large fhell of the whorled kind, the breadth of each whorl correfponding with that of the infect's body; and which, in the circumference of the whole cavity, amounts to four or five circles. After having fufficiently deepened the cavity by a repetition of this motion, it fmooths the fides into a regular fhape, by throwing out the fuperfluous fand by means of its forceps, which, when clofed, together with the head, forms a convenient kind of fhovel for the purpofe. The grains of fand thus difcharged often fall to the diftance of ten or twelve inches beyond the verge of its cavity. The depth of the cavity is ufually equal to its diameter. The fingular larva, whofe manners of life appear fo interefting when it has attained its full fize, is about three quarters of an inch long, and has much the afpect of a large fpider in the form of its body: its head and legs more nearly refemble thofe of the pediculi of fome particular animals, and are very fmall, and in the ftructure and proportion of the jaws or forceps its character is peculiar, thefe being enormous. Its general colour is pale reddifh, very prettily variegated with diftinct marks and fpots of deep ferruginous both on the back and belly; the whole is befet with a few hairs, fome of which appear in tufts. It remains two years in the larva ftate; in the fummer it is active, but it is torpid during winter; when full grown it changes into a pupa, the animal previoufly enveloping itfelf in a round ball of fand agglutinated and connected by a very fine filk, which it draws from a tubular procefs at the extremity of the body: with this filk it alfo lines the internal furface of the ball. The complete infect is furnifhed with four tranfparent fpotted wings, and, like the larva, preys on infects.

Hymenoptera.—The larvæ of the tenthredines bear the neareft refemblance poffible to thofe of fome lepidopterous infects, and have for this reafon acquired the name of baftard caterpillars, or falfe caterpillars; the fpiral manner in which they roll themfelves up is one character that feems to remove them from the true caterpillar, but they are more clearly diftinguifhed by the number of feet, which, though varying in different fpecies of both families, may be faid to be conftantly more numerous in the tenthredo genus than in any of the lepidoptera orders. The firft have from eighteen to twenty-two feet; the latter never more than fixteen, including the fpurious or pofterior ones. Thefe live chiefly on the rofe and willow trees. The larvæ of the firex genus is cylindrical, and furnifhed with fix feet, and the head rounded; they perforate wood, and frequently eat their way into the bodies of other infects, or their larva, and confume their vitals. Thefe are the principal hymenopterous larvæ that are furnifhed with feet: the fucceeding infects are deftitute of thofe organs when in the larva ftate.

One of the moft curious tribes of larva among the hymenopterous genera are thofe called the gall-flies; they are in no particular manner remarkable in appearance, but the effects they produce render them extraordinary. Every one muft have obferved thofe vegetable excrefcences, of a globular form, which appear on the leaves and foot ftalks of the oak at particular feafons of the year, and which in autumn have acquired the fize of a cherry or a fmall plumb, its colour a bright red, and forming a pleafing contraft with the verdure of the leaves; thefe are the habitations formed by the punctures of the gall-fly, in which the eggs were depofited each fingly in its globule by the parent infect, and each of thofe excrefcences at this feafon, on being opened, will be found to contain a larva; a fmall worm of a cylindrical form and without feet. There are an amazing number of fpecies of the gall-fly (cynips) that conftruct their dwellings, and fubfift on the juices of the oak, and many others that attack in like manner the maple and the willow. The larva is found like a nucleus, in a fmall cavity immediately in the centre of each excrefcence.

The manners of the ichneumon, as popularly defcribed, are fully known, and the hiftory of the ichneumon flies feems to accord in a peculiar degree with all that has been fabuloufly related of the former. They are entirely parafitical, and derive their fuftenance, till they arrive at the perfect ftate, from the vital juices of other infects. Their eggs are depofited only in the bodies of other living infects, generally thofe of the caterpillar kind. The female, felecting her victim, faftens upon it, plunges her abdominal tube into the body, and, in defpite of all refiftance, maintains her hold till fhe has lodged her ftore of eggs. In the courfe of a few days the young larvæ, which refemble minute maggots, are hatched. Thefe nourifh themfelves with the juices of the caterpillar, which, notwithftanding it affords fuftenance to the parafitical brood, continues to move about, and feed till the time of its change into the chryfalis ftate, when the larvæ creep out by perforating the fkin in various directions, and form little oval filken cafes, the whole of which with the fpinning forms an envelope to the withered remains of the infect from which they derived nurture. The latter inevitably perifhes from the injury fuftained; in a fhorter or longer period, according to the fpecies, the ichneumons appear in a perfect ftate. This parafitical family, when produced, are found to be either entirely of the winged kind, or to confift both of alated and apterous infects, the females in certain fpecies being deftitute of wings. Thefe are, notwithftanding, perfect infects, as they never acquire thofe organs afterwards, and being befides, after an intercourfe with the

the other ſex, in a condition to depoſit fertile eggs, and thus perpetuate the breed. The apterous females attack caterpillars and other inſects in the ſame manner as the winged kinds, and depoſit their eggs in the living body.

So far as we are acquainted with the natural hiſtory of the ſphex tribe, the larvæ of theſe are lodged in the bodies of other inſects, in a manner ſimilar to that adopted by the ichneumons, with this difference, that the ſphex generally deſtroys the principle of life in thoſe creatures it attacks, inſtead of leaving them to linger through a tedious exiſtence of torture. Theſe inſects are very abundant in wood and hedges, and the larvæ feed chiefly on dead inſects, in the bodies of which they are produced from the egg. Some ſpecies dig holes in the earth with their fore feet, in which they bury their dead inſects, conſiſting chiefly of ſpiders and caterpillars, having previouſly depoſited their eggs therein; theſe holes are carefully cloſed with earth or clay, through which the larvæ force a paſſage when hatched. The larvæ are vermiform. The manners of theſe inſects is ſtrongly exemplified in the ſpecies figulus, a native of Upſal, and which is deſcribed by writers with conſiderable attention. This ſphex inhabits the holes in old wooden partitions, abandoned by other inſects, the interior of which the female cleanſes by gnawing the ſurface of the cavity throughout, and prepares it for the reception of her victim, by placing a piece of clay in the bottom. She then ſeizes on a ſpider, which having killed, and faſtened upon the clay, ſhe next proceeds to the depoſition of the egg, which is lodged in the dead body. This laid ſhe cloſes up the opening with clay. The larva hatched from the egg reſembles the maggot of the bee, and which, having devoured the food provided for it, ſpins itſelf a ſilken web, and changes to the pupa ſtate. In this manner each female inſect prepares ſeveral ſeparate holes, in each of which a dead inſect and an egg are depoſited. The larvæ of waſps and bees are ſoft, without feet, and feed on the nectar and honey collected by the parent inſects. The larvæ of the ants are alſo well known. The three latter mentioned families live in ſocieties, and with thoſe already noticed form the principal kinds of hymenopterous inſects.

Diptera.—Theſe larvæ vary much in different genera. Commonly they appear like a ſmall worm, the likeneſs to which is heightened by the animal having no feet, and in ſome ſpecies by the head being ſoft, like the body. Others differ in having the head ſcaly. The larva of the oeſtri, or gad-flies, depoſits its eggs in various parts of the bodies of cattle, which, when hatched, produce the moſt painful tumours. Some lay their eggs under the ſkin of cows or oxen, which they perforate for that purpoſe: others enter the inteſtines of horſes by the vent; and others, again, depoſit them in the noſtrils of ſheep. The larva of oeſtrus bovis is brown, and conſiſts of eleven ſegments, with tranſverſe rough interrupted lines. That of equi, known by the name of bots, depoſits its eggs on the hairs of horſes, and always on thoſe parts which are moſt likely to be licked with the tongue, and are thus conveyed into the ſtomach. The eggs of hæmorrhoidalis are laid on the lips of horſes, occaſioning a titillation, which cauſes the animal, when attacked by it, to move its head violently, and gallop about with every ſymptom of diſtreſs: this larva is carried into the inteſtines like the former, and is voided with the dung when its period of change to the pupa ſtate approaches.

In the genus tipula the larvæ are ſoft, cylindrical, and truncated at the head: theſe feed on the roots of plants. The larvæ of the different natural tribes, comprehended among the Linnæan muſcæ, exhibit ſome very diſſimilar appearances in form and habit. Generally, they poſſeſs a worm-like aſpect, ſometimes blunt at the anterior part, and acute behind, and at others pointed at both ends. Many live in watery places and devour inſects; others feed on decaying animal matter, or on the juices of vegetables. The larvæ of muſca vermileo preys on inſects, and in its mode of entrapping its prey imitates the manners of myrmeleon formicarius, like that ferocious inſect forming a circular den in the ſands which it inhabits, and watching in an aperture at the bottom for the unwary inſects that unfortunately wander too cloſe to its cavity. But of all the peculiarities related of the muſca tribe, nothing appears in any degree ſo extraordinary as the hiſtory of the larva of muſca tenax, recorded on the authority of Linnæus, and ſanctioned by that of Fabricius. The larva is repreſented as a brown maggot with a long tail, which latter is extenſile, and conſiſts of a double tube, the exterior annulated into numerous ſegments, and the interior ſlender and terminated by a circle of hairs, ſurrounding a ſpiracle. This maggot is ſeen in muddy ſtagnant waters, drains, and other ſimilar places; and is, according to Linnæus, a frequent inhabitant of the turbid pulp uſed in the operation of paper making. Hence it is often in this ſtate expoſed to the action of the wooden mallets uſed in this proceſs, as well as ſqueezed in the ſtrongeſt preſſes, and yet it ſurvives uninjured theſe ſeemingly deſtructive operations.

This circumſtance is deſcribed in a paper entitled "Miracula Inſectorum," inſerted in Am. Acad. 3. p. 331, and though purporting to be the production of Emanuel Avelin, obtained the ſanction of Linnæus. The ſame obſervation is confirmed in the "Syſtema Naturæ;" and is repeated in this place as a moſt extraordinary trait in the hiſtory of this inſect, without deeming ourſelves in the leſt reſponſible for its veracity.

The tabani nouriſh themſelves with the blood of horſes and cattle; and ſome think the larvæ are aquatic, though Degeer aſſerts they live under ground. The larvæ of culices (gnats) are very curious in their conformation: the body conſiſts of nine ſegments, which become gradually ſmaller from the head towards the extremity. The head is very large, and furniſhed on each ſide with a pair of pointed forceps, or hooks, with which it ſeizes its prey. The tail terminates in a tubular opening, at the tip of which are four ovate ſcales, two of which exceed the others in ſize. At the end of the body, near the tail, is a ſmall elevated reſpiratory tube, which the creature frequently raiſes above the ſurface of the water, while the head remains ſuſpended downwards. The colour of the larva is browniſh, extremely pellucid, and its motions remarkably lively. The larva, when firſt hatched, is extremely minute, and in the ſpace of fourteen days from its birth attains its full ſize, its length being then about half an inch. The painful ſenſation occaſioned by the ſting of the gnat, or, in other words, its ſucking proboſcis, is well known, and hence we are taught to conſider the gnat as an inſect ſubſiſting only on the blood of other animals: this is not, however, the opinion of ſome naturaliſts, who, reflecting on the myriads of theſe creatures, with which every watery place is infeſted, conclude they could not find ſufficient ſuſtenance, unleſs they ſubſiſted equally on the juices of vegetables and animals. Whatever may be the truth in this reſpect, the weapons of annoyance with which nature has furniſhed the larva indicate very clearly to us that in that ſtate, at leaſt, it is of the carnivorous kind. We ſhall laſtly mention the hippoboſcæ, a dipterous genus in the Linnæan ſyſtem, and which, unlike thoſe before adverted to, do not appear to have any larva; they are the produce of an egg which partakes of the two-fold

fold character of being at the fame time an egg and a pupa. The female, at diftant intervals, depofits an egg, which in magnitude is nearly equal to the whole bulk of its parent's body: the figure of this egg is oval, with an excavated depreffion at the lower end; the colour, at its firft exclufion, is milk white, except a large black fpot on the fore part, from which it afterwards becomes brown, and then of a jet black, with a very high polifh. This change in colour marks the progreffive advancement of the infect inclofed towards its maturity of formation, the parts becoming gradually developed. The egg depofited in autumn acquires its deepeft colour in the fummer following, at which time the infect burfts from its confinement in the winged form.

Aptera.—No infect of this order, except the common flea, are fuppofed to undergo thofe fucceffive changes which are ufual in moft other infects. They are almoft entirely produced from the egg in their perfect form, and cannot therefore be faid to have any larva. In the flea, however, the fmall worm which correfponds with the larva in other infects is clearly afcertained; and if we may place fufficient reliance on the evidence of certain naturalifts, one or two more of the apterous genera exift for a fhort period in a ftate fomewhat analogous either to the larva or pupa. Leeuwenhoek obferved that the mite was oviparous, laying very fmall oval whitifh eggs, from which proceeded the young animals, refembling their parents in all refpects, except in the number of their legs, thefe being only fix in number, inftead of eight; and after they caft their fkin another pair of legs appear, a fact that evidently implies two periods of transformation, the firft of which may be compared with that of larva. An advancement, or progreffive increafe in the number of feet, is alfo well known to take place in fpecies both of the julus and fcolopendra genera, after they are produced from the egg ftate. The julus fabulofus, when firft excluded, is furnifhed with three pair of legs, which are fituated at each fide near the head: fome days after about fourteen become vifible, and the remainder, to the amount of one hundred and twenty on each fide, are gradually acquired afterwards. The fame remark will apply to certain fpecies, if not the whole of the fcolopendræ genus. Scorpions are produced by the female parent in a living ftate; they are at firft very fmall and white, and become of a darker hue in a few days: thefe, like the fpiders, caft their fkin as they increafe in fize.

Of the Pupa ftate.

By this term, as underftood in the very extenfive fenfe Linnæus propofes, we comprehend that ftate of an infect which fucceeds the larva and precedes the pupa, without any regard to the particular appearance it affumes in this ftage of transformation. From this latitude of meaning it includes, therefore, with equal precifion, and no lefs propriety, ftates of the moft difcordant character. It alike implies the uncouth grub incafed in its fhelly repofitory, and immured in the earth, fluggifh, almoft deftitute of motion, or the appearance of any other animal function, with the lively half-winged locuft, or the cicada, animals fporting in the full enjoyment of life. The bot, imprifoned in its oval covering, without the leaft external fign of animation, is termed a pupa. The moth, quiefcent and abftinent for months, concealed in its fhelly covering in the earth, or fufpended aloft in its filky envelope to the branch of a tree, is a pupa; and we denominate thofe pupæ alfo which have the wings only half expanded; though, like the nimble-footed cimex, they are perpetually roving, and deriving fuftenance from the blood of other animals; and fo alfo the reftlefs libellula, which is continually traverfing the watery element, with the facility of fifhes in fearch of prey. Surely the difference between thefe is too great to be defined by any fingle term.

Writers have obferved, that before the time of Linnæus this ftate of transformation was known only by the term chryfalis, a word derived from the Greek, and expreffive of that golden luftre peculiar to certain butterflies; but this appearance not being general, the word was changed by Linnæus to that of pupa, in allufion to the indiftinct refemblance which many infects in that ftate bear to a child fwathed or dreffed in fwaddling clothes. Thefe obfervations are certainly incorrect, for the word nymph, implying exactly the fame fanciful comparifon, was in ufe before the time of Linnæus; the earlier authors fo named one particular tribe of infects in this ftate, namely, thofe having all their limbs inclofed within a fkin: Linnæus adopted the idea but changed the word to pupa, and affigned it indifcriminately to all infects in that period of transformation from which the perfect fly is produced.

If we take a retrofpective view of the ftate of entomology before the time of Linnæus, and confider attentively the terms by which the different ftates of infects were then known, there does not appear much reafon to commend the alterations which he has introduced. From the labours of Swammerdam, Reaumur, Roefel, Lifter, Ray, and others, the transformations of infects were then generally known, and particular terms had become eftablifhed by which the feveral ftates, appearances, &c. might be difcriminated. Thefe were not fufficiently numerous, and of thofe in ufe fome were lefs expreffive than could be wifhed; but it is ftill not to be concealed that fome, at leaft, were preferable to thofe introduced by Linnæus. This is the more to be regretted, as Linnæus wrote under favourable circumftances, and on his authority the introduction of a few expreffive terms would have been attended with particular advantage. For inftance, we fhould have conceived it defirable if he had defignated this ftate of infects, which he calls pupa, by different terms, applying to each particular family a name at once expreffive of their ftate, and the order to which they belong. When, in the works of his predeceffors, we read either of the aurelia, nymph, or femi-nymph, we know that in a word it implies the fame ftate as Linnæus means by pupa, with this additional information, that it is either of the dormant kind, like the moth, or active, like the nepæ, &c.; the Linnæan name conveys no fuch additional information; it applies without diftinction to all, and merely intimates its ftate of transformation.

Perhaps the alteration of the word chryfalis to pupa may be thought by fome an amendment; we do not difapprove of it, but object to the very indifcriminate fenfe in which it is employed. As it applies to the nymphs of one family defcribed by earlier writers, it is admiffible; to others it is not. Or if the term pupa were adopted in its moft extenfive fenfe, to comprehend this ftate throughout the whole race of infects fubject to this period of transformation, the want of terms to diftinguifh the particular tribes of which they confifted would be equally felt. The general manner in which the term pupa is applied by Linnæus, and the inconfiftency attending it, cannot be more fully exemplified than by the following circumftance. Linnæus, we are told, changed the word chryfalis to pupa, becaufe the former implied a golden appearance not obfervable in all the fpecies; yet he applies the word pupa, which he defines as alluding to the appearance of a child in fwaddling clothes, fuch as we fee in the moth and butterfly tribe, to the blatta, gryllus, cimex, and a hoft of other active creatures which exhibit no fuch refemblance, and which bear no relation whatever to the others either in manners or aſpect! The firſt of theſe were called by old writers nymphs, the latter ſemi-nymphs; but theſe diſtinctive terms are confounded by Linnæus under the ſingle term pupa. Surely the impropriety is as great in the alteration made as in the error it is deſigned to remedy.

To obviate, in ſome degree, the confuſion ariſing from this general adoption of the word pupa, Linnæus propoſed afterwards to divide them, according to their form, into five families, to each of which he aſſigns a trivial or ſecondary name.

Theſe diſtinctions are not objectionable, but are rather too few in number, and they are certainly not expreſſed in terms ſuitable for general uſe. Nor does Linnæus himſelf appear ſatisfied with them, for although they are inſerted with definitions at ſome length in the "Fundamenta Entomologia," they are not adopted in the "Syſtema Naturæ," and are for this reaſon rather to be regarded as matter of curioſity than of utility. The pupæ are divided into ſections, according to the following circumſtances. When confined in a caſe of a globular form, which has no reſemblance to the inſect it contains, it is called coarctata, or ſtraightened, the examples of which are the muſci and oeſtri; obtecta, diſguiſed or ſhrowded, when the inſect is wrapped up in a ſhelly covering of ſuch a form that the part which contains the head and thorax may be diſtinguiſhed from that wherein the abdomen is lodged, as in lepidopterous inſects. It is termed incompleta when the pupa has perceptible wings and feet, but cannot move them: ſemi-completa, theſe can walk or run, but have only the rudiments of wings. The difference between the pupa and the larva of this claſs is very inconſiderable; in the firſt ſtate they have no wings, and in the pupa the wings begin to be developed as in the graſshopper: completa, in which the egg may be conſidered analogous to the pupa, the inſect being produced in its perfect form from the egg without paſſing through any other change.

Swammerdam divides inſects into four claſſes, the characters of which are founded principally upon their appearance in this ſtate of transformation, and the particulars attendant thereon.

The firſt of theſe comprehends thoſe inſects which, after being formed in their egg without the aid of food, and which, after having acquired, by the evaporation of the ſuperabundant humidity, the neceſſary conſiſtency, quit that ſtate, and iſſue from the ſhell under the form they are to retain during life, without undergoing any other transformation, as inſtanced in the ſpider.

The ſecond conſiſts of thoſe inſects which, after leaving the egg, are without wings, but with all the other members, as in the perfect inſect; in this ſtate they eat and grow, paſs into the nymph form, and from that iſſue with perfect wings, and with the ability to propagate their ſpecies. The dragon flies, graſshoppers, and cimices are of this family.

The third includes all kinds of butterflies and moths. They iſſue from the egg which lay in a diſguiſed ſtate and without food; the ſecond ſtate eats and grows, and the members of the animal into which it is to be transformed are formed under the ſkin, which it at laſt quits and becomes a nymph, and then after the evaporation of the ſuperfluous humidity produces the perfect inſect.

The fourth family, after having arrived at the nymph ſtate, like thoſe before-mentioned, does not diveſt itſelf of the ſkin in order to enter into that ſtate, but aſſumes the form of a nymph under its ſkin, where it continues ſhut up, till quitting two ſkins, at once it comes forth in its perfect ſtate. This is the metamorphoſis which ichneumons undergo. Theſe are the four families into which Swammerdam divides inſects, and the explanations he affords; and theſe, with ſome improvements and modifications, form the baſis upon which the pupæ are arranged by many of the continental naturaliſts at this time.

The following obſervations on the ſame ſubject by Lyonet deſerve attention. "By the term nymph (ſays this writer) is meant a ſtate of imperfection, attended ſometimes with inactivity, inaction, abſtinence, and weakneſs, through which the inſect paſſes, after having attained a certain bulk, and in which its body receives the preparatives neceſſary for its paſſing to a ſtate of perfection, all the external parts of the inſect are then found enveloped, either with their natural ſkin, or with a fine membrane, or with a hard and cruſtaceous cruſt. In the firſt caſe the limbs of the inſect remain free, it preſerves its power of acting, it eats, and its form is little different from what it was before. In the ſecond caſe the limbs of the inſect are folded over the breaſt but ſeparate; it can neither eat nor act, it retains hardly any traces of its former figure, and has only a confuſed reſemblance to that which it is going to aſſume. In the third caſe, the cover brings all theſe parts of the animal into one maſs; it makes it equally incapable of eating and acting; it has no reſemblance either to what it formerly was, nor what it is to be. Theſe three ſorts of change are evidently very different, and yet we have only two words in our language (French) to diſtinguiſh them by. We ſay of the inſects in the two firſt caſes, that they are changed into nymphs, and of thoſe in the laſt caſe that they have aſſumed the form of chryſalids. To theſe terms it would be proper to add a third, in order to mark the difference between the two firſt. It might be done I think very conveniently by allowing the laſt to retain the name of nymph, and calling thoſe of the firſt kind ſemi-nymph, or demi-nymph, a name which would not perhaps be inapplicable to them, conſidering the ſmall degree of change they have undergone. Graſshoppers, which, inſtead of the long wings they acquire, have ſtill only on their backs the ſmall caſes in which theſe wings are formed, are nymphs of this kind; they may properly be called ſemi-nymphs. Thoſe who have had an opportunity of examining a bee hive, cannot fail to have remarked bees ſtill imperfect in the ſhut cells; theſe are the nymphs of the ſecond order. The ſilk-worm furniſhes a well known example of inſects under the form of chryſalis.

"Inſects which undergo no other metamorphoſis than that which has converted them from the ſoft ſubſtance of an egg to a well formed and living body, are thoſe which conſtitute the firſt claſs of transformations ſpoken of. They increaſe in ſize, the greater part caſt their ſkin; ſome of their parts acquire greater ſize than the reſt, and ſometimes take a different colour from what they had before. This is almoſt the only change they undergo. The tranſformations of the inſects of the other three claſſes do not terminate here; after having caſt off their ſkins for the moſt part ſeveral times, and after having acquired their deſtined bulk, all become either ſemi-nymphs, nymphs, or chryſalids. They paſs a certain time under this form, and upon quitting it aſſume that of a perfect inſect, capable of generation. It is from the diverſity which takes place in theſe three ſorts of changes that the principal characters, which diſtinguiſh the inſects of the ſecond from thoſe of the third, are taken."

The inſects of the ſecond claſs are thoſe that paſs through the ſtate which Lyonet calls ſemi-nymphs. They do not undergo a transformation which is entirely complete, but in their laſt change they have ſtill generally all the members they had before, without having acquired any others, ex-

cept

cept they have wings; and as already remarked the semi-nymph differs very little from the animal which produced it. What always distinguishes it is, that there are seen upon its back at the base of the thorax the cases in which the wings are formed, which before that appeared but little, and often not at all. In other respects it walks, runs, leaps, and swims as before. The difference between the semi-nymphs, and the winged insect which it produces, is not always so obscure. In some species it is so large that it is with difficulty we can discover its first form. But the greater part in their last state differ chiefly in the wings.

The insects of the other two classes do not enjoy the same advantages as the other. They lose the use of all their members when they enter upon their transformation, and have no resemblance to what they were before. An animal of these two classes which before had no legs, or had five, six, seven, eight, nine, or ten pairs, has now no more than three pairs, which, with the wings and antennæ, are folded up under the breast and remain immoveable.

What distinguishes these two last classes from each other is, that the insects of the third class quit their skin, when they change into nymphs or into chrysalids, and that those of the fourth change into nymphs under their skin, which hardens round them, and forms a case.

Reaumur found, in the transformation of insects of the fourth class, a character that seems to distinguish it essentially from the rest, namely, that they changed into nymphs without quitting their skin. He discovered that they undergo one transformation more than other insects; because before they become nymphs, they assume under their skin an elliptical form, or that of an elongated spheroid, in which no part of the animal is discernible; that in this state the head, thorax, wings, and legs of the nymph are inclosed in the interior cavity of the abdomen, from which they issue successively by the anterior part, nearly in the same manner as the extremity of the finger of a glove, which has been drawn in, is pushed out again. Thus, the insects of this class are not solely distinguished from others by their changing into nymphs under their skin, but principally in undergoing a double transformation before they become nymphs.

Bergman distinguishes three kinds of pupa, which he calls chrysalids, nymphs, and semi-nymphs. The first he describes as hard and motionless, that does not eat, and shews obscurely the members of the future insect; the nymph is tender, lying at rest, not eating, and which shews clearly the separate members of the future insect; the semi-nymph is furnished with legs, and runs, eats, and is hardly different from the larva, except in having the rudiments of the wings, which the larva wants.

This inquiry, if duly pursued, would lead to much farther digression. From what is already advanced we presume it will be apparent, that the writers prior to the time of Linnæus, or cotemporary with him, (for those alone are mentioned,) are not agreed in their manner of distinguishing insects in this third state of transformation; and that their appearance is so various in different tribes, while in this state, that they ought to be distinguished by several, instead of a single name. Fabricius, one of the most considerable entomological writers since the time of Linnæus, employs the word pupa in the same general sense as the latter; but he is the principal late continental writer worthy of consideration, who has imitated this example. The French naturalists chiefly follow Lyonet, with some slight variation. This arrangement is still susceptible of much improvement, but is notwithstanding perhaps the most perspicuous yet proposed. To the chrysalis properly so called, namely, those of the butterfly tribe, this name given to them by the Greeks is retained; the rest of those which have their members enveloped in a common skin are called nymphs, and are divided into three or four families, according as those parts are more or less visible through the exterior membrane. The term féve (bean) is also introduced, to express in a general manner this state of the insect, when of an oblong form, and distinguished only by a few annulations and eminences. Insects in the third state, which differ only from the perfect form in having half-wings, are called semi-nymphs.

In the present section, to avoid confusion, it may be more convenient to adopt the Linnæan term, and under this head describe such of the leading differences in insects as are observable in this state of transformation.

Coleoptera.—The nymphs or pupæ of this order have commonly the limbs detached or not laid under the exterior envelope close to the body, as in lepidopterous insects. Most of them bury themselves in the earth previously to this change; some form cells in decayed trees, others perforate seeds and nuts, and great numbers remain in the dung of animals, or other filthy substances, where the larvæ have been nourished. Their appearance, while in this state, is nearly the same in all, an emollient pupa of a whitish colour tinged more or less with brownish, and in form remotely resembling that of the moth kind, but with the limbs distinct. The mutations of scarabæus nasicornis affords an interesting description of the pupa of a coleopterous insect, and may serve as an example for the rest of the tribe. When the time approaches for this larva to change into the pupa form, it penetrates deeper into the ground than the larva had done before. Having found a proper place, it forms with the posterior feet a polished cavity, in which it remains for some time immoveable; after this, by voiding excrementitious substances, and the evaporation of moisture, it diminishes in size, and the skin becomes furrowed and wrinkled, as if the animal were partly starved. If dissected at this time, the head, belly, and thorax may be distinguished. While some external and internal parts are changing by a slow accretion, others are gently distending by the force of its impelled humours. The body, contracting itself while the fluid is propelled towards the fore parts, forces the skull open in three parts, and the skin in the middle of the back is separated by means of an undulating motion of the incisions of the back; at the same time the eyes and the horns, &c. cast off the exuvia. During this operation, a thin watery humour is diffused between the old and new skin, which renders the separation easier. The process going on, the larva is at last disengaged from its skin, and the limbs and parts are by continual unfolding transformed into the pupa state: after which it twists, and compresses the exuvia at the vent, and throws it towards the hinder parts under the belly. The pupa is at this time very delicate, tender, and flexible, and affords a curious spectacle.

The pupa of this beetle weighs, a little time after its change, much heavier than it does in the beetle state, which is also the case with the bee and the hornet, which latter have been known to weigh ten times as much as the insect when perfect. If the skin be taken off at this time, many curious circumstances may be noted, but what claims our attention most, is, that the horn which is so hard in the male beetle when in a state of maturity, that it may be sharpened on a grind-stone, in the pupa is quite soft and like a fluid. How long this particular remains in this state is uncertain, some beetles of the same kind rest in this form the whole winter, more particularly those who quit the larva state in autumn. Some beetles go through all the stages of their

 existence

exiftence in a feafon, while others remain two or three years even in the pupa ftate.

When the proper time for their final change arrives, all the mufcular parts grow ftrong, and are thus able to fhake off their laft integuments, which is performed exactly in the fame manner as in the paffage of the infect from the larva to the pupa ftate, fo that in this laft fkin, which is extremely delicate, the traces of the pulmonary tubes that have been pulled off and turned out again become vifible.

Hemiptera.—The pupæ in this order are the femi-nymphs of the old writers, and refemble the perfect infect in fize and figure, but are without wings. The rudiments of thefe members, of larger or fmaller dimenfions in different fpecies, are fituated at the pofterior parts of the thorax. They have the fame manners, and fubfift on the fame food as the perfect infects; and we have reafon for fufpecting that fome at leaft of thefe are not deficient in any of the animal functions.

Lepidoptera.—When the caterpillar of a butterfly or moth has attained its full growth, fome writers affirm, that the rudiments of the perfect fly may be diftinguifhed upon accurate inveftigation beneath the fkin. This is afferted by Swammerdam, who declared he could demonftrate all the parts of the future butterfly in a caterpillar near the change. To difcover this, it is directed, that the caterpillar be taken at the time the fkin begins to open, when it is to be drowned in fpirit of wine or fome ftrong liquor, and to be left therein for feveral days, that it may take more confiftency and harden itfelf, the fkin of the caterpillar muft be then removed, which will be eafily accomplifhed, and the inclofed moth will appear. The rudiments of the future infect are extremely tender, and fhould be touched with the utmoft delicacy, when the legs, antennæ, and other parts, may be unfolded and difplayed to view. The parts of the moth or butterfly are not exactly difpofed in the fame manner in the body of the caterpillar, as when left naked in the chryfalis. The wings are faid to be longer and narrower, being wound up in the form of a cord, and the antennæ are rolled up on the head, but in a very different manner from what it is in the perfect infect, and different from that in which it lies in the chryfalis; fo that it is by a progreffive and gradual change that the interior parts are prepared for the moth and pupa ftate; and even the eggs, hereafter to be depofited by the perfect animal, are to be found both in the caterpillar and pupa, the whole arranged in their natural and regular order.

Many of the chryfalides of the butterfly tribe poffefs a peculiar luftre in colour and brilliancy, refembling gold. It is not an appearance common to all butterflies, it is confined to certain fpecies, and is not feen in any of the pupæ belonging to the moth tribe. This colour does not appear immediately in the chryfalides, but is affumed by degrees as the inclofed infect acquires confiftency. It owes its fplendour to the luftre of the white or light colour of the inclofed animal fhining through the yellow tranfparent membrane of the cafe, as M. Reaumur has defcribed in his work. This metallic appearance feems to have afforded a favourable pretext to the alchemifts of former days, who were weak enough to draw delufive hopes from this appearance, and conceive it would afford them gold.

The following very curious and indeed inftructive defcription of the chryfalis of a butterfly is given by our countryman Lifter, nearly half a century before the fcience of entomology had made any confiderable progrefs on the continent of Europe, and from which it would appear, that in his time the knowledge of that fcience was in a great meafure confined to this country: it is from his annotations on the works of Goedartius,

"The middle ftate or difguife of a butterfly is called by the Greeks chryfalis, or a thing gilt, as the word importeth: the Latin hath left us no name that I know of: we have tranflated it aurelia. The Latins, however, call the caterpillar eruca; which is a word (as I guefs from a place in Vitruvius), which fignifies in the old Tufcan language viride æris, and thence borrowed to fignify a caterpillar: for fome caterpillars there are, which I have feen in Languedoc feeding on a certain common tithymal, very notably painted with a fea-green colour, or blue. So that as the gilding of fome few chryfalifes gave a denomination to all; in like manner, the blue colour of fome one caterpillar gave the name to all the reft: as for the gilding itfelf, I take it to be nothing elfe but the fcum of an evaporated juice between the fkin of the caterpillar and the fhell of the chryfalis, which laft it covers."

The butterfly remains only a fhort time in the chryfalis ftate, the interval between the larva and perfect ftate feldom exceeding ten, twenty, or thirty days. Thefe chryfalides are commonly fufpended by means of a few filken threads with the head downwards to the leaves or ftems of trees, or againft palings, &c. The chryfalis of the "common garden white" is a familiar example of this mode of fufpenfion, and of the brilliant appearance which this order of infects affume in this ftate.

The moth tribe remain much longer in the pupa form, and evince more care towards themfelves, in making choice of a fituation adapted to this defencelefs ftage of life. The caterpillar having acquired its full fize, feeks for a proper place in which it may remain in fafety during this period, and having made choice of this, prepares for the important change. Some fpin webs or cones in which they inclofe themfelves, others conceal themfelves in little cells which they form under ground, &c. Preparatory to the change the larva ceafes to take any food, empties itfelf of all the excremental matter which the inteftines contained, voiding at the fame time the membrane which ferves as a lining to thefe of the ftomach. It generally perfeveres in a ftate of reft and inactivity for feveral days about this time. In proportion as the change into the pupa form approaches, the body is obferved to extend and contract itfelf very often: the hinder part is firft difengaged from the fkin, and after a while the fkin is entirely caft off.

The caterpillar, thus ftripped from its fkin, is called the pupa; the exterior covering gradually becomes hard, while the interior remains fo foft that the flighteft touch will decompofe them. The exterior covering is at firft covered with a vifcous fluid, which thickening and drying up, forms a thin fkin or coat capable of refifting external injuries. Thofe who are defirous of tracing the various members of the future butterfly or moth in the pupa, fhould examine it before this fluid dries up.

The length of time an infect remains in the pupa form varies much in different fpecies. As foon as the inclofed animal acquires fufficient ftrength to break the bonds of its confinement, it makes a powerful effort to efcape. The moth frees itfelf from the pupa with greater facility than the pupa from the caterpillar; for the cafe of the pupa becomes fo dry, when the moth is near the time of throwing off its covering, that it will crack and break to pieces if it be only gently preffed between the fingers; and very few of the parts will be found, on examination, to adhere to the body. Hence, when the infect has acquired a proper degree of folidity, it does not require any great exertion to fplit the membrane which covers it: a fmall degree of motion, or a little inflation of the body, is fufficient for this purpofe; thefe motions reiterated a few times enlarge the hole,

hole, and afford the moth room to escape from its confinement. The opening through which they pass is always at the same part of the skin, a little above the trunk, between the wings and a small piece which covers the head: the different fissures are generally made in the same direction. If the outer case be opened, it is easy to discover the efforts the insect makes to emancipate itself from the shell. When the operation begins, there seems to be a violent agitation in the humours contained in the little animal; the fluids being driven with rapidity through all the vessels, the limbs and various parts of the body are put in motion, and by repeated efforts it breaks through the brittle skin that envelopes it. Those inclosed in cones or cases, after bursting through the pupa covering, have another difficulty to overcome, that of piercing through the inclosure, which, in many instances, is of a stronger texture than the case of the pupa. For the accomplishment of this, most insects are provided with a liquor, which they discharge from the mouth upon that part of the cone through which they intend to escape, and this so moistens and weakens it, that after a short time they force their passage through with some facility. Some insects not provided with this fluid leave one end of their cone weaker than the rest, and close it only with a few threads, so that a slight effort of the head enables the insect to burst from its prison.

The butterfly or moth, on emerging from the pupa, is moist and humid, the abdomen swollen, the antennæ bent down, and the wings crumpled, small, and shapeless. These parts gradually change and assume their destined form. The wings extend, and the fibres, which were at first flexible, become hard and rigid like bone. In proportion as the fibres lose their flexibility, the fluids which circulate within them extend, and the wings cease to act; so that if any extraneous circumstance arrests the progress of this fluid through the fibres, at the first instant of the moth's escape, the wings immediately become crippled, and never afterwards assume any other form. These parts expand with such rapidity, that the naked eye cannot entirely trace their developement. The wings, which at one instant are small and like four little buds at the sides of the thorax, in a few minutes after acquire their full size, so as to be nearly five times as large as they were before. Nor are they the wings only which are thus increased: all their spots and marks, heretofore so indistinct and small as to be scarcely discernible, are proportionally extended, so that what before appeared as only so many unmeaning and confused points, become distinct and beautiful ornaments. When the wings are unfolded, the tongue rolled up, the mouth sufficiently dried, and the different members strengthened, it takes its flight. Most insects, soon after they have attained their perfect state, void an excrementitious substance, which some suppose to be the last they eject during life.

If the moth be now opened down the belly, and the fatty parts which fill it be removed, the gross artery or heart will be visible, and the contractions and dilatations, by which it pushes forward the liquor it contains, may be easily observed. One of the most remarkable circumstances is, that the circulation of this fluid in the moth is directly contrary to that which took place in the caterpillar. In this it moved from the tail to the head, whereas in the moth its current is from the head to the tail. The intestines are now formed in a more delicate manner, and suited to a purer aliment than that on which it subsisted before its change into the pupa: the caterpillar devoured the grosser parts of vegetables; the nutriment of the perfect insect is the nectar of flowers. Many internal parts of the caterpillar disappear in the pupa, and many that could not be before perceived are at length rendered visible. And thus the creature, which heretofore crept on the earth, flies freely through the air, and, far from creating aversion by its foul appearance, now attracts attention by the elegance of its form and beauty of colour.

The industry of the caterpillar in the construction of its cocoon, or other repository, in which it passes the time destined for it to remain in the pupa state, is highly worthy of remark. Some caterpillars, towards the time of their change, suspend themselves from the branch of a tree, with the head downward, and are transformed in this position. Many of the moth kind cover with threads that part of the branch from which it means to suspend itself: it places these in different directions, and then covers them with other threads successively, till the cone in which it is to become a pupa is finished. The caterpillar hooks itself by the hinder feet to this hillock; and when it has found by several trials that it is strongly fixed thereto, throws itself forward, letting the body fall with the head downwards. Soon after it is thus suspended it bends the fore part of the body, which posture it retains for some time; then stretching the body, again in a little time bending it, and so on, repeating this operation till it has formed a slit in the skin upon the back. Part of the pupa soon forces itself through this, and extends the slit as far as the last crustaceous feet: the pupa then forces upwards the skin, by means of its little hooks, and the motion of the body, till it has slipped it off to that part from which the caterpillar had suspended itself.

The mode of suspension adopted by some insects is very different from that pursued by others. Some fix themselves in an horizontal position, by means of a girdle, which they tie round the body, so as to support the caterpillar, and yet leave it at full liberty to effect the changes: others suspend themselves in webs, in temporary habitations, formed by weaving together two or three leaves of the plant on which they feed, by means of silken threads. The industry of those which spin cones or cases, in which they inclose themselves, in order to prepare for their transformation, is very generally known from the familiar history of the common silk-worm, an insect from which man derives the most essential benefits. In northern Europe these advantages are scarcely known, and are esteemed valuable only in proportion as they contribute to the luxury of dress; because our woollens are better suited to the vicissitudes of the climates. But in a far more extensive portion of the habitable globe, silk constitutes an article of the first necessity in useful clothing; and hence the labours of this industrious little creature become in the highest degree important and beneficial to the human race.

The silky tissues of this insect are spun by the caterpillar, for the sole purpose of enveloping and suspending itself in security during its pupa state. The substance of which the silk is formed is a fine yellow transparent gum, contained in two reservoirs that wind about the intestines, and which, when unfolded, are about ten inches long; they terminate in two exceeding small orifices near the mouth, through which the silk is drawn or spun to the degree of fineness which its occasions may require. This apparatus has been compared to the instrument in use for drawing gold and silver into threads. Each thread proceeds from the two reservoirs at the same time, but they are united as the thread forms; so that, if examined by the microscope, it will be found to consist of two cylinders or threads glued together, with a groove along the middle, and in which sometimes even a separation may be perceived.

When the silk-worm is near the time of change to the

pupa,

pupa, the refervoirs of filk are full, and it is preffed by its fenfations to relieve itfelf from this incumbrance. Having made choice of a convenient fituation, the operation of fpinning commences. At firft it throws out fome loofe thread, which ferves to fupport the future fuperftructure: upon thefe it forms an oval of a loofe texture, confifting of what is called flos filk; and within this it forms a firm and more confiftent ball of filk. It is now inclofed within the circumference of the fpheroid, the interior of which is the fcene of its further operations: in this it is feen refting on its hinder parts, and with its mouth and fore legs directing and faftening the threads. Thefe threads are not directed in a regular circular form, but are fpun in different fpots, in an infinite number of zig-zag lines; fo that, when wound off, it proceeds in a very irregular manner. This thread, when meafured, has been found to be about three hundred yards long, and fo fine that eight or ten are generally rolled off into one by the manufacturer. The filk-worm ufually employs about three days in finifhing this cone; the infide is generally fmeared with a kind of gum, which is defigned to keep out the rain. It next affumes the pupa form, in which it remains from fifteen to thirty days, in different climates, before the moth is produced. When the infect intends breaking from the cocoon, it moiftens one end of the cone, and by frequent motions of the head loofens the texture of the filk, fo as to form a hole without breaking it. See Silk-Worm, *Phalæna Mori*.

From a feries of experiments made by Reaumur on the filk of this infect and that of the fpider, in order to afcertain their comparative excellence, it was found that the thread would bear the weight of thirty-fix grains, while that of the fpider could not fuftain twelve grains, breaking under its weight. There are filks fpun by other infects, with which we are little acquainted, that in point of ftrength far exceeds that of the common filk-worm. The popular opinion, that the filk worn in different parts of the world is the fole produce of this fpecies (phal. mori), is erroneous. This kind of filk is generally efteemed for its peculiar beauty and delicacy of texture. There are others lefs coftly, which, from their fuperior ftrength, are better adapted to common wear, and are for this reafon in more general ufe in fome parts of the globe. The filk obtained from the cocoons of the two fpecies of bombyces paphia and cynthia are of this kind, as appears from an interefting paper on thefe infects by Dr. Roxborough, F.L.S., inferted in the feventh volume of the Tranfactions of the Linnæan Society.

Thefe infects bear the names of tuffeh and arrindy filk-worms in India: both exceed the common filk-worm in fize, the firft efpecially, which is one of the largeft of the attaci family of bombyies, and the filk of which appears to be more valuable than that of the other kind.

The tuffeh filk-worm is found in fuch abundance over many parts of Bengal, and the adjoining provinces, as to have afforded the natives from time immemorial an ample fupply of a moft durable coarfe filk, commonly called tuffeh filk, which is woven into a kind of cloth called tuffeh doot'hies, much worn by the Bramins, and other fects of Hindoos. This fubftance would no doubt be highly ufeful to the inhabitants of many parts of America, and the fouth of Europe, where a cheap, light, cool, and durable drefs, fuch as this filk makes, is much wanted. The caterpillar, when full grown, is about four inches in length, and bulky in proportion; its colour green, with a lateral ftripe of yellow edged with red. The plate in which the caterpillar is reprefented, if we miftake not, is engraven from a drawing executed by an Indian artift, and muft be received with fome allowance for inaccuracy; but from this we may collect that it has a fingle feries of yellow oval dots beneath the lateral line, (amounting to fix or feven in number,) which are perhaps its fpiracles; and thefe, in the defcription, are denominated fpecks of gold colour. When thefe are ready to fpin, each connects, by means of the recent glutinous filament of which the cafe is made, two or three leaves of the jujube tree, the vegetable on which they feed. Thefe connected leaves form an exterior envelope, which ferves as a bafis to fpin the complete cafe or cocoon in; and "befides this," fays the writer, "the cafe is fufpended from a ftrong branch of the tree in a wonderful manner by a thick, ftrong, confolidated cord, fpun of the fame materials from the bowels of the animal." It remains nine months in the pupa ftate. The infect, when produced, expands to the breadth of five or fix inches, and thofe of the female to eight inches.

There is another kind of wild filk-worm produced in the Burbhoom hills, which is faid to be more capable of being domefticated; and a fourth fort, a fuppofed variety of the tuffeh-worm, in the hills near Bauglipore, the cocoon of which is fmaller than that of either of the two firft mentioned.

The arrindy filk-worm ftill remains to be noticed. This is of a fpecies altogether different from the former, and is the bombyx cynthia of entomologifts. This infect, known to the Hindoos by the name of arrindy in fome parts, and in others arrundi, appears to be peculiar to the interior parts of Bengal; and it is prefumed, may be even confined to the two diftricts Dinagepore and Rungpore, where the natives breed and rear it in a domeftic ftate, as they do the common filk-worm. The food of the caterpillar confifts entirely of the leaves of the common ricinus or palma chrifti, which plant is cultivated abundantly over every part of India, on account of the oil obtained from the feed. The Hindoos call this plant arrindy, and hence is derived the name of the infect. The caterpillar, when full fed, is about three inches long; the colour pale green; and each fegment verticillated with a few conic tubercles difpofed in a fingle line. The cocoon is white or yellowifh, of a very foft and delicate texture, about two inches long, and three in circumference, and pointed at each end. There is a wide diftinction between this fpecies and B. paphia, in the period it remains in the pupa form; this requiring at the utmoft not above twenty days, inftead of nine months, to complete its laft transformation.

The filaments of which the cocoon is compofed are fo exceedingly delicate, that it is faid to be impracticable to wind off the filk: it is therefore fpun like cotton. The cotton, thus manufactured, is wove into a coarfe kind of white cloth, of a feemingly loofe texture, but of incredible durability; the life of one perfon being feldom fufficient to wear out a garment made of it, fo that the piece defcends from mother to daughter. Some of the Indians, however, have a method of fpinning the filk of this fpecies, and the procefs is related as follows. Four or five of the cocoons are faftened to a piece of wood, with fomething heavy to make it fpin round, while fufpended by the thread. When they let out a fufficient quantity of the cocoons from their hand, it is twifted by this piece of wood fpinning round; and when well twifted, it is wound round the wood, and another length let out of the hand. The cocoons are fpun wet, but only with cold water. The cloth is woven in fmall pieces in a loom: its ufes are for clothing for both men and women; it will conftantly wear ten, fifteen, or twenty years. This filk muft be always wafhed in cold water; for if put into boiling water, it will tear like old rotten cloth. Some

manufacturers

manufacturers feem to be of opinion that fhawls, and other filken articles of drefs, equal in quality to any manufactured in India, could be fabricated with this material. There is reafon to apprehend that this filk is highly valued in India; nor can we entertain the leaft diftruft of its want of durability, fince it is well known that the coverings of their palanquins are of this particular kind of filk.

On further inveftigation and refearch into the hiftory of the larger fpecies of the bombyx tribe, we are perfuaded others will be found to form cocoons or pupa fpinnings, which, with proper attention and culture, may hereafter be productive of fimilar advantages. We are not ignorant that in other parts of Afia, and in America, there are many fpecies that fpin in the fame manner an envelope round the pupa; and fome of thefe at leaft, we muft fuppofe, capable of producing a filk of beauty and durability equal to fome of thofe in prefent ufe. We fhould not be furprifed to learn that bombyx atlas, the moft confiderable in magnitude of all the moth tribe, is exprefsly reared in China for the fake of its filk. We fufpect this to be the truth. It would be defirable alfo to afcertain whether the cocoons of the fpecies hefperus, cecropia, cytherea, promothea, and fome others, could not be beneficially employed in the production of filk. Mr. Abbot, in his Infects of North America, fpeaks generally of fome attempts being made to fabricate the filk of one or two of the larger moths of that country; the cloth prepared from which is reprefented as ftrong and durable: but he expreffes doubt how far the experiment might be ufeful, as the infects which produce the filk are not abundant. This objection might eafily, we fhould imagine, be obviated by cultivation: infects are highly prolific, and if they could be reared in what may be termed a domefticated ftate, could be produced in any numbers.

Among a variety of other curious information which this paper conveys, the following circumftances appear fo amufing, and feem to reflect fuch new light on the hiftory of thefe ufeful infects, that we cannot refrain repeating them. The cocoons of this infect, bombyx paphia, feed on the leaves of a plant called byer by the Hindoos (rhamnus jujuba), and likewife on the plant they call affeen (terminalia alta glabra of Roxb.). They are annual, remaining nine months in the pupa ftate, and three months in that of the egg and caterpillar. The fpecies cannot be domefticated, nor can the natives even retain any for feed. The hill people fay, they go into jungles, and under the byer and affeen trees they find the excrement of the infect; on which they examine the tree, and, on difcovering the fmall worms, they cut off branches of the tree fufficient for their purpofe, with the young brood on the branches. Thefe they carry to convenient fituations near their houfes, and diftribute the branches on the affeen tree, in proportion to the fize of them; but they put none on the byer tree. The Parieahs, or hill people, guard the infects night and day, while in the worm ftate, to preferve them from the crows and other birds by day, and from bats by night. As foon as the moth pierces the cafes, it efcapes; nor do the people prevent this, as they have learnt by experience that it cannot be kept alive more than a few days, and that retaining it would not be attended with any advantage.

To wind off thefe cocoons, the natives put them into a ley made of plantain afhes and water for about two hours; after which they take them out of the ley, and put them in their wet ftate into an earthen pot: thofe which are properly foftened are firft applied to the reel, and fo on as the cocoons become foft, for four or five days, till the whole are wound off. The implement ufed for taking off the thread is a fmall common reel of four bars. The cocoons are laid in a fmooth earthen difh without water; the reel is turned by the right hand, whilft the thread of four or five cocoons paffes over the left thigh of the fpinner, and he gives the thread a twift with his left hand upon his thigh. The thread is exceedingly apt to come off double and treble for feveral yards together, which is not regarded by the natives, as breaking off double threads would diminifh the produce, and moreover would occafion lofs of time: a very even thread, however, with care may be reeled off. The bughy filk-worm feeds indifferently on byer or affeen leaves.

The jarroo cocoon is the pupa fpinning of an infect clofely allied to the preceding, but whether a diftinct fpecies or variety, from the knowledge we at prefent poffefs, feems difficult to determine. Thefe are called the jarroo cocoon, from being produced in January, the coldeft month of the year; and the natives affirm, that they are different from the bughy. The jarroo will eat the byer leaf, if it cannot get the affeen; but will always prefer the latter, and will produce better cocoons when fed on it. The filk is duller in colour. The natives are able to retain part of the jarroo cocoons for feed. Thefe they hang out on the affeen trees, when the proper feafon of the moth arrives. The males, when hatched, invariably fly away; but the females remain on the trees. Thefe are not impregnated by the males bred along with them, but in ten or twelve hours, or perhaps two or three days, a flight of males arrive, fettle on the branches, and impregnate the females; and it is worthy of remark, that the hill people confider it good or ill fortune, in proportion to the fpeedy or tardy arrival of thefe male vifitors. The purpofes of nature accomplifhed, the males expire, and the females live only long enough to depofit the eggs in fafety on the branches of the trees. Thefe males are fuppofed by the natives to come from a vaft diftance: it is affirmed even, that by marking the wings of a number of males, previoufly to letting them fly, their progrefs in queft of the females has been traced to the diftance of one hundred miles and upwards. This, though remarkable, is not more extraordinary or unworthy of credit than the circumftance (if truly ftated), that the males and females of the fame brood never affociate together in any manner, when they enter the fly ftate; the males regularly flying off in fearch of another brood of females, and leaving thofe of their own family to the embraces of another flight of males.

There is a caterpillar which forms its filken cone in the fhape of a boat turned bottom upwards, whence it is called by Reaumur "coque en batteau." It confifts of two principal parts, each of which is framed by itfelf, and formed of an innumerable quantity of minute filk rings; in the fore part there is a projection, in which a fmall crevice may be perceived, which ferves when opened for the efcape of the moth; the fides are framed with fo much art, that they open and fhut as if framed with fprings; fo that the cone from which the fly has efcaped appears as clofe as that which is ftill inhabited.

Thofe caterpillars which do not fpin a cone fupply that want with various materials, which they form into a habitation to fecure them from injury while in the pupa ftate: fome form a covering with leaves and branches tied or made faft together, others connect the leaves with great regularity; many ftrip themfelves of their hairs and form a mixture of hair and filk, others conftruct a cone of fand or earth, cementing the particles together with a kind of glue:

ſome gnaw the wood into powder, or like ſaw-duſt, and cement it together; and others make caſes in holes, which they form in the trunks of trees.

The period of their change into the chryſalis or pupa ſtate is very regular in moſt inſects, unleſs in ſeaſons peculiarly unfavourable. Some change in May, others in June, July, Auguſt, and September, and the time of emerging from the ſtate of pupa is fixed with no leſs preciſion. This is a fact well known to every practical entomologiſt. Some remain in the pupa ſtate only twelve or fifteen days, others twenty or thirty, and theſe are chiefly of the butterfly tribe. Thoſe of the moth kind are commonly much longer, ſome remaining in this ſtate only two or three months, others ſix, nine, or twelve, ſome two years, and others even it is known ſo long as three years. Lyonet has remarked, that the periods of change to the chryſalis ſtate is not ſo conſtant, but that a degree more or leſs will affect it. The ſame inſect, he ſays, which in the middle of ſummer would have acquired its utmoſt ſize in leſs than three weeks, will require as many months, and even much more if it comes forth at the end of the ſeaſon. And again, he obſerves, that ſuch a nymph or chryſalis which in ſummer will change into a winged inſect in fifteen days, will employ ſometimes ſix, ſeven, or eight months for the ſame purpoſe, merely from having gone into the chryſalis ſtate a few days later than thoſe which have changed ſo rapidly. That particular incidents may occaſionally juſtify theſe remarks of Lyonet, we ſhall not diſpute, but this can be only underſtood of in-inſects hatched in ſeaſons of unuſual inclemency, or under circumſtances in the higheſt poſſible degree uncongenial to their transformations. Irregularities will ariſe from this cauſe. In general, however, the appearance of every ſpecies (whoſe hiſtory is once correctly aſcertained) whether in the larva, pupa, or winged ſtate, may be determined by the time of the year. Moſt inſects perform all their changes within the courſe of twelve months, and are found in their ſeveral ſtates at particular periods annually; others have two broods in the courſe of that time, and conſequently appear in the ſame ſtate at two different periods of the year.

Neuroptera.—Some of this order are ſemi-nymphs, as the libellulæ and ephemeræ, in which the rudiments or half-wings are developed, and which eat and purſue the ſame manners of life as the larva. Others are like the nymphs of the coleopterous order in appearance, and lie dormant in the ground, generally in caſes conſtructed of extraneous materials. The myrmelion forms a hollow ball of ſand for this purpoſe.

Hymenoptera.—In the pupa of the cynips the limbs are partially diſcloſed in its external figure, and it remains in the central cavity of the gall in which it lives during the ſtate of larva, while in the pupa form. The tenthredo forms a kind of exterior caſe or envelopement, within which it aſſumes the pupa form, and which in ſome kinds reſembles the texture of thin parchment. The pupa of the ſirex is quieſcent, and is uſually found lodged in timber: this has the limbs diſtinctly formed. The pupæ of the ichneumons are incloſed in oblong ſilken cones. Thoſe of the waſps and bees are well known. In the ants the limbs are diſtinct.

Diptera.—The pupæ of the tipulæ are uſually cylindrical like the larva, and quieſcent; many of the muſcæ appear of an elongated egg ſhape, without any ſegmental diviſions, and totally devoid of motion. The pupa of the culex is curiouſly incurvated and ovate, with reſpiratory tubes, through which it breathes; it is an inhabitant of the waters. The egg of the hippoboſcæ ſerves in lieu of a pupa, or in other terms the hippoboſcæ are oviparous, and have no pupa.

Aptera.—As the individuals of this order are produced with few exceptions in the perfect form from the egg, they have no pupa, at leaſt the common flea is the only inſtance to the contrary; this undergoes the uſual transformations from the egg to the perfect ſtate; its pupa reſembles that of ſome coleopterous inſects when magnified.

Imago: the final or perfect ſtate which all inſects aſſume after paſſing through the ſucceſſive changes from the egg, the larva, and pupa form; which latter it quits in the imago ſtate. This might, with more ſimplicity, be termed the winged ſtate, were it not that ſome inſects, after quitting the pupa, are apterous, or without wings. In the imago form the inſect is in every reſpect perfect in all its parts, and poſſeſſed of every function which nature has intended the ſpecies to enjoy.

Habitation of Inſects.

Inſects are of two kinds, aquatic and terreſtrial, and their habitation muſt be conſidered ſeparately.

Some live only in watery places, appearing occaſionally on the ſurface of that element, and which very rarely plunge themſelves in, or if they fall in, either riſe again immediately to the ſurface or periſh. Others live only in water, and cannot ſubſiſt out of it. Many, after having lived in the water while in the larva and pupa ſtate, come out afterwards with wings, and become entirely terreſtrial. Some undergo all their transformations in the water, and then become amphibious. Others again are born and grow in the water, but remain during the pupa ſtate on dry land, and after they attain their perfect form live equally in air and water. There are, laſtly, ſome who live at the ſame time occaſionally both in the water and on land, and which, after their transformation, ceaſe to be aquatic.

Among the inſects which remain on the ſuperficies of the water, are ſome ſpiders which run with great addreſs and agility, without moiſtening their feet or their body. There are aquatic cimices which ſwim or rather run on the water with great velocity, and by troops, as may be often ſeen on the ſurface of ſtill water. Some walk ſlowly on the ſurface. The gyrinus moves ſwiftly and in circles. The nepæ are of that kind which live only in the water, and cannot ſubſiſt out of it, or at leaſt can remain out of it only a ſhort time. The number of thoſe which, after having lived in the water, leave it when in a winged ſtate is very great: among theſe are the libellula, the ephemera, the phryganea, culex, tipula, and ſome other ſpecies of muſcæ; all theſe are of the aquatic kind, both in the larva and pupa ſtate, but when they have aſſumed their perfect form are entirely terreſtrial, and would be drowned therein. The kinds moſt ſtrictly amphibious are the water beetles, ſuch as the dytiſcus and hydrophilus; theſe remain in the water all day, but towards evening come upon the ground and fly about, plunging themſelves again into the water at the approach of ſun-riſe: the larvæ of theſe inſects are entirely aquatic; but when the time of their pupa ſtate arrives they deſcend into the earth, where they make a ſpherical caſe, thus becoming entirely terreſtrial, and in the perfect ſtate are amphibious.

Moſt inſects of theſe tribes prefer ſtagnant waters, others thoſe of a purer nature, and we have inſtances of certain inſects which inhabit, with perfect convenience, ſprings of a warm and mineral nature. At the baths of Abano, in the Venetian ſtates, is a ſpring of this deſcription, impregnated with ſulphur, in which ſmall water beetles are ſeen ſwimming about, and which die on being taken out and plunged into cold water.

Many

Many insects that live under the surface of the earth in the perfect state crawl out occasionally, as the mole cricket, and some of the aptera, as the julus and scolopendra; these are generally found in the earth under stones, or beneath rotten wood in damp situations. Some insects remain underground part of their life, but quit that situation after their change, as in the coleoptera. A vast number of others live in animal substances of every kind. The habitation of some, as the myrmeleon formicarius, is curiously constructed in the sands.

There is a species of spider found in Jamaica (aranea venatoria) which burrows in the earth like a rabbit; it is of a size very far surpassing the largest of the European spiders, and is not uncommon there. This creature forms a hole twelve or fifteen inches deep, of a cylindrical shape, rather more than an inch in diameter, and which it lines with a thick coat to prevent the earth from tumbling in. The aperture is closed with a kind of lid or door attached by a single hinge, and which open outwardly, falling down and shutting the aperture by its own gravity. Into this the spider retires with its prey, and devours it in safety, as few insects can penetrate into its cell. These nests or cases form a complete habitation, should the sands in which they are constructed give way.

Insects of the lepidopterous order are very rarely carnivorous; there are instances of this, but these are uncommon. Their food and that of many other insects are of the vegetable kind, and their habitations are trees and plants. The oak and the willow among trees, and numbers of different plants among herbage, are the natural habitation of insects in great abundance. Some live in the roots, others in the wood; in the leaves, and in galls formed therein; in flowers; in fruit; and in grain. Some caterpillars form a kind of hammock, in which they eat and go through their various changes; while others construct a tent, under which they live till they have consumed the surrounding herbs, when they leave their abodes and pitch their tents in another spot, where they can find abundance.

Many insects associate together all their lives, others only for a certain period. Those who live together proceed from the same moth who deposited the eggs near each other, or laid them in a heap, and thus formed a kind of nest. These are generally hatched about the same time, and live together, forming a kind of republic. These societies include two, three, or four hundred individuals, and usually live inclosed in a large web, like the lackey moth, (phal. neustria) and the ermine moth. Of these social caterpillars there are some kinds which never quit the society to which they belong, but pass into the pupa form in the same nest. One of the most remarkable of these caterpillar communities is that of the bombyx processionea. These live on the oak separate till they arrive at a certain age, when they associate together, and do not quit their society till they acquire their perfect form. As the number of the caterpillars thus assembled is considerable, the nest is also very large. They remain in their habitation till sun set. When they go out one of the body precedes the rest as a chief, whom they regularly follow. When the leader stops the rest do the same, and wait till it goes on again before they recommence their march. The first file generally consists of a single caterpillar, which series is succeeded by a double file, these by three in a row, which are then followed by files of five, and so on. They keep close to each other, not leaving any interval either between the ranks or between those in each rank, all following their captain in compact order, whether in a straight or irregular course. After they have taken their repast they return to the nest in the same order as they set out. This conduct is regularly pursued till they are full grown, when each spins a cone for itself in the nest. It has been remarked, that though these caterpillars proceed often very far from the nest, it is by no means difficult for them to get back again, because they spin a thread in their route. The first leads the way, the second follows spinning, the third spins after the second, and soon forming thus a path of threads.

Upon the same tree, shrub, or plant, we often find numbers of caterpillars which have no affinity to each other, and of which the actions of one have no influence over the manners of the other; they may in this respect be considered solitary. There are others who seem still more independent of each other even than these, because they shun all intercourse, constructing lodgments formed of leaves tied together with considerable ingenuity, in which they live as in an hermitage. The operation by which these caterpillars tie the leaves together is far surpassed by another kind, who fold and bend one part of the leaf till it meets the other. These are again excelled by those who roll the leaves which they inhabit. For this purpose the caterpillar makes choice of part of a leaf which it finds in some degree bent; here its work commences, the caterpillar moving the head with great velocity in a curved line, or rather vibrating it like a pendulum, the middle of the body being the centre on which it moves. At each motion of the head a thread is spun and fixed at that part to which the head seems to be applied. The threads are extended from the bent to the flat part of the leaf, and the curvature which is to be given to it. There is another species of which it is observed, that at each new thread it spun, the edges of the leaf insensibly approached to each other, and were bent more and more, in proportion as the caterpillar spun new threads; when the last thread was spun, that which preceded it was loose and floating in the air. To effect this the caterpillar, after it has fixed a thread to the two edges of the leaf, and before it spins another, draws it towards itself by the hooks of its feet, and by this means bends the leaf; it then spins another leaf to maintain the leaf in this position, which it again pulls towards itself, and repeats the operation till it has bent the leaf in its whole direction. It now begins again placing the threads further back, upon the bent part of the leaf, and by proceeding in this manner it is rolled up; when it has finished this business it strengthens the work by fastening the ends of the leaf together. The habitations thus formed are open at both ends, and within which the insect feeds in safety. At the approach towards the pupa state, the caterpillar lines the rolled leaf with silk, that the rougher parts may not injure it.

A great number of the smaller larvæ require an artificial covering to protect them. Some inhabit the interior part of leaves in which they form large oval or circular spaces; others form a kind of gallery within, which in some is straight, in others crooked. Many of the tineæ are found lodged in cylindrical tubes or cases, which they form of different substances closely woven with fine silken threads. The small caterpillar found in neglected woollens and other similar articles is of this kind, living in a cylindrical case, and producing a small moth.

The phryganea larvæ construct cases somewhat similar in form, and which are also open at both ends; in these the larvæ reside, the outside is formed of different substances, such as bits of reed, stone, gravel, and small shells, which they arrange and manage with singular dexterity. When they walk they only advance a few of the anterior rings of the body, training the case after them. When they are

about

about to aſſume the pupa form they cloſe up the ends with ſilken threads.

But the habitations of theſe inſects, though conſtructed with ingenuity, are in no manner comparable with the architectural fabrications of many other inſects, as thoſe of the waſp, the bee, the common ant (formica), the white ant (termes), &c. The ſtructure of the neſts conſtructed by the common waſp, and the common honey bee, cannot be unknown to any reader. Among the habitations of the ſolitary, or thoſe called the wild bees, there are many which deſerve remark. Some of the bee tribe penetrate into the earth, where they form ſmall contiguous cavities, in each of which they depoſit an egg, with a ſufficient quantity of proviſions for the ſuſtenance of the larva. There is one kind whoſe neſt conſiſts of ſeveral cells artfully let into each other, but not covered with a common incloſure; each cell conſiſts of two or three membranes, inexpreſſibly fine, and placed over each other. The cavity in which the neſt is placed is ſmeared over with a layer of matter, like that of which the cells are formed, and apparently ſimilar to that viſcous humour which ſnails ſpread in their paſſage from one place to another. An egg is depoſited at the bottom of each cell, where, after it is hatched, the grub finds itſelf in the midſt of a plentiful ſtock of proviſion, for in each cell there is placed a quantity of paſte, or a kind of wax, which is to ſerve as food for the worm, and as ſupport to the wall of the cell.

Another ſpecies that forms its neſt under ground makes a perpendicular hole in the earth about three inches deep and cylindrical, till it comes within three-fourths of an inch of the bottom, when it begins to open wider. The ſuitable proportions being given, the bee proceeds to line with tapeſtry not only the whole of the inſide, but alſo the entrance; the ſubſtance with which it is lined is of a crimſon colour, and appears as very beautiful. This lining is formed of fragments of the flowers of the poppy, which the bee cuts out curiouſly, and then ſeizing them with her legs conveys them to her neſt. If theſe pieces are rumpled, ſhe preſſes them ſmooth, and then affixes to the walls of her cell; or if the piece ſhe has cut and tranſported is found too large, ſhe clips off the ſuperfluous parts, and conveys the ſhreds out of the apartment. After the bee has lined the cell, ſhe fills it nearly half an inch deep with a kind of paſte, proper to nouriſh the larva when hatched from the egg. When the bee has amaſſed a ſufficient quantity of paſte, ſhe folds the tapeſtry over the paſte and the egg, which is by this means incloſed as it were in a bag of paſte; and the bee then fills up with earth the empty ſpace that is above the bag. Another of the bee tribe is ſaid to conſtruct its neſt in the ſame way, with this difference only, that the lining is of the corolla of the roſe.

The carpenter bee (apis centuncularis) conſtructs her neſt in pieces of wood, whence the name; in this ſhe perforates long cylindrical hollows, which ſhe divides into ſtages, and depoſits her eggs, each incloſed in a curious cylindrical caſe formed of leaves, not quite an inch in length, and leſs than half an inch in diameter, and theſe are diſpoſed endwiſe one above another to the amount of ten, twenty, or more, the cylindrical perforation in the wood being two or three feet long, or ſometimes more. They bore the wood moſt commonly in the longitudinal direction of its ligneous fibres, but this is not always the caſe. There are ſeveral ſpecies of this order in appearance much like each other. The leaves which form the lining of the caſes in one ſpecies is that of the roſe.

The former are called the carpenter bees on account of the holes which they bore in the wood; there is another which bears the name of maſon bee, from the peculiar ſtructure of the neſt. Their manner of building is this: the bees collect with their jaws ſmall parcels of earth and ſand, which they glue together with a ſtrong cement, which is furniſhed from the proboſcis; and of this they form a ſimple but commodious habitation, which is generally placed along walls that are expoſed to the ſouth. Each neſt reſembles a lump of rude earth of about ſix or ſeven inches diameter, thrown againſt the wall; the labour of conſtructing an edifice of ſuch magnitude muſt be conſiderable, as the bee can only carry a few grains at a time. The exterior form is rude and irregular, but the art exhibited within more than compenſates for the ruggedneſs of the external appearance. The interior is divided into twelve or fifteen cells, ſeparated from each other by a thick wall; in each of theſe an egg is depoſited by the parent bee. The cells are conſtructed progreſſively, for when one is finiſhed ſhe places an egg in it, with a ſufficient quantity of honey to nouriſh the larva; ſhe then builds another, and ſo proceeds till all her eggs are depoſited. When the young are hatched the ſtrength of their jaws enable them to penetrate through their cells with perfect eaſe.

There is a ſpecies of ſphex called the ichneumon waſp, whoſe manner of conſtructing the neſt is ſtill different from either of thoſe before mentioned. This little creature generally begins its work in May, and continues its labours through the greater part of June. The object of her labour ſeems at firſt to be the digging of a hole a few inches deep in the ground, in the conſtruction of which ſhe forms however a hollow tube above ground, the baſe of which is the opening of the hole, and which it raiſes as high above ground as the hole is deep below; it is formed with great care, reſembling a coarſe kind of fillagree work, conſiſting of the ſand drawn from the hole. The ſand out of which ſhe excavates her cell is nearly as hard as a common ſtone. This it readily ſoftens with a penetrating liquor, with which ſhe is well provided; a drop or two of it is imbibed immediately by the ſand on which it falls, which is inſtantly rendered ſo ſoft, that ſhe can ſeparate and knead it with her jaws and fore feet, forming it into a ſmall ball, which ſhe places on the edge of the hole as the foundation ſtone of the pillar ſhe is about to erect; the whole of it is formed of ſuch balls, ranged circularly, and then placed one above the other. She leaves her work at intervals, probably in order to renew her ſtock of that liquor which is ſo neceſſary for her operations; theſe intervals are of ſhort duration; ſhe ſoon returns to her work, and labours with ſo much activity and ardour, that in a few hours ſhe will dig a hole two or three inches deep, and raiſe a hollow pillar two inches high. After the column has been raiſed to a certain height perpendicularly from the hole, it begins to curve a little, which curvature increaſes till it is finiſhed, though the cylindrical form is preſerved. She conſtructs ſeveral of theſe holes, all of the ſame form and for the ſame purpoſe. It is evident the hole was dug in the ground to receive the egg, but the purpoſe of the tube of ſand is not very apparent. By attending to the labours of the waſp, one end, however, may be diſcovered; it will be found to ſerve the purpoſe of a ſcaffold, and that the balls are as uſeful to the waſp as materials to the builder, and are therefore placed as much within her reach as poſſible. She uſes it to ſtop and fill up the hole after ſhe has depoſited an egg in the cell, ſo that the pillar is then deſtroyed, and not the leaſt remains left in the neſt. The parent inſect generally leaves ten or twelve worms as proviſions for the young larva.

In

In all thefe fabrications there is a degree of ingenuity in defign, and exactnefs of execution, which, independently of the labour required in their conftruction, excites our admiration. The talent, if it may be fo expreffed, of the infect race, is more obvioufly difplayed in the formation of the dwellings than in moft other particulars of their hiftory. It is a pleafing fubject of inquiry, and extremely worthy of attention, but for an elementary difcourfe we have, perhaps, already purfued thefe obfervations to a due extent, and fhall therefore conclude with a concife account of one other, which, from its ftupendous dimenfions, the order, regularity, and beauty of its architectural defign, and inimitable convenience to the purpofes for which it is intended, cannot fail to excite the aftonifhment of every obferver: it may be anticipated that the allufion is to the buildings of the termites. Thefe diminutive infects, known more generally by the name of the white ants, though, technically fpeaking, they are entirely of a diftinct genus, are natives of the Eaft Indies, Africa, and the fouthern parts of America. They live in focieties, each of which is compofed of fome thoufand individuals, all of whom are accommodated in the fame habitation. Their ftructures are of a pyramidal form, rifing to the height of ten or twelve feet, and covering no inconfiderable extent of ground at the bafe. They ufually build in the plains feveral contiguous to each other, and from their fize and form may fometimes be miftaken at a diftance for the huts of the natives.

Thefe nefts are fo common all over the ifland of Bananas, and the adjacent continent of Africa, that it is fcarcely poffible to ftand on an open place where one of thefe buildings is not to be feen. The domes are fo ftrong that they will eafily bear the weight of three or four men ftanding on them at once, and fhelter the interior from every attack of the weather. The interior is divided with the utmoft regularity into an immenfe number of apartments, arched chambers, magazines, and avenues leading to them; and the centre, on a level with the ground, contains the royal apartment, in which the queen refides, furrounded by the nurfery, &c. The white ant is the termes fatale; there are two, if not more, fpecies befides, namely, deftructor and arda, both inhabitants of Africa, which build nefts of a fimilar form, but of much fmaller fize. See the article TERMES.

Food of Infects.

Infects feed on all kinds of vegetable and animal fubftances. There is fcarcely any production of thefe two kingdoms which does not ferve for food to fome kinds of infects. They may therefore be confidered under two heads; thofe which live on vegetables alone, and thofe fupported chiefly on animal food. The organs of the mouth point out the very wide diftinction nature intended in this refpect, fome being adapted to the purpofes of maftication, others to that of fuction only; fome, like ruminating animals, have two ftomachs, others only one; the alimentary canal in fome is fhort, in others long, and upon the whole, their internal conformation, as well as external form, prefents the moft ftriking differences, each being in a peculiar manner adapted to the nature of the food upon which the animal fubfifts.

There is yet another circumftance well worthy of remark; in all thofe infects which undergo material change, the transformation of their external figure is accompanied with an entire revolution in their internal ftructure and economy; the larvæ deftined to feed on vegetables, or the grub on carrion, after effecting their transformation, prefent no longer the fame appearance within; parts adapted to their former mode of life, and inapplicable to their prefent one, totally difappear, and other organs, either before not exiftent, or which remained concealed, are now developed. The ftomach of the butterfly, when in the larva ftate, is adapted to the reception and digeftion of its vegetable food, as its organs of maftication are to its previous preparation; but this ftomach and this mouth both difappear in the butterfly, and other organs make their appearance; its mode of life is totally changed; it derives its fuftenance from the nectar of flowers, and its whole conformation is adapted to its new mode of life. Thefe arguments are not inferred from a few folitary inftances; they are exemplified in numberlefs examples: nothing is more common than to find the larvæ fubfifting on food altogether different from that which fupports the fame infect in the winged ftate.

Among thofe numerous tribes which feed on vegetables, fome fink into the earth, where they feed on the roots of grafs, and do confiderable injury to gardens. The food of others is dry and hard; they pierce the wood, reduce it to powder, and then feed on it: in this manner many of the cerambyx tribe and other coleoptera feed in the larva ftate. Some attack the leaves, eating the whole fubftance, except the principal nerves; while others feed only on the parenchymous parts which are contained between its fuperficial membranes, forming paths and galleries within. Thefe infects are not always content with the leaf; fome eat the flowers, and even this food is too grofs for many; the bee, the butterfly, the mufca, and a hoft of others, feed only on the nectareous juices, or the farina which they collect from flowers, or the delicious fluids of fruits. Corn and other grain are not free from them; they divide the produce with us, or often deprive us of large quantities. They infinuate their larvæ into the moft tender parts, and each oftentimes deftroys more than would be fufficient to feed fifty of them. We frequently find the larvæ of fome infects in pears, plumbs, peaches, and other fruit. There, indeed, appears fcarcely any part of a plant which does not ferve as food to different infects; each has its appropriate food, and though the parent animal does not, perhaps, fubfift on the fame vegetable, yet fhe inftinctively depofits her eggs on that particular fhrub or plant which will be food for her young. Some more voracious than the reft feed upon all with equal avidity; the migratory locuft, gryllus migratorius, is a ftriking example of this. The ravages of this infect have been at particular times fo extenfive as to lay wafte the vegetation of whole diftricts, of even kingdoms; an inftance is mentioned in the Amœnitates Academicæ, in which they overran all Sweden, and devoured all the plants, infomuch that cattle perifhed with hunger, and men were forced to abandon their country, and fly to the neighbouring regions. Similar refults have arifen from the ravages of locufts in various parts of the world at various periods, as appears from the moft credible hiftorians. The facred writings are not filent on this fubject. In the year 593 of the Chriftian era thefe animals appeared in fuch vaft numbers, as to caufe a famine in many countries. Syria and Mefopotamia were over-run by them in 677. In 852 immenfe fwarms took their flight from the eaftern regions into the weft, and deftroyed all vegetables, not even fparing the bark of trees, and the thatch of the houfes, after devouring the crops of corn, grafs, &c. Their daily marches were obferved to be about twenty miles each, and it is faid their progrefs was directed with fo much order, that there were regular leaders among them, who flew firft and fettled on the fpot which was to be vifited at the fame hour the next day by the whole legion; their marches were always undertaken at fun-rife. In 1541 incredible hofts afflicted Poland, Wallachia, and all the adjoining territories, darkening the fun with their num-

 bers,

bers, and ravaging all the fruits of the earth. The years 1747 and 1748 afforded a memorable inftance of the ravages of thefe animals in Germany and other parts of Europe, as far north as England. In the eaftern parts of the world fuch flights of locufts appear more frequently than in Europe, and it is often found neceffary for the governors of particular provinces to command a certain number of the military to take the field againft armies of locufts with a train of artillery.

The far greater number of infects feed, however, more difcriminately; fome are confined to one particular plant, and others only to two or three kinds; and neither in many cafes will eat any other food; they often perifh in the midft of abundant vegetation, becaufe they cannot procure that kind which is their natural food. The quantity of food which a caterpillar will devour is aftonifhing; that which feeds upon the cabbage (papilio brafficæ) deftroys in twenty-four hours more than twice its weight. If larger animals required a proportionable quantity of food, the earth would not be able to nourifh its inhabitants. It fhould, however, be remembered, that it is only during one period of their lives that they are fo voracious, or fubfift on fuch food; after they quit the larva form they are nourifhed in a different manner.

A vaft number of infects reject vegetabes in the larva ftate, and live only on animal food; fome feeking that which is beginning to putrefy, while others delight in that which is entirely putrid, or on the dung of animals. Some attack and feed on man himfelf, while others are nourifhed by his victuals, clothes, furniture, and habitation; and again others prey on his cattle. No animal whatever is exempt from thefe depredators. Some fubfift on the blood and humours of quadrupeds, others of birds, and a great proportion of them prey on infects of other kinds, or often attack their own, and thus perpetuate an endlefs war among each other.

Every larger animal has its appropiate lice, which feed on and infeft it: thefe in fize or voracity bear no regular proportion to the animal they fubfift upon. Thofe of man are diminutive in the extreme, compared with thofe which torment fome animals. The hippobofcæ and the tick, though not in technical terms the lice of the animals they infeft, have the fame habits, and draw nourifhment from the body in the fame manner; and thefe, in comparative bulk with the victims of their depredation, are an hundred, nay even, in fome inftances, a thoufand times larger than thefe uncleanly vermin in man. Some are not content with the blood and juices which they fuck from animals; they feek their food in the flefh, and that while full of life and health. The oeftri, or gad-flies, are familiar examples of this, the larva feeds upon the flefh beneath the fkin in cattle. The parent lodges its eggs in the flefh by making a number of little wounds, in each of which it depofits eggs, fo that every wound becomes a neft, and the eggs are hatched by the heat of the animal. Here the larva finds abundance of food, and is at the fame time protected from the changes of the weather, and they undergo their transformations in fecurity. The parts they inhabit are often difcovered by a lump or tumour which they occafion; this fuppurates, and is filled with matter, in which the head of the larva is always found plunged. When the time of change arrives the larva drops out, and feeks a convenient place in the ground, where it paffes to the pupa ftate. The ravages of the larva hatched from the ichneumon eggs, in the body of the caterpillar, are ftill more deftructive, as they entirely deftroy the vitals of their victims. The number of infects which are of a carnivorous difpofition is very great; and it is among thefe we find the traces of the greateft art and cunning, as well for attack as defence. Every one is acquainted with the dextrous arts of the fpider, to feize his prey, the curious neft he fpins, and the central pofition he affumes in order to watch more effectually the leaft motion communicated to its tender threads when the incautious infects fettle upon it. D.

ENTONNER, *Fr.* in *Roman Catholic Churches*, is announcing to the choir the tone or found with the organ, or the voice of the officiating prieft, with which a chant, hymn, pfalm, or anthem is to begin. In our cathedrals this is done for the refponfes by a canon, vicar choral, or by a fingle note on the organ.

ENTORSIS, in the *Manege*. See Pastern.

ENTOYER, or Entoire, in *Heraldry*, is ufed to exprefs a bordure, charged entirely with things without life. See Bordure.

ENTRACQUE, in *Geography*, a town of Italy, in the principality of Piedmont, on the Geffo; 5 miles S.S.E. of Demont.

ENTR'ACTE, *Fr.* the fpace of time which elapfes between the end of one act of a drama and the beginning of another; and during which the reprefentation is fufpended, while the action is fuppofed to be advancing elfewhere. The orcheftra fills up this fpace by performing a fymphony, which fupplies the place of what ufed, in England, to be called an *act-tune*.

It does not appear that the Greeks ever divided their dramas into acts; confequently, they had no act-tunes. The reprefentation was never fufpended on their ftage empty from the beginning of the piece to the end.

The Romans, lefs interefted in thefe exhibitions than the Greeks, were the firft who divided their pieces into feveral diftinct parts, the intervals of which afforded a relaxation to the attention of the fpectators; and this cuftom has been continued elfewhere ever fince.

But as the entract was intended to fufpend the attention, and give fome repofe to the mind of the audience, the ftage fhould have remained vacant. But the interludes with which the vacuity was formerly filled furnifhed an interruption in a very bad tafte, which infallibly injures the piece in breaking the thread of the action.

However, Moliere himfelf did not fee fo fimple and obvious a truth; the fpaces between the acts of his laft pieces were filled with interludes.

The French, whofe public fpectacles have more reafon than enthufiafm in them, and who dread being long kept in filence, have fince reduced their interacts to their due fimplicity, and it is to be wifhed for the perfection of the drama, that they were imitated, in that particular, every where elfe.

The Italians, whom an exquifite fenfibility often guides better than reafon, have profcribed the dance of the dramatic action (fee Opera); but by an inconfiftence arifing from the too long duration which they allow to their reprefentations, they fill their interacts with ballets, which banifh them from the piece in reprefentation, and if they avoid the abfurdity of a double imitation, they give into an equal abfurdity by a tranfpofition of fcene, and by haraffing the fpectator from object to object, they make him forget the principal action, lofe the intereft, and, in order to give pleafure to his eyes, rob him of thofe of the heart.

They began, however, to feel (in 1768) the defect of this monftrous affemblage; and after having already almoft driven intermezzi from their ftage, they will doubtlefs, ere long, get rid of the dance, referving it only as a brilliant and detached fpectacle at the end of the grand piece.

 But

But though the ftage remains vacant during the interact, it is not to be underftood that the mufic ought to be filenced; for at the opera, where it conftitutes the principal exiftence of every thing, the fenfe of hearing ought to be fo connected with that of fight, that as long as the ftage is feen the harmony fhould be heard, which is fuppofed infeparable from it; fo that its concurrence may not appear afterwards foreign or new, but united with the melody of the vocal performers. Chiefly from Rouffeau.

The difficulty which prefents itfelf on this fubject, is to fuggeft what the compofer ought to dictate to the orcheftra when nothing is doing or tranfacting on the ftage: for if the fymphony, as well as all dramatic mufic, is only a continued imitation, what is it to fay when nobody fpeaks? What ought it to do when there is no action? "I anfwer to that (fays Rouffeau) that though the ftage is vacant the heart of the fpectator is not; there ought to remain a ftrong impreffion of what has been feen and heard. It is for the orcheftra to cherifh and fuftain this impreffion during the interact, that the fpectator at the beginning of the enfuing act may not find himfelf as cold as at the beginning of the piece, but that the intereft may be as much linked in his mind as the events are in the action reprefented.

By this means the mufician will always have an object of imitation, either in the fituation of the perfonages, or in that of the fpectators. Thefe fhould hear nothing from the orcheftra but expreffions of what they have felt, identified with what they hear; and their fituation will be fo much the more delicious, as there fhall be a more perfect accord between that which ftrikes their fenfes and which touches the heart.

An able mufician will draw from the orcheftra another advantage, which will contribute to give the reprefentation all the effect poffible, in conducting the fpectator, by degrees, to the ftate of mind the moft favourable to the effect of the fcenes which are going to be reprefented in the following act.

The interact has no fixed duration; but it is fuppofed to be more or lefs confiderable, in proportion to the time neceffary for that part of the action, which is paffed behind the fcenes. However, that duration fhould have its bounds of fuppofition, relative to the hypothetic duration of the whole action; and the real bounds relative to the duration of the whole reprefentation.

This is not the place to examine whether the rule of 24 hours is well founded, and if it ought never to be violated. But if we would give to the fuppofed duration of an interact bounds regulated by the nature of things, I fee no other rule than that of the time during which no fenfible and regular change happens in nature, which cannot be made apparently tranfacting on the ftage during the interact. Now this time being 12 hours, which compofe a day or a night, if that is exceeded, there is no longer any poffibility of illufion during the fuppofed length of the act."

This is reviving the old contention concerning the unities, which have never been received as a law in this country. And as to act-tunes analogous to the bufinefs of the drama, it is an idea which was executed by Purcell in many of the plays of Dryden and Congreve; and Arne, when compofer in falary at Drury-lane theatre, compofed very pleafing and appropriate act-tunes to many of the ftock plays, which never were printed, but preferved in MS. in the archives of the old theatre; but we fuppofe that the ftrains of Orpheus or Amphion might be as eafily recovered now as thefe compofitions.

ENTRAIGUES, in *Geography*, a fmall town of France, in the department of the Aveyron, chief place of a canton, in the diftrict of Efpalion, with a population of 1748 individuals. It is fituated near the place where the river Truyere falls into the Lot, 18 miles S. of Aurillac. Its canton contains 6 communes, and 6691 inhabitants, on a territorial extent of $147\frac{1}{2}$ kiliometres.—Alfo, a fmall town of France, in the department of the Ifére, chief place of a canton, in the diftrict of Grenoble, with a population of 521 individuals. The canton contains 10 communes and 4988 inhabitants, on a territorial extent of 355 kiliometres.—Alfo, a fmall town of France, in the department of Vauclufe, 6 miles N.E. of Avignon.

ENTRAILS, the inteftines or guts of an animal. See INTESTINES.

Menage derives the word from the barbarous Latin, *interalia*, formed of the Greek, εντερον, *inteftine*.

ENTRAILS is alfo ufed, in a more extenfive fenfe, for the vifcera, or all the parts contained in the cavities of the bodies of animals. See VISCERA.

The arufpicina of the ancients was employed in confidering the entrails of victims; as the heart, lungs, liver, &c. See ARUSPICES, &c.

ENTRANCE, in *Sea Language*, is a name often given to the foremoft part of a fhip under the furface of the fea.

ENTRANCE *of hounds*, a phrafe ufed by our *Sportfmen*, to exprefs the inftruction of thefe creatures in the art of hunting. They are faid to be entered when they are thoroughly taught this.

The time of entering of hounds is when they are about twelve months old; when they are firft brought up from their walks, they fhould be kept feparate from the pack: they are then to be taught to take the water and fwim; they are to be laid abroad in the heat of the day, to enure them to fatigue and exercife; and they muft be frequently led through flocks of fheep, and warrens, to ufe them to be under command, and to know that they are to run at nothing but what the huntfman orders. They muft be carefully inftructed each to know his own name, and to underftand the voice of the huntfman, and the notes of the horn ufed in hunting; and finally, to ufe their own language in a proper manner. When young hounds well know and anfwer to their names, they fhould be put into couples, and walked out amongft fheep; and if any be particularly fnappifh leave the couples loofe about their necks in the kennel, till they are more reconciled to them. If any of them fhould be very troublefome, couple them to old hounds, always avoiding coupling two dogs together, if poffible, and taking care that the couples be tight enough to prevent their heads being flipped out of the collar. After being walked out frequently amongft the fheep, they may be uncoupled, a few at a time, and fuch as offer to run after them fhould be well chaftifed; the cry of *ware, fheep*, will afterwards ftop them, without further application of the whip; proper attention will foon make them afhamed of it; but if once fuffered to tafte the blood, it will be difficult to reclaim them. If young and old hounds are aired together, let the former be in couples; they are always ready for mifchief, and idlenefs may induce even the latter to join in it. It may be as well to air the young hounds in that country where they are defigned to hunt, as they thus acquire fome knowledge of it, and if at any time they fhould be left behind, they will more readily find their way home. Young hounds fhould be entered as foon as you can; in woodlands and grafslands, it will of courfe be earlier than in corn countries. Sport in fox-hunting cannot be faid to begin before October; but in the two preceding months, a pack is either made or marred.

The beſt time of entering them is about noon; and it ſhould be in a fair warm day; for if they be entered in the morning, they will give out when the heat of the middle of the day comes on, and betake themſelves to ſhady places to reſt and ſleep. Accordingly it is ſaid that hounds ſhould be entered in the heat of the day, and about October or November, for hare-hunting, the weather being then temperate, and young hares that have not been hunted are then more eaſily taken for their encouragement. A neceſſary caution is alſo added, never at the entering of young hounds to help them to kill the hare with grey-hounds, for this will deter the hounds from putting their noſes to the ground, or trying to hunt her themſelves. Take the moſt advanced, that the game may not ſtand long before them, and let them be well rewarded when all is over. This ought to be repeated at leaſt once a week, for two months ſucceſſively; by this means they will be ſo fleſhed and ſeaſoned with what game you may enter them at, that they will never afterwards leave off the purſuit. Hounds, after two years old, ſhould be hunted three times a week, if they feed well, and may be kept out the greateſt part of the day to try their ſtoutneſs. The new hounds ſhould always be entered with the beſt and ſtauncheſt hounds that can be had; and there is not to be one barking dog ſuffered in the field on this occaſion.

Whatever chace the hounds are intended for, it has been ſaid that the hare is the beſt game to enter them at, becauſe in this chace, they will learn all the turns and doubles that they can poſſibly meet with in any other kind, and how to come to the hollo. They will learn alſo from this chace, to have a perfect and nice ſcent, and hard feet, by being uſed to highways, beaten paths, and dry hills.

On the other hand, it has been more reaſonably maintained, that young hounds ſhould always be entered at their own game; becauſe it is a ſtrange contradiction to enter them at a hare, and then to cut them to pieces for afterwards hunting the hare. This, it is ſaid, is laying a foundation for future cruelty and vexation. Moſt dogs like that ſcent beſt, which they were firſt blooded to; and if the blood of the fox be of ſo much ſervice, that of the hare cannot be deemed a matter of indifference. It is, therefore, without doubt moſt rational to uſe them to that ſcent *only*, which it is intended they ſhould hunt. It has been aſſerted, that the way to render hounds ſteady from hare, is to encourage them to hunt her. The advantage reſulting from this kind of paradoxical practice is ſaid to be, that hounds are thus taught to hunt, and made to learn obedience; but the ſurer method to make hounds obedient is calling them over often in the kennel, to accuſtom them to their names, walking them out frequently amongſt ſheep, hares, and deer, from which they are to be ſtopped, to make them know a "rate;" and by this practice they will learn obedience. Nature will inſtruct them how to hunt: art is only neceſſary to prevent their hunting what they ought not to hunt. Should any young hounds be very fond of hare, let ſome be found ſitting, and ſtarted before them, and they will ſoon be checked and ceaſe to run after them. If they are to be ſteadied from deer, they ſhould often ſee deer, and they will not regard them. After this probation, a cub ſhould be turned out before them, with ſome old hounds to lead them on, and they will not long give trouble. After young hounds ſtoop to a ſcent, are become handy, know a "rate," and ſtop eaſily, put them, a few only at a time, into the pack after the old ones have been hunted and had blood; let them be taken the firſt day where they are certain of finding. Hounds ſhould be low in fleſh when hunting commences; becauſe the ground being generally hard at that ſeaſon, they are liable, if luſty, to be ſhaken. If foxes are plentiful, take the young, with ſome of the ſteadieſt of the old hounds, where there is leaſt riot, and ſhould you there find a litter of foxes, the young hounds will be ſo much improved as to need little ſubſequent inſtruction. If any cubs be ran to ground, and blood be not then wanted, let them be brought home, and they will be ſerviceable, ſhould blood be neceſſary at any time for the young hounds. Frequent hallooing is of uſe with young hounds, as it keeps them forward, prevents their being loſt, and from hunting after the others: the more, therefore, a fox is ſeen and hallooed, the better. Young hounds are thus made eager, and taught to exert themſelves. At their firſt entering, hounds cannot be encouraged too much: when they are handy, love a ſcent, and begin to know what is right, it will be ſoon enough to chaſtiſe them for doing wrong; in which latter caſe, one ſevere beating will ſave much trouble. The whipper-in ſhould uſe his voice as well as his whip, when he flogs a hound, and take care that the ſtroke precedes the "rating;" and he ſhould remember, that the ſmack of the whip is often as ſerviceable as the laſh to one who has already felt it. The day after young hounds have had blood is a proper time to take them where there is riot, and if they merit it, to chaſtiſe them: it is always beſt to correct them, when they cannot help knowing what they are corrected for. When hounds go out for this purpoſe, it ſhould be at a late hour; as the worſe the ſcent is, the leſs inclinable will they be to run it, and the ſtopping of them will be more eaſy and immediate. Upon the day when a fox is propoſed to be turned out, young hounds ſhould draw ſmall covers and furze brakes, where are hares or deer; a little rating and flogging, before they are encouraged to vermin, teaches them both what they ſhould not and what they ſhould do. A hound that hears a voice which has often rated him, and the whip he has often felt, ought to ſtop: when hounds are rated, and do not anſwer the rate, they ſhould be coupled up immediately, and made to know the whipper-in. A moſt eſſential point in rendering hounds obedient is to make them underſtand you; and therefore the language ſhould be appropriate and uniform. Young hounds ſhould be hunted in large covers to tire them out, provided the whipper-in can eaſily get at them; but when there is much riot there are no openings, the purpoſe will not be anſwered, unleſs you have a body of old hounds to carry on the right ſcent: for the young hounds, as ſoon as the ground becomes foiled, will be ſcattered about the cover, hunting old ſcents, and will not proceed faſt enough to tire themſelves. Beſides, every fox-hound will leave a bad ſcent of a fox for a good one of either hare or deer, unleſs he has been made ſteady from both. Young hounds are all given to riot; but the better they are bred, the leſs trouble will they be likely to give: high bred fox-hounds love their own game beſt: they ſhould have little reſt; one day they ſhould be hunted in large covers, where foxes are plentiful; the next, they ought to be walked out amongſt hares and deer, and ſtopped from riot; and the day following, be hunted again as before. By this management young hounds will ſoon become ſteady. At firſt young hounds ſhould be entered to vermin only; and they ſhould be uſed as early as poſſible to the ſtrongeſt and thickeſt woods and furzes, and they will ſeldom be ſhy of them afterwards. By being awed from hare and deer, and being taught to hunt only vermin, hounds will ſtop at a word, becauſe that word will be underſtood by them; and a ſmack of the whip will ſpare the inhuman trouble of cutting hounds in pieces for faults, which, if entered at hare, they have been invited to commit.

In

In hare-hunting the hounds, when firſt entered, muſt have all the advantages given them that can be. When the hare is put up, from her form, it muſt be obſerved which way ſhe went, and the ſcent muſt be left to cool a while, and then they muſt be laid in, and helped as much as can be, by wind, view, hollo, or pricking the paſſage; nor will it be amiſs, for the firſt time, to give them a hare tired the ſame morning in her courſe.

Some are of opinion, that the beſt way to enter young hounds is, to take a live hare, and trail her upon the ground, ſometimes one way, and ſometimes another, and then to draw her off to a convenient diſtance, and hide her, that the dogs, taking the ſcent, may follow all the traces through which ſhe was drawn, and at length find her.

It has been ſaid, however, that beating the hare up from her ſeat is a ſhorter way than trailing her from her feed to her form. Great exactneſs was formerly obſerved in the firſt entering of hounds, not to uncouple them repeatedly in the ſame ſort of ground, leſt by being uncoupled conſtantly in an open field, they would be at a loſs what to do when turned into a cover. It was a received opinion, that according to the places where hounds were firſt entered, they would ſhew a preference: *e. g.* if entered in a champaign country, they would always hunt better there than in covers, marſhy, or mountainous grounds. Hence it was deemed right to uſe them to every ſort of ground, and diverſity in the country was ſtrongly recommended, that they might be perfect in all. Some lands, which were of a glutinous and greaſy ſhining mould, never bore any ſcent, and there the huntſman was to help out the dogs by pricking the hare. In plains and downs where the graſs was ſhort, and the ſcent dried immediately, there alſo he was allowed to follow his game by the eye, in order to aſſiſt the noſe of the hounds. Some of the early ſportſmen never permitted the hare to be hallooed, or the hounds to be aſſiſted when they were at fault, but ſuffered them to work it out by themſelves; and this, though tedious, was conſidered a ſure way to aſcertain the goodneſs of the hounds: others took all advantages, and killed them as ſpeedily as poſſible. The method of rewarding the young hounds was curious. The hare, after being laid upon the graſs, and bayed by the hounds, was ſkinned before them; and after the gall and lights were taken away, which were ſuppoſed to make the hounds ſick, the huntſman, who carried a wallet with bread cut in ſmall pieces, dipped them in the blood, and with the entrails gave them to the hounds; the hare was afterwards diſtributed, and if any young hound was fearful to come in among the reſt, he had the head given him by himſelf. After this feaſt, the hounds had bread given them to prevent ſickneſs.

The huntſman ought very well to underſtand the nature and diſpoſition of his hounds, in finding out the game; for ſome hounds are of that temper, that when they have found the ſcent, they will run forward with it, not making any noiſe, nor ſhew of the tail; others, when they have found a head, will ſhew the game; and ſome, having found the footings of the beaſt, will prick up their ears a little, and either bark, or only wag their ears, or the hinder part of their bodies. This difference of natural diſpoſition, the huntſman is particularly to obſerve in the young and newly entered pack, otherwiſe he will never underſtand them, nor ever be able to hunt them to any credit or advantage.

For entering the hound at hart or buck, he ſhould be in the prime of greaſe, for then he cannot ſtand up, or hold the chace ſo long. The foreſt pitched upon ſhould have all the relays at equal diſtances, as nearly as may be; but then the young hounds ſhould always have ſome old ſtaunch ones to enter them, and they ſhould be led to the fartheſt and laſt relay, and the hart or buck ſhould be hunted to them. Being come up, the old hounds ſhould be uncoupled; and when they have found the hart, and well entered the cry, then the young ones are to be uncoupled alſo; and if any of them are found to lag behind, they muſt be whipped and beaten forward.

In whatever place the hart is killed, the neck ſhould be immediately flayed, and the hounds rewarded; for it is beſt always to do this while the fleſh is hot. Another very good method of entering hounds at the buck, is to take one in the toils or nets, and to wound one of his legs, ſo as to diſable him from running either very ſwiftly or very far: then let him looſe, and firſt let a blood-hound trace the creature, then let looſe all the young hounds; and when they have run down the animal, reward them with the neck.

Some enter their hounds with a toil; but this is a bad way; for the hart being in this caſe always in ſight, and not able to run an end, makes a great number of doubles and turnings: this is very different from the chaces they are to meet with afterwards; and when they find a hart run in the common way, ſtraight forward, and out of ſight, they will leave the chace, as unlike that by which they were taught. Daniel's Rural Sports. See HUNTING.

ENTRASME, in *Geography*, a ſmall town of France, in the department of Mayenne; 6 miles S. of Laval.

ENTRAVES, ENTRAVONS, in the *Manege*. See LOCKS.

ENTRE AMBOS OS RIOS, in *Geography*, a town of Portugal, in the province of Entre Minho Douro; 8 miles S.S.W. of Amarante.

ENTRE *Minho Douro*, a province of Portugal, ſo called from its ſituation between the rivers Minho and Douro, bounded on the north by Gallicia, a province of Spain; on the eaſt by Trazos Montes and Spain; on the ſouth by the province of Beira, from which it is ſeparated by the Douro; and on the weſt by the Atlantic ocean; and extending from 40° 50′ to 42° N. lat., and from 8° 55′ to 7° 55′ W. long., being 70 miles in length and 52 in breadth. It contains 963 pariſhes, 1460 churches, 1130 convents, 6 ſea-ports, and 804,000 inhabitants. This is the moſt northerly, the moſt fertile, and the moſt populous territory in the kingdom. Its numerous and fine vallies are ſhaded by beautiful trees, and watered by limpid ſtreams. Its air is pure and healthy; and it produces corn, wine, oil, and flax in abundance, with a great number of ſheep, and plenty of game and fiſh. The principal towns are Braga, Oporto, Viana, Amarante, Guimaræns, Ponte de Lima, and Pezo de Regna. Its chief rivers are the Minho, Lima, Neiva, Cavado, Ave, and the Douro or Duero, augmented by the Tamega; all of which run weſtward to the ſea.

ENTRECASTAUX, a ſmall town of France, in the department of the Var, near Barjols.

ENTRE'E, *Fr.*, the overture to a ballet, and ſometimes the beginning of the dance itſelf. In the firſt operas in France, the overture was called the entrée.

ENTREPAS, in the *Manege*, is a broken pace, or going, properly a broken amble, that is, neither walk nor trot, but has ſomewhat of an amble. This is the pace, or gait, of ſuch horſes as have no reins or backs, and go upon their ſhoulders, or of ſuch as are ſpoiled in their limbs.

ENTREVEAUX, in *Geography*, a ſmall town of France, in the department of the Lower Alps, chief place of of a canton in the diſtrict of Caſtellane, with a population of 1326 individuals. It is ſituated at the foot of the Alps, on the river Var, near Glandeves. N. lat. 44°.1′. Its canton has a territorial extent of 197½ kiliometres, eight communes, and 2694 inhabitants.

ENTRICOMA, from εν and θριξ, *hair*, in *Anatomy*, the name of the outer edge of the eye-lid, on which the hairs grow.

ENTRIES, amongſt *Hunters*, thoſe places in thickets through which deer are found lately to have paſſed; by means whereof their bigneſs or ſize is gueſſed at; and at which the hounds or beagles are put to them for the view.

ENTRIES, *Books of*, in *Law*, are ancient and modern, and contain tranſcripts of proceedings that have been had in ſome particular actions; the principal of ſuch are neceſſary for gentlemen educated to the profeſſion of the law.

ENTRING *a Ship*, in *Sea Language*, the ſame with boarding her. See BOARDING.

ENTRING-*Ladder*, in a *Ship*, is of two ſorts; one is uſed by the ſhip's ſides, in a harbour, or in fair weather, for perſons to go in and out of the ſhip: the other is made of ropes, with ſmall ſtaves for ſteps, and is hung out of the galley to enter into the boat, or to come aboard the ſhip from thence, when the ſea runs ſo high that they dare not bring the boat to the ſhip's ſide for fear of ſtaving her. See GANG-WAY.

ENTRING-*Ropes*. See ROPE.

ENTROCHUS, in *Natural Hiſtory*, the name of a genus of foſſils of a very regular figure and ſtructure, ſuppoſed by many authors to be lapides ſui generis, and ſtones in their native ſtate. They are, however, in reality, the foſſile remains of ſome marine animal, probably either of the echinus, or of the ſtar-fiſh kind, filled like the foſſile ſpecies of the echini, with a plated ſpar. Our imperfect knowledge in the animal hiſtory has not yet been able to aſcertain to what creature they really belong; but their analogy, with the other animal remains, found in the foſſile world, plainly evince, that they are of that origin. They are cylindric columns, uſually about an inch in length, and are made up in a number of round joints, like ſo many ſmall wheels or ſegments of cylinders. Theſe joints, when found ſeparate, and naturally looſe, as they ſometimes are, are called trochitæ. They are all ſtriated, from the centre to the circumference, and have a cavity in the middle, which is ſometimes found empty, but more frequently filled up with various matter, of the nature of the ſtratum, in which they have lain, or of other of the native foſſile ſubſtances.

The entrochi are compoſed of the ſame ſort of plated ſpar with the aſteriæ, and the ſpines and ſhells of the foſſile echini: and this is in theſe uſually of a blueiſh-grey colour, and very bright and gloſſy, where freſh broken. They are ſubject to accidental injuries, like the other extraneous foſſils, which have been formed in animal moulds, and are frequently met with compreſſed, or crooked.

That the entrochi are of marine origin, is evident from this, that they have not unfrequently ſea-ſhells found adhering to them; and when theſe are broken off, there remain on the entrochi no deficiencies, but the ſhells themſelves ſhew that they have been formed upon, and have grown to the entrochi, there being always natural hollows in them to anſwer to that part of the entrochus from which they have been ſeparated; whence it appears very plainly, that theſe entrochi, however altered ſince in their ſubſtance, were, however, exiſting in their preſent ſhape, in thoſe very ſeas where theſe ſhells had their growth.

There are not unfrequently found among the entrochi, larger or ſmaller fragments of plated bodies.

We meet with the entrochi of all the ſizes, from that of a pin's head to a finger's length, and the thickneſs of one's middle finger. They are, in ſome places, found looſe upon ploughed lands; in others, they are lodged in great quantities in the ſtrata of clay, and very often in ſtones of different kinds, and different hardneſs.

Mr. Parkinſon, in his ſecond volume of "Organic Remains," treats very largely of this claſs of animals; and Mr. William Martin, in his recent and valuable work, the "Petrificata Derbienſia," has paid conſiderable attention to the curious remains of this kind which Derbyſhire affords: among which he enumerates, 1ſt, the even-jointed entrochite (Entrochites lævis); 2d, the convex-jointed entrochite (E. prominens); 3d, the warted entrochite (E. verrucoſus); and 4th, the ring-jointed entrochite (E. cannulatus).

Entrochi abound in ſome particular beds of the firſt or upper lime-ſtone rock of the Derbyſhire lime-ſtone or toad-ſtone ſeries, and from hence the beautiful figured marbles are principally obtained, at Ricklow-dale, Bricks, and High-low, near to Monyaſh; at Foolow, Calver, Lexley in Aſhover, Crick-Cliff, and other places. The three other lime-ſtone rocks, which lie below the above, contain ſome few beds with a ſprinkling of entrochi in them; but they are very inferior in number or ſize to thoſe in the upper rock.

Entrochi are alſo found in ſmall numbers, in the yellow or magneſian range of lime-ſtone, which traverſes the country from Wetherby in Yorkſhire to near Nottingham; appears again at Bredon, Cloud's-hill, Barrow-hill, and Gracedieu in Leiceſterſhire; again at Ruſhall and Walſall; between Wolverhampton and Dudley in Staffordſhire; at Abberley in Worceſterſhire, &c.

The foſſil deſcribed by Mr. Walcot, in his "Petrifications found near Bath," p. 46, under the name of an entrochus, is more properly a trochus or top-ſtone, very different from the entrochi of which we have been ſpeaking: it belongs to the Bath free-ſtone ſtrata.

ENTROCHO *Aſteriæ*, the name given by authors to a peculiar kind of entrochus, differing from the common kind, in having a ſtellar cavity inſtead of a round one, in its centre.

ENTROCHUS *Pyramidalis*, a name given by ſome writers to the ortho-ceratites, or tubulus marinus concameratus, a ſpecies of ſhell-fiſh, not known to us in its recent ſtate, but very common in the ſtones brought over from Sweden for pavements. Klein. de Tubul. Marin. p. 7. See TUBULI *Concamerati*.

ENTROCHUS *Ramoſus*, the name of a foſſile body, the ſeveral parts of which reſemble the entrochi; but as they are joined together in this body when perfect, they ſhew themſelves in their proper light, and a ſight of them in this ſtate is ſufficient to explode the opinion advanced by ſome perſons, of the entrochi being of a vegetable nature; or, as they have pleaſed to call them, "rock-plants." The foſſil has evidently once been a ſtella-marina, or ſea ſtar-fiſh, conſiſting of twenty rays at the extremity of the body. The manner of inſertion of theſe has been this: the body is of a pentagonal figure, and from this there have ariſen five rays; theſe, at their extremity, have been divaricated, each into two, ſo as to make the number ten in the ſecond progreſſion; and each of theſe laſt being again divaricated into two at its extremity; the third and laft progreffion is of twenty rays. All this is eafily diftinguifhable in the foffil, when perfect, and feems to have been the whole figure of the animal while living. The prototype, or living animal, however, is not found; but this is not an accident peculiar to this foffil, the cornua ammonis, and conchæ anomiæ, with many other bodies that have been once evidently fhell-fifh, being no where at this time found in their recent ftate, though fo very numerous in the foffile world. This remarkable foffile ftar-fifh is the body called by fome authors, lilium lapidium. Keppeler's Epift. ad Klein de Entrochis.

ENTROCHORUM Radix. See Radix.

ENTROPIUM, (from ἐν and τρέπω, *to turn*,) a furgical difeafe, in which the eyelid turns inward towards the eye, fo as to occafion, by the friction and irritation of the eyelafhes, chronic ophthalmy, and various inconveniences. See Trichiasis.

ENTRUSION, in *Law*. See Intrusion.

ENTRY, or Entrance, in its general fenfe, denotes a door, gate, paffage, &c. through which to enter, or arrive within a place.

Entry, in *Book-keeping*. See Book-keeping.

Entry, *Bill of*. See Bill.

Entry, is fometimes alfo ufed to denote a duty or impoft laid on commodities imported into a ftate, either by land or fea.

The duties of entry, or importation, are paid according to a tariff fettled for that purpofe. Where the duty of entry of any commodity is not fixed by the tariff, it is paid by eftimation, *i. e.* in proportion to what fome other commodity of nearly the fame quality and value ufes to pay. In making entries inwards, it is ufual for merchants to include all the goods they have on-board the fame fhip in one bill, though fometimes there may happen to be upwards of twenty feveral kinds; and in cafe the goods are fhort entered, additional or port entries are now allowed; though formerly the goods fo entered were forfeited. As to bills of entry outwards, of including goods to be exported, upon delivering them and paying the cuftoms, you will receive a cocket, which teftifies your payment thereof, and of all duties for fuch goods. If feveral forts of goods are exported at once, of which fome are free, and others pay cuftoms, the exporter muft have two cockets, and therefore muft make two entries. Entries of goods, on which a draw-back is allowed, muft likewife contain the name of the fhip in which the goods were imported, the importer's name, and time of entry inwards. The entry being thus made, and an oath taken, that the cuftoms for thefe goods were paid as the law directs; you muft carry it to the collector and comptroller, or their deputies; who, after examining their books, will grant a warrant, which muft be given to the furveyor, fearcher, or land-waiter, that they may certify the quantity of goods; after which the certificate muft be brought back to the collector and comptroller, or their deputies, and oath made, that the faid goods are really fhipped, and not landed again in any part of Great Britain. See Debenture, Importation, and Exportation.

Entry, alfo denotes a folemn reception, or a ceremony performed by kings, princes, ambaffadors, legates, &c. upon their firft entering a city, or their return in triumph from fome expedition.

Entry, in *Law*, fignifies the taking poffeffion of lands or tenements by the legal owner, when another perfon, who hath no right, hath previoufly taken poffeffion of them. See Possession.

In this cafe the party entitled may make a formal, but peaceable entry thereon, declaring that thereby he takes poffeffion; which notorious act of ownerfhip is equivalent to a feodal inveftiture by the lord (fee Investiture); or he may enter on any part of it in the fame county, declaring it to be in the name of the whole (Litt. § 417.); but if it lies in different counties, he muft make different entries; for the notoriety of fuch entry or claim to the *pares* or freeholders of Weftmorland, is not any notoriety to the *pares* or freeholders of Suffex. Alfo, if there be *two* diffeifors, the party diffeifed muft make his entry on *both*; or if *one* diffeifor has conveyed the lands with livery to *two* diftinct feoffees, entry muft be made on *both* (Co. Litt. 252.); for as their *feifin* is diftinct, fo muft alfo be the act which divefts that feifin. If the claimant be detained from entering by menaces or bodily fear, he may make *claim*, as near to the eftate as he can, with the like forms and folemnities; which claim is in force for only a year and a day. (Litt. § 422.) And this claim, if it be repeated once in the fpace of every year and day (which is called *continual claim*) has the fame effect with, and in all refpects amounts to, a legal entry. (Litt. § 419, 423.) Such an entry gives a man feifin, (Co. Litt. 15.) or puts into immediate poffeffion him that hath right of entry on the eftate, and thereby makes him complete owner, and capable of conveying it from himfelf by either defcent or purchafe. This remedy by entry takes place in three only of the five fpecies of oufter, *viz.* abatement, intrufion, and diffeifin (Co. Litt. 237, 238.); for as in thefe the original entry of the wrong-doer was unlawful, they may therefore be remedied by the mere entry of him who hath right. But, upon a difcontinuance or deforcement, the owner of the eftate cannot enter, but is driven to his action; for herein the original entry being lawful, and thereby an apparent right of poffeffion being gained, the law will not fuffer that right to be overthrown by the mere act or entry of the claimant. Yet a man may enter on his tenant by fufferance; for fuch tenant hath no freehold, but only a bare poffeffion; which may be defeated, like a tenancy at will, by the mere entry of the owner. But if the owner thinks it more expedient to fuppofe or admit fuch tenant to have gained a tortious freehold, he is then remediable by writ of entry, *ad terminum qui præteriit*. (Co. Litt. 57.) On the other hand, in cafe of abatement, intrufion, or diffeifin, where entries are generally lawful, this right of entry may be *tolled*, that is, taken away by defcent. Defcents, which take away entries (Litt. § 385—413.) are, when any one, feifed by any means whatfoever of the inheritance of a corporeal hereditament, dies, whereby the fame defcends to his heir; in this cafe, however feeble the right of the anceftor might be, the entry of any other perfon who claims title to the freehold is taken away; and he cannot recover poffeffion againft the heir by this fummary method, but is driven to his action to gain a legal feifin of the eftate. In general it appears, that no man can recover poffeffion by mere entry on lands, which another hath by defcent. And this title of taking away entries by defcent is ftill further narrowed by the ftatute 32 Hen. VIII. c. 33. which enacts, that if any perfon diffeifes, or turns another out of poffeffion, no defcent to the heir of the diffeifor fhall take away the entry of him that has right to the land, unlefs the diffeifor had peaceable poffeffion five years next after the diffeifin. But the ftatute extendeth not to any feoffee or donee of the diffeifor, mediate or immediate. (Co. Litt. 246. 256.) By the ftatute of limitations it is enacted by ftatute 21 Jac. I. c. 16, that no entry fhall be made by any man upon lands, unlefs within 20 years after his right fhall accrue: and by ftatute 4 and 5 Ann. c. 16, no entry fhall be of force to fatisfy the faid ftatute of limitations,

tions, or to avoid a fine levied of lands, unlefs an action be thereupon commenced within one year after, and profecuted with effect. Moreover, this remedy by entry muft be purfued, according to ftatute 5 Ric. II. ft. 1. c. 8. in a peaceable and eafy manner; and not with force or ftrong hand. For, if one turns or keeps another out of poffeffion forcibly, this is an injury of both a civil and criminal nature. The civil is remedied by immediate reftitution; which puts the ancient poffeffor *in ftatu quo;* the criminal injury, or public wrong, by breach of the king's peace, is punifhed by fine to the king. Blackftone's Comm. b. iii. See FORCIBLE *Entry*.

ENTRY, *writ of*, is a poffeffory remedy, which difproves the title of the tenant or poffeffor, by fhewing the unlawful means by which he entered or continues poffeffion. (Finch. L. 261.) This writ is directed to the fheriff, requiring him to "command the tenant of the land that he render (in Latin, *præcipe quod reddat*) to the demandant the land in queftion, which he claims to be his right and inheritance; and into which, as he faith, the faid tenant had not entry but by (or after) a diffeifin, intrufion, or the like, made to the faid demandant, within the time limited by law for fuch actions; or that upon refufal he do appear in court on fuch a day, to fhew wherefore he hath not done it. This is the original procefs, the *præcipe*, upon which all the reft of the fuit is grounded; wherein it appears, that the tenant is required, either to deliver feifin of the lands, or to fhew caufe why he will not. This caufe may be either a denial of the fact, of having entered by or under fuch means as are fuggefted, or a juftification of his entry by reafon of title in himfelf, or in thofe under whom he makes claim; whereupon the poffeffion of the land is awarded to him who produces the cleareft right to poffefs it.

Writs of entry are of divers kinds, diftinguifhed into four degrees, according to which the writs are varied. The *firft* degree is a writ of entry *fur diffeifin*, that lieth for the diffeifee againft a diffeifor, upon a diffeifin done by himfelf; and this is called a writ of entry in the nature of an affife. The *fecond* degree, by fome reckoned the firft, is a writ of entry *fur diffeifin in le per* and lies againft the heir by defcent, who is faid to be in the *per*, as he comes in by his anceftor; and fo it is if a diffeifor make a feoffment in fee, gift in tail, &c. The feoffee and donee are in the *per* by the diffeifor. The *third* is a writ of entry *fur diffeifin in le per and cui*, where the feoffee of a diffeifor maketh a feoffment over to another; when the diffeifee fhall have this writ of entry fur diffeifin, &c. of the lands in which fuch other had no right of entry, but by the feoffee of the diffeifor, to *whom* the diffeifor demifed the fame, who unjuftly and without judgment diffeifed the demandant. (1 Inft. 238.) Thefe three degrees thus ftate the original wrong, and the title of the tenant who claims under fuch wrong. If more than two degrees (that is, two alienations or defcents) were paft, there lay no writ of entry at the common law. For, as it was provided, for the quietnefs of men's inheritances, that no one, even though he had the true right of poffeffion, fhould enter upon him who had the apparent right by defcent or otherwife, but he was driven to his *writ of entry* to gain poffeffion; fo, after more than two defcents or conveyances were paffed, the demandant, even though he had the right both of poffeffion and property, was not allowed this *poffeffory* action, but was driven to his *writ of right*, a long and final remedy, to punifh his neglect in not fooner putting in his claim, while the degrees fubfifted, and for the ending of fuits, and quieting of all controverfies. (2 Inft. 153.) But by the ftatute of Marlbridge, 52 Hen. III. c. 30, it was provided, that when the number of alienations or defcents exceeded the ufual degrees, a new writ fhould be allowed without any mention of degrees at all. Accordingly a new writ, or a *fourth*, has been framed, called a writ of entry in the *poft*, which only alleges the injury of the wrong-doer, without deducing all the intermediate title from him to the tenant; ftating it in this manner; that the tenant had not entry unlefs *after*, or fubfequent to, the oufter or injury done by the original diffpoffeffor; and rightly concluding, that if the original title was wrongful, all claims derived from thence muft participate of the fame wrong. Upon the latter of thefe writs it is (the writ of entry *fur diffeifin* in the *poft*) that the form of our common recoveries of landed eftates is ufually grounded. See FINE and RECOVERY.

This remedial inftrument of writ of entry is applicable to all the cafes of oufter (fee OUSTER), except that of difcontinuance by tenant in tail, and fome peculiar fpecies of deforcements. Such is that of deforcement of dower, by not affigning *any* dower to the widow within the time limited by law; for which fhe has her remedy by writ of *dower, unde nihil habet.* (F. N. B. 147.) See DOWER. But in general the writ of entry is the univerfal remedy to recover poffeffion, when wrongfully withheld from the owner. It would, therefore, be endlefs to recount all the feveral divifions of writs of entry, which the different circumftances of the refpective demandants may require, and which are furnifhed by the laws of England. (See Bracton, l. 4. tr. 7. c. 6. § 4. Britton, c. 114. fol. 264.) Of thefe the moft ufual were, 1. The writ of entry *fur diffeifin*, and of intrufion (F. N. B. 191. 203.), which are brought to remedy either of the fpecies of oufter. 2. The writs of *dum fuit infra ætatem*, and *dum fuit non compos mentis* (Ibid. 192. 202.) which lie for a perfon of full age, or one who hath recovered his underftanding, after having, (when under age or infane,) aliened his lands; or for the heirs of fuch alienor. 3. The writs of *cui in vita*, and *cui ante divortium* (Ibid. 193. 204.) for a woman, when a widow or divorced, whofe hufband during the coverture hath aliened her eftate. 4. The writ *ad communem legem* (Ibid. 207.) for the reverfion, after the alienation and death of the particular tenant for life. 5. The writs *in cafu provifo*, and *in confimili cafu*, (Ibid. 205, 206.) which lay not *ad communem legem*, but are given by ftat. Gloc. 6 Edw. I. c. 7. and Weftm. 2. 13 Edw. I. c. 24, for the reverfioner after the alienation, but during the life of the tenant in dower or other tenant for life. 6. The writ *ad terminum qui præteriit* (Ibid. 201.) for the reverfioner, when the poffeffion is withheld by the leffee or a ftranger, after the determination of a leafe for years. 7. The writ *caufa matrimonii prælocuti* (Ibid. 205.) for a woman who giveth land to a man in fee or for life, to the intent that he may marry her, and he doth not: and the like in cafe of other deforcements. Thefe writs are plainly and clearly chalked out in that moft ancient and highly venerable collection of legal forms, the "regiftrum omnium brevium," or regifter of fuch writs as are fueable out of the king's courts, upon which Fitzherbert's "Natura Brevium" is a comment.

In the times of our Saxon anceftors, the right of poffeffion feems only to have been recoverable by writ of entry (Gilb. Ten. 42.); which was then ufually brought in the county-court. The proceedings in thefe actions were not then fo tedious, when the courts were held, and procefs iffued from and was returnable therein at the end of every three weeks, as they became after the conqueft, when all caufes were drawn into the king's courts, and procefs iffued only from term to term, which was found exceedingly dilatory, being at leaft four times as flow as the other. Hence a new a new remedy was invented, in many cafes, to do juftice to the people and to determine the poffeffion in the proper counties, and yet by the king's judges. This was the remedy by *affife*, which fee. Blackft. Comm. b. iii. For other particulars on the fubject of this article, fee Jacob's Law Dict. by Tomlins.

ENTRY *Ifland*, in *Geography*, one of the Magdalen iflands in the gulf of St. Lawrence. N. lat. 46° 18'. W. long. 61° 20'.—Alfo, an ifland in the Pacific ocean, about nine leagues N. from Cape Tierawite and under the fame fhore, which may be diftinctly feen from Queen Charlotte's Sound, at the diftance of about fix or feven leagues. The name was given to it by lieutenant Cook, who paffed it in January 1770.

ENTYPOSIS, from ἐντυπόω, *I make an impreffion*, in *Anatomy*, the articulation of the fhoulder with the arm.

ENTZERSTORFF, in *Geography*, a town of Germany, in the archduchy of Auftria; fix miles S. of Laab.—Alfo, a town of Germany, near the conflux of the rivers Reftinpach and Reifenpach; 10 miles W.N.W. of Bruck.

ENTZERSTORFF in *Logenthal*, a town of Germany, in the archduchy of Auftria; two miles S.E. of Corn Neuburg.

ENTZERSTORFF or *Statl-Entzerftorff*, a caftellated town of Germany, in the archduchy of Auftria, on the north fide of the Danube, belonging to the bifhop of Freyfingen; 24 miles W. of Prefburg and nine E. of Vienna.

ENVERMEU, a fmall town of France, in the department of the Lower Seine, chief place of a canton in the diftrict of Dieppe, with a population of 896 individuals. The canton contains 40 communes and 13,402 inhabitants, on a territorial extent of 265 kiliometres.

ENVELOPE, in *Fortification*, denotes a mount of earth fometimes raifed in the ditch of a place, and fometimes beyond it, being either in form of a fimple parapet, or of a fmall rampart bordered with a parapet.

Thefe envelopes are made where weak places are only to be covered with fingle lines, without advancing towards the field, which cannot be done but by works which require a great deal of room: fuch as horn-works, half-moons, &c. Envelopes are fometimes called fillons contregards, conferve, lunettes, &c.

ENVIRON, among *Military Men*, relates to that complete inveftment of a town, or fortrefs, which utterly precludes the acquifition of fupplies, or of reinforcements, and, in a general fenfe, may be faid to be the bafis of a blockade. When we fay that a place is environed, we are not indifcriminately to conclude, that any circumvallation has taken place; but, that the country round is fo completely poffeffed by the enemy, as to render any attempt to afford fuccour to the inhabitants unavailing. Thus, if there be feveral paffes leading to a town fituated in a valley, furrounded by mountains inacceffible, or impaffable in every part, except at thofe paffes; or if a town ftands on a peninfula, of which the ifthmus is cut off by the enemy, who likewife poffefs the navigation of the circumferent waters, fuch towns are, to all intents and purpofes, environed; and, if the blockade be duly fupported, muft in time furrender merely from a want of fupplies.

If, however, the enemy fhould not be ftrong enough to keep the inhabitants within clofe bounds, or if, notwithftanding the whole of the adjacent country may be under his controul, fupplies may be attainable from the exterior, whether by connivance among the peafantry, or by the operations of enterprifing partizans, then the place cannot be faid to be environed. When we confider the many chances arifing in favour of fuch garrifons as make a good defence, it fhould appear to be the beft policy, as well as the moft honourable conduct, to hold out to the very utmoft, and never to furrender except under the laft extremity. As to being environed, or blockaded, it is fometimes a very important advantage gained by the defending power, becaufe it muft prove a complete diverfion, by caufing a very large force to be occupied in fhutting up a comparative hand-full.

It, however, very rarely happens, that towns are, properly fpeaking, environed: the old fyftem of circumvallation is now obfolete, except in very confined cafes, and where there is no army in the field capable of raifing the fiege. We have, indeed, a recent inftance of a large city, namely, Saragoffa, having been environed; but it was under moft peculiar circumftances; for the place fell rather from a want of an adequate force to cope internally with the affailants, though, on the other hand, the want of fupplies was feverely felt. If any thing could ftrengthen the recommendation we have juft given, of continuing a defence to the laft moment, furely the noble example fhewn by that loyal and illuftrious, but moft unfortunate city, muft ferve as a ftimulus, and prompt every perfon in charge of a befieged fortrefs, or town, to defpife the efforts of the environing army, and to fell every inch of ground at the higheft price that valour can impofe on a fuperior force.

Thofe who undertake a blockade, by completely environing a town, &c. have a moft arduous tafk to perform. They have not only to oppofe the fallies of the garrifon, but to keep a very fharp look-out againft exterior attacks, which may often be fo effectually made, by an enterprifing partizan, as to coerce a very numerous army to confiderable relaxation, fuch, indeed, as muft prove favourable to the defenders. When we confider thefe circumftances, we fhall be lefs furprifed at the great loffes fuftained by befiegers, who, as well as the befieged, fuffer under all the difadvantages attendant upon fixed camps; whereby not unfrequently the moft deftructive difeafes are engendered.

ENVIRONNE', in the *French Heraldry*, is when a lion or other figure is environed, or encompaffed round with other things. Environné with fo many bezants, &c. in orle.

ENULA, in *Botany*. See INULA.

ENULION, from ἐν and οὖλον, the *gums*, a word ufed by fome medical writers for the flefh of the gums.

ENUMERATION, the act of enumerating, or counting. At the time of our Saviour's birth, Auguftus Cæfar had commanded an enumeration to be made of all the world, or rather of all the people under his empire: though feveral able authors are of opinion, that the cenfus, tax, or enumeration mentioned by St. Luke, did not extend to the whole empire, but only to the people of Judæa. See Perizonius de Cenfu Judaico, and Berger de Viis Militaribus.

At Rome, it was an ufual thing to have an enumeration made of all the families: the firft of thefe was under Servius Tullius, when the men amounted to eighty thoufand. Pompey and Craffus made another, when they reached to four hundred thoufand. That of Cæfar did not exceed one hundred thoufand; fo that the civil wars muft have deftroyed three hundred thoufand Roman citizens. Under Auguftus, in the year 725, the Roman citizens throughout the empire were numbered at four millions fixty-three thoufand. In the year of Rome 746, the citizens, being numbered again, were found four millions two hundred and thirty-three thoufand. In the year 766, being the laft year of Auguftus's reign, that prince, together with Tiberius, made another enumeration of the citizens of Rome, when they were found four millions one hundred and thirty-feven thoufand perfons.

Claudius made a new computation in the year of Chrift 48, when, as Tacitus relates it, the Roman citizens throughout the whole empire amounted to fix millions nine hundred and fixty-four thoufand; though others reprefent the number as confiderably greater. A very rare, yet indifputable medal of Claudius, never yet made public, expreffes the precife number in this lift made by Claudius, which was called oftenfio, to be feven millions of people fit to bear arms, befide all the foldiers on foot in the armies, which amounted to fifty legions, fifty-feven cohorts, and fixty foldiers. After this enumeration, we find no more till that of Vefpafian, which was the laft.

ENUMERATION, in *Rhetoric,* denotes a part of the peroration, wherein the orator, collecting the fcattered heads of what has been delivered throughout the whole, makes a brief and artful rehearfal or recapitulation thereof. See RECAPITULATION.

ENUMERATION is alfo a rhetorical figure: for which fee APARITHMESIS.

ENUMERATION *of the parts,* amounts to the fame with what we more ufually call diftribution. In this part of rhetoric, the orator acquaints his hearers with the feveral parts of his difcourfe, upon which he defigns to treat. See DISTRIBUTION and PARTITION.

ENUNCIATION, a fimple expreffion or declaration of a thing, in terms either of affirmation or denial.

The fchoolmen ufually diftinguifh three operations of the underftanding; apprehenfion, enunciation, and reafoning.

ENUNCIATION, among *Logicians,* denotes the fame as propofition.

ENUNCIATION, which, without violation of etymology, might be applied to fignify the whole act of fpeech or delivery of language, is, in conformity with the theory and fyftem laid down under the article ELOCUTION, confined to the utterance and combination of the elements, and the confequent pronunciation of fyllables, words, &c. as contradiftinguifhed from the tones, and tuning of the voice, and all that belongs to the melody of fpeech.

The perfection of enunciation confifts in the following particulars; 1. *Diftinctnefs,* or the clear and perfect formation of the refpective elements by right motions and pofitions of the organs of the mouth, accompanied by proper degrees of energy and impulfe to imprefs thofe elements fully and contradiftinctly on the ear. 2. *Articulation,* or the act of combining and linking together of the refpective elements, fo as to form them into intelligible fyllables and words, capable of being again combined into claufes and fentences for the proper conveyance of our ideas, thoughts, and determination. 3. *Implication,* or the combination and apparent union of words in oral utterance, which are graphically feparated; and by which, without injury to the intelligible diftinctnefs of the refpective words, all differences of auditory impreffions are removed between monofyllabic and polyfyllabic compofition in language.

The faults immediately oppofed to diftinctnefs are, 1. *Mumbling,* or an indolence or want of precifion in the action of the lips, affecting, of courfe, principally the labial founds, but impeding, to a certain degree, the clear progrefs of the fpecific impulfes given to other elements, by the interior organs of the mouth. 2. *Thicknefs,* or indolence and imperfection in the action of the tongue, and affecting, more or lefs, the whole or part of the lingual founds. 3. *Drawling,* which refults from indolence or inaptitude of the whole organs of fpeech, vocal as well as enunciative. Thefe are defects of lethargy, or deficiency of organic action. Thofe that follow are of another defcription. 4. *Mouthing,* a pompous but dull fpecies of indiftinctnefs, which refults from affectedly purfing up the mouth, and confequent drawing the cheeks too clofe upon, or even between the teeth, during the act of fpeaking: it is one of the unfuccefsful theatrical means of aiming at fublimity and pathos. 5. *Cluttering,* a fpecies of St. Vitus's dance of the organs; hurrying them with too much rapidity and indecifion from one elementary pofition to another, before the refpective elements are completely formed, or have had time to make their refpective impreffions diftinctly on the ear. This laft is one of the fruitful fources of impediment of fpeech.

The faults oppofed to articulation and implication are, a *fau-ul-ter-r-ring he-e-fi-i-ta-a-tion,* a *pŭl,fă,tĭve ĭn,tĕr, rŭp,tion,* (fuch as is almoft univerfally obfervable in the early reading of fchool boys, and which fome people in their reading never get rid of as long as they live,) and a pèdán-tic fòr-má-lì-ty', fuch as was ridiculed in a gentleman, who, afking his friend if he came to town in his *cha-ri-ot,* was anfwered, no, fir, I came in my *co-ach.* But the contradiftion, and even oppofition, thus marked between diftinctnefs and articulation, though fo indifpenfible to the intelligible treatment of the fubject of elocutionary fcience and inftruction, is fo little authorized by thofe who have hitherto treated upon thefe fubjects, that the writer of this article deems it neceffary controverfially to refer to thofe authorities, and to ftate the objections to the cuftomary and confufed phrafeology which they have fanctioned. Among thefe, fome have defined the term articulation as if it embraced the whole art and practice of enunciative utterance, as the ingenious, and generally fpeaking, profound and accurate Mr. Gough,—"Articulation," fays he, "is the art of modifying the founds of the larynx by the affiftance of the cavity of the mouth, the tongue, teeth, and lips." (Manch. Mem. vol. v. pt. ii. p. 645.) But much more frequently it is ufed as a pure fynonym with *diftinctnefs.* (Mr. Sheridan, in his lectures, confounds it not only with diftinctnefs but with enunciation generally, and even with idiomatic pronunciation, Lect. ii. p. 21. 8vo. edit.) But, not to infift particularly upon the important axiom, that the very admiffion of fynonyms is inconfiftent with the progrefs and communication of fcientific truth, if fuch were the ufe to which the term articulation were to be applied, why did the Englifh grammarian go to the Greek language and to the fcience of anatomy to borrow a name for an idea which he had already a good and familiar Englifh word fully and completely to convey? How came he to apply that word fo fuperfluoufly borrowed in a fenfe diametrically oppofite to that which it bears in the fcience from which it is taken? For articulation in anatomy fignifies the *juncture of bones,* or that flexible combination of joints or elementary portions into a limb, or of limbs into a body, by which the unity of the whole is conftituted, without injury to the individuality of the parts. And laftly, how came he to look out for a fupernumerary name to one idea, while another idea equally indifpenfible to his fcience (for the combination of elements is as neceffary to fpeech as their formation) without any feparate or fpecific defignation? Without going further, therefore, into critical difquifition, we may venture to lay down, as one of the canons of elocution and grammatical nomenclature, the following definition.—Articulation (as one of the effential properties of human enunciation, is the jointing or linking together of the refpective elements, and fyllables, and words (the portions, limbs, and members of fentences) as the bones themfelves, (the portions, limbs, and members of the anatomical frame) are linked or jointed together, by an analogous articulation in animal economy. Implication will then remain to be confidered merely as that part of articulation which relates feparately to the articulation

tion of ſeparate graphic words in the act of oral delivery, and conſequently as indicating rather a grammatical diſtinction, than a diſtinct ſpecies or modification of organic action: for in well delivered ſpeech (it is contended, by the authority ſo frequently referred to in the different articles relative to elocution) the ear, unaſſiſted by the memory of the eye, knows of no ſuch thing as a diviſion or diſtribution of ſpeech into ſuch ſeparable portions as in graphic compoſition are denominated words. The proceſs of enunciation and implication conſiſts in a delicate preciſion of the motion of the organs, without ceſſation of ſound, from one elementary poſition to another, by which the termination of the perfect ſound is glided more or leſs intimately into the ſucceeding element or commencement of the enſuing ſyllable. Thus literal ſounds, intimately glided into each other, are articulated into ſyllables; as, *a* and long *l* into *all*. Syllabic ſounds, intimately glided into each other, are articulated into words; as, *all* and *ways* into *always*. The terminations of words (as they are called in conformity with graphic diſtinctions) glided into the initial ſounds of ſucceeding words, are implicated into clauſes, or parts of clauſes; as

the man, a ſhip, an apple,

Harry to Harry might, and horſe to horſe, &c.

A good enunciation, then, conſiſts in that clear and accurate delivery of verbal language, by which the requiſite qualities of diſtinctneſs and articulation are combined and modified; and the due proportions and alterations of ſound and interruptions, conſtituting the ſpecific relations of letters, ſyllables, members, clauſes, and ſentences, are preſerved in diſcourſe or reading.

ENUNCIATIVE Organs, thoſe portions and members of the human mouth, by the motions, poſitions, and contact of which, ſpecific character is ſuperadded to the original impulſes of voice, ſo as to render them communicable ſigns of diſtinct ideas. See Organs *of Speech*.

ENVOICE. See Invoice.

ENVOY, a public miniſter ſent by one ſovereign prince or independent ſtate to another to negociate ſome affair, or to watch over the intereſts of that ſtate or prince in general, and furniſhed with the credentials of an envoy. Like embaſſadors, envoys may be either *ordinary*, who reſide permanently at the court of a foreign prince, or *extraordinary*, who are diſpatched for one particular purpoſe, and retire when their miſſion is accompliſhed. Envoys hold the ſecond rank among public miniſters ſent to foreign courts: but they are alike under the ſpecial protection of the law of nations, and enjoy all the privileges and immunities of embaſſadors, except thoſe relating to the ceremony of their reception, public entry, and ſolemnity of their audiences. See Embassador.

The quality of envoy extraordinary, Wicquefort obſerves, is very modern; more modern than that of reſident: the miniſters inveſted therewith, at firſt, took on them moſt of the airs of embaſſadors; but they have ſince been taught otherwiſe.

In the year 1639, the court of France made a declaration, that the ceremonies of conducting envoys extraordinary to their audience in the king and queen's coaches, with divers others, ſhould no longer be practiſed to envoys.

S. Juſtiniani, the firſt envoy extraordinary from Venice, after that regulation, offered to cover in ſpeaking to the king, but it was refuſed him; and the king of France himſelf declared, that he did not expect his envoy extraordinary at the court of Vienna ſhould be regarded any otherwiſe than as an ordinary reſident. Since this time, thoſe two kinds of miniſters have been treated alike. Wicquefort.

ENURE, in *Law*, ſignifies to take place, or be available, and is as much as to have effect. Thus for inſtance, a releaſe made to tenant for life ſhall enure, and be of force and effect to him in the reverſion.

ENURESIS, in *Medicine*, from ἐν and οὔρησις, *mingendi actus*, the noſological term for incontinence of the urine. See Urine, *incontinence of*.

ENVY, in *Ethics*, is defined by Mr. Locke to be an uneaſineſs of mind, occaſioned by the conſideration of a good we diſcover in poſſeſſion of another perſon, whom we deem leſs worthy of it than ourſelves. It is a compoſition of ſorrow and hatred, and ſtands in direct oppoſition to congratulation. Otherwiſe, envy entertains a degree of ſorrow that the good contemplated ſhould eſcape ourſelves, and of anger that it ſhould fall to the ſhare of another. Or, it is that ſpecies of malevolence which is inſpired by the conjoined influence of pride, ſorrow, and anger. It differs from *emulation* (which ſee), or a diſquiet, occaſioned by the felicity of another, not becauſe he enjoys it, but becauſe we deſire the like for ourſelves; as it occaſions an uneaſineſs not merely from the want of the felicity poſſeſſed by another, but becauſe he enjoys it. Envy, in its nature and effects, is the baſeſt, moſt miſchievous, and moſt tormenting of all paſſions. Ariſtotle (De Rhetor. l. ii. c. 12.) obſerves, that this paſſion moſt uſually affects perſons who were once upon a level with thoſe they envy. The method preſcribed by Cicero (De Orat. l. ii. c. 52.) for leſſening or removing the influence of this paſſion is to ſhew that the things which occaſioned it, have not happened to the envied perſon undeſervedly; but are the juſt rewards of his induſtry or virtue; that he does not ſo much convert them to his own profit or pleaſure, as to the benefit of others; and that the ſame pains and difficulties are neceſſary to preſerve them, with which they were at firſt acquired.

Envy, in *Mythology*, is repreſented by the Greek and Roman poets as an infernal divinity, with ſquinting eyes, lean body, pale countenance, diſturbed air, head encompaſſed with ſerpents, &c.

ENURNY, is the *herald's* term for the bordure of a coat of arms being charged with any kind of beaſts.

ENXYLON, of ἐν and ξύλον, *wood*, a name uſed by the Greek authors for a ſpecies of worm or maggot, hatched from the egg of a beetle, and having its habitation in wood; which, in this ſtate, it erodes and burrows into, in various directions. The old Greeks called it alſo *dex* and *thrips*, and uſed the pieces of wood eroded by it in remarkable figures, as ſeals. See Thrips.

ENY, Saint, in *Geography*, a ſmall town of France, in the department of La Manche; 9 miles S. W. of Carentan.

ENYDRA, in *Botany*, (ἔνυδρος, *living in the water*,) a Syngeneſious genus of Loureiro's Fl. Cochinch. 510, which appears to belong to the 4th ſection of Juſſieu's *Corymbiferæ*, and to the order *Polygamia-ſegregata* of Linnæus. The character is, Common Calyx of four leaves; partial of one leaf, rolled up into a tube, ſingle-flowered. Corollets all tubular; thoſe of the radius three-cleft. Receptacle naked. Down none. The ſpecies is E. *fluctuans*, a native of the marſhes of Cochinchina, with oppoſite, ſerrated, rather haſtate leaves, and a white terminal flower. We know not whether it be reducible to any previouſly-deſcribed genus.

ENYSTRON, of ἐν and ὕστερος, *poſterior*, a word uſed by Ariſtotle for the ſecond ventricle in ruminating quadrupeds, in which the food is elaborated and concocted.

ENZ, in *Geography*, a river of Germany, which riſes about 10 miles W. of Altenſtadt, in the circle of Swabia, paffes by Wildbad, Neuenburg, Pfortzheim, &c., and joins the Neckar at Beffigheim, in the duchy of Wurtemberg.

ENZELLI. See Einzellee.

ENZIG, a lake of Germany, in the circle of Upper Saxony, and new mark of Brandenburg; 12 miles W.S.W. of Dramberg.

ENZINAS, Francis, in *Biography*, was born at Burgos, in Spain, about the year 1515. In Moreri and other works he is known by the name of Dryander, which is a Greek tranflation of his family name. He was educated in Germany, and became a zealous difciple of Melancthon, who thought very highly of his talents, and wrote a letter in his favour to archbifhop Cranmer in the year 1548. He publifhed a Spanifh tranflation of the New Teftament, which he dedicated to the emperor Charles V.; and which drew down upon him the vengeance of the higher powers, and he fuffered an imprifonment of 15 months duration. He efcaped in the year 1545, and went to Calvin, who refided at Geneva. He publifhed "A hiftory of the State of the Low Countries, and of the Religion of Spain," which is very rare, and forms a part of the "Proteftant Martyrology," printed in Germany.

Enzinas, John, brother of the former, refided a confiderable time at Rome, and became a convert to the proteftant religion, and was fetting out for Germany to join his brother John, when fome expreffions which he dropped, relative to the corruptions and diforders of the church, occafioned his being accufed of herefy, and thrown into prifon. The terrors of a dungeon, and the profpect of a cruel death, did not daunt his noble foul, but when brought before the pope and cardinals to be examined, he refufed to retract what he had faid, and boldly avowed and juftified his opinions, for which he was condemned to be burnt alive, a fentence which was put into execution at Rome in the year 1545. Moreri, under the word Dryander.

ENZOWAN, in *Geography*, a town of Bohemia, in the circle of Leitmeritz; four miles E. of Leitmeritz.

EO, Eu, or *Miranda*, a river of Spain, which rifes in the mountains of Afturias, feparates the province of Afturias from Galicia, and runs into the Atlantic, a little to the north of Rivadeo.

EOA, in *Ancient Geography*, a town of Africa Propria, according to Ptolemy; called Oea by Mela.

EOBANUS, Helius, in *Biography*, an eminent Latin poet, was born, in 1488, on the confines of Heffe; hence he obtained the name of Heffus. His parents were fo poor, that it has been faid he was born in the open air under the fhade of a wide fpreading tree; but his education was not neglected. He was taught Latin at a fmall fchool, and purfued his more advanced ftudies at the univerfity of Erfurt, where he afterwards taught the belles lettres till the year 1526, when Philip Melancthon procured him an invitation from the city of Nuremberg. Here he taught for feven years and then returned to Erfurt, where his reputation was fo high and fo firmly eftablifhed, that he is faid to have had 1500 fcholars at a time. His fame produced him but very trifling emoluments, and he was often labouring under the greateft poverty. He at length obtained through the intereft of Philip, landgrave of Heffe, a good fituation at the univerfity of Marpurg, where he died on the 5th of October 1540. Camerarius, who wrote his life, praifes his good qualities, his application to labour, and his talent at poetry. He was a man of great good nature, fincere in his attachments, and averfe from contention. He took credit to himfelf for being a hard drinker, and would challenge any man as to the quantity of liquor which he would drink, and in a conteft of this kind his antagonift fell dead on the floor. He wrote many books, a lift of which is given by Moreri: his poems and epiftles have been frequently publifhed. Moreri.

EODANDA, in *Ancient Geography*, a defert ifland, fituated E. of Arabia Felix.

EOLIAN, in *Ancient Mufic*. The Eolian tone or mode was one of the mean or principal modes of the Greek mufic, and its fundamental found was immediately above the Phrygian.

The Eolian mode was grave, according to Lafus. "I fing (fays he) Ceres and her daughter Melibæa, the fpoufe of Pluto, upon the Eolian mode, full of gravity."

The name of Eolian, given to this mode, is not derived from the Eolian ifles, but from Eolia, a country of Afia Minor, where it was firft ufed.

EOLIC, or rather *Æolic*. See Æolic.

EOLIPILE. See Æolipile.

EOLUS, and Eolus's *harp*. See Æolus.

EON, or Æon. See Æon.

Eon, a word ufed by fome anatomical writers to exprefs the whole ambit or compafs of the eye.

Eon, de l'Etoile, in *Biography*, a French fanatic, who, from the refemblance of his name to the word *eum*, applied to himfelf this paffage, "per Eum qui venturus eft judicare vivos et mortuos," and was fatisfied that he was the perfon alluded to, *viz.* the fon of God. This doctrine he taught with much fervour, and fucceeded, like other enthufiafts, in making many converts, who gave him the homage due to one on whom their future deftiny depended. At Rheims he drew down the notice of the clergy, who caufed him to be apprehended, and after an examination he was committed to prifon, where he languifhed a few days, and miferably died. Many of his adherents perfifting in the fame follies which had characterized their mafter, were apprehended, and, refufing to abjure their errors, were delivered over to the fecular power, and were burnt alive in the neighbourhood of Rheims. Such was the perfecuting fpirit of the priefts who never fail to abufe the power entrufted to them, and who would, in this inftance, have been better employed in inftructing their own flocks than in murdering thefe deluded fanatics. Moreri.

EOOA. See Ea-oo-wee.

EORDÆA, in *Ancient Geography*, a country of Macedonia, in Mygdonia.

EORIA, in *Mythology*, a feaft celebrated by the Athenians in honour of Erigonus, who, by way of punifhment, for their not avenging the death of his father Icarus, engaged the gods to inflict the curfe on their daughters, that they fhould love men who never returned their paffion. The feaft was inftituted by the order of Apollo.

EOSTRE, a Saxon goddefs, to whom they facrificed in the month of April, called the month of Eoftra; and thence the name Eafter, which the Saxons retained after their converfion to Chriftianity, applying it to the feftival celebrated in commemoration of our Saviour's refurrection. Bed. de Rat. Temp. cap. 13.

EPACRIA, in *Ancient Geography*, a town of Greece, in Attica.

EPACRIS, in *Botany*, from επι, *upon*, and ακρις, *the fummit of a mountain*, alluding to the native fituation of feveral of the fpecies. Mountain-bloffom. Forft. Gen. t. 10. Linn. Suppl. 19. Schreb. 113. Willd. Sp. Pl. v. 1. 834. Mart. Mill. Dict. v. 2. Gærtn. t. 94. Clafs and order, *Pentandria Monogynia*. Nat. Ord. *Ericæ*, Juff.

Gen. Ch. *Cal.* Perianth of feveral imbricated, ovate, acute leaves; the five innermoft longeft and equal. *Cor.*

of one petal, funnel-ſhaped; tube dilated upwards; limb in five equal, ovate, ſpreading ſegments. Nectary of five obovate blunt ſcales, cloſely ſurrounding the baſe of the germen. *Stam.* Filaments five, equal, very ſhort, inſerted into the ſummit of the tube of the corolla; anthers incumbent, roundiſh oblong, of two cells and two lobes, burſting longitudinally, deſtitute of any appendage. *Piſt.* Germen ſuperior, roundiſh, with five furrows; ſtyle cylindrical, rather ſhorter than the tube; ſtigma capitate. *Peric.* Capſule roundiſh, ſomewhat depreſſed, with five furrows, of five valves and five cells, the partitions from the centres of the valves. *Seeds* numerous, minute, angular, affixed to the central column.

Eſſ. Ch. Calyx imbricated. Corolla tubular. Stamens inſerted into its orifice. Scales five, at the baſe of the germen. Capſule ſuperior, of five cells and five valves, with partitions from their middle. Seeds numerous, chaffy.

The numerous ſpecies of this elegant genus, but few of which have, as yet, found their way into botanical books, are all natives of New Holland or New Zealand. They bear a general reſemblance to the vaſt Cape genus *Erica*, with which botaniſts have aſſociated them in natural order, not without ſome uncertainty. Willdenow enumerates but four ſpecies, of which the fineſt is E. *grandiflora*, Sm. Exot. Bot. v. 1. 75. t. 39. Curt. Mag. t. 982. (E. longiflora; Cavan. Ic. v. 4. 25. t. 344.) "Leaves heart-ſhaped, pungent, recurved, on footſtalks. Flowers pendulous." Native of dry ſandy places in New South Wales, flowering in October. Its chief beauty conſiſts in its copious long pendulous flowers, with a crimſon tube and white border.

To theſe are now added, E. *obtuſifolia*, Sm. Exot. Bot. v. 1. 77. t. 40. "Leaves elliptic-lanceolate, very obtuſe, and pointleſs, on ſhort footſtalks. Flowers drooping toward one ſide." Grows in a ſandy ſoil near Port Jackſon, New South Wales, bloſſoming in October. The flowers are cream-coloured, with a browniſh calyx.

E. *pulchella*, Cavan. Ic. t. 345. Curt Mag. t. 1170. Branches clothed with ruſty down. Leaves heart-ſhaped, recurved, pungent. Flowers axillary, crowded. Native of Port Jackſon. Flowers white, ſweet-ſcented.

E. *pungens*, Cavan. Ic. t. 346. Branches ſmooth. Leaves ovate, pungent. Flowers axillary, crowded. Tube cylindrical. Common about Port Jackſon. The flowers are copious, large, ſnow-white, and very fragrant, reſembling thoſe of a *Phlox* in ſize and figure. Cavanilles' plate, a truly miſerable repreſentation of this magnificent ſpecies, miſled Dr. Sims in Curt. Mag. to confound it with the laſt. We apprehend this laſt writer has committed a further error in taking the red-flowered ſpecies, repreſented in his t. 1199, for a variety of the *pungens*. They ſeem to us very diſtinct.

Forſter and Cavanilles confounded with the genus of *Epacris* that of *Styphelia*, whoſe fruit is a drupa, with five ſeeds.

EPACTHES, Επαχθης, in *Antiquity*, a feſtival celebrated in honour of Ceres, named Αχθεια, from αχθος, *i. e. grief*, in memory of her ſorrow, when ſhe had loſt her daughter Proſerpine.

EPACTS, in *Chronology*, the exceſſes of the ſolar month above the lunar ſynodical month; and of the ſolar year above the lunar year of twelve ſynodical months; or of ſeveral ſolar months above as many ſynodical months; and ſeveral ſolar years above as many dozen of ſynodical months.

The epacts, then, are either *annual* or *menſtrual*.

Epacts, *Menſtrual*, are the exceſſes of the civil or calendar month above the lunar month.

Suppoſe, *e. gr.* it were new moon on the firſt day of January; ſince the lunar month is 29 days, $12^h\ 44'\ 3''$; and the month of January contains 31 days; the menſtrual epact is 1 day $11^h\ 15'\ 57''$.

Epacts, *Annual*, are the exceſſes of the ſolar year above the lunar.

Hence, as the Julian year is 365 days 6^h, and the Julian lunar year 354 days $8^h\ 48'\ 36''$, the annual epact will be 10 days $21^h\ 11'\ 22''$; that is, nearly 11 days. Conſequently, the epact of two years is 22 days; of three years, 33 days; or rather three, ſince 30 days make an emboliſmic, or intercalary month.

Thus the epact of four years is 14 days, and ſo of the reſt; and thus, every 19th year the epact becomes 0; conſequently, the 20th year the epact is 11 again; and ſo the cycle of epacts expires with the golden number or lunar cycle of 19 years, and begins with the ſame, as in the following table; which is formed by the conſtant additions of 11, caſting off 30; ſuppoſing the lunar month to conſiſt of 29 and 30 days, and the civil year of 365 days, with a biſſextile every fourth year. This natural order of the epacts is ſuch as was eſtabliſhed by the council of Nice, A.D. 325.

Gold. Numb.	Epacts.	Gold. Numb.	Epacts.	Gold. Numb.	Epacts.
1	XI	7	XVII	13	XXIII
2	XXII	8	XXVIII	14	IV
3	III	9	IX	15	XV
4	XIV	10	XX	16	XXVI
5	XXV	11	I	17	VII
6	VI	12	XII	18	XVIII
				19	XXIX

Again, as the new moons are the ſame, that is, as they fall on the ſame day every 19 years, ſo the difference between the lunar and ſolar years is the ſame every 19 years. And becauſe the ſaid difference is always to be added to the lunar year, in order to adjuſt or make it equal to the ſolar year; hence the ſaid difference reſpectively belonging to each year of the moon's cycle is called the "epact of the ſaid year," that is, the number to be added to the ſaid year, to make it equal to the ſolar year, the word being formed from the Greek επαγω, *induco, intercalo*.

Upon this mutual reſpect between the cycle of the moon and the cycle of the epacts, is founded this rule for finding the Julian epact, belonging to any of the moon's cycle. Multiply the year given of the moon's cycle into 11; and if the product be leſs than 30, it is the epact ſought; if the product be greater than 30, divide it by 30, and the remainder of the dividend is the epact. For inſtance, we would know the epact for the year 1712, which is the third year of the moon's cycle. Wherefore 3 is the epact for 1712, for $11 \times 3 = 33$, and 33 being divided by 30, there is left three of the dividend for the epact. But the difference of the Julian and Gregorian years being equal to the exceſs of the ſolar above the lunar year, or 11 days, it happens that the Gregorian epact for one year is the ſame with the Julian epact for the preceding year.

By the help of the epact may be found what day of any month in any year the new moon falls on, thus: to the number of the month, from March incluſively, add the epact of the year given: if the ſum be leſs than 30, ſubtract it out of 30; if greater, ſubtract it out of 60; and the remainder will be the day whereon the new moon will fall.

If the new moon be ſought for in the month of January or March, then nothing is to be added to the epact; if for February or April, then only one is to be added.

For

For example: we would know what day of December the new moon was on A.D. 1711, the epact, whereof is 22. By the aforesaid rule, we find it will be December the 28th; for $22 + 10 = 32$, and $60 - 32 = 28$. (See MOON.) The day whereon the new moon falls being thus found, it is easy to infer from thence what the age of the moon is on any day given. See MOON.

However, there is a peculiar rule commonly made use of for this purpose, which is this: add the epact of the year, the number of the month, from March inclusively, and the given day of the month all into one sum; this, if it be less than 30, shews the age of the moon; if it be greater than 30, divide it by 30, and the remainder of the dividend shews the age of the moon, or how many days it is from the last new moon: this method will never err a whole day.

For instance; what was the age of the moon on December 31st, A.D. 1711? by this rule, we find, that the moon was then three days old; that is, it was then three days from the last new moon. For $22 + 10 + 31 = 63$, and 63 being divided by 30, there will remain of the dividend 3. And this exactly agrees to the other foregoing rule, whereby it was found, that the new moon was on December 28, 1711.

It must be observed, that at the time of the general council of Nice in 325, it was thought, that 19 Julian solar years were exactly equal to a cycle of 19 lunar years, or 235 synodical months; and therefore, that at the end of 19 years the new moons would happen exactly at the same time as they did 19 years before: but this a mistake;

	days.	h.	′	″	‴
For 19 Julian solar years contain	6939	18	0	0	0
Whereas 235 synodical months contain only	6939	16	31	56	30
And are therefore less than 19 Julian solar years, by	0	1	28	3	30

Hence it appears, that the cycle of 19 years anticipates the new moons by one day in 310.7 years very nearly; and therefore the same cycle of epacts will not always hold; the moon's anticipation lessening the several epacts by one every 310.7 years.

To have the epacts, therefore, point out the new moons perpetually; that epact given in the calendar is not sufficient; but all the 30 epacts should be bestowed throughout the whole year, that the calendar may exhibit all the cycles of epacts. See a table of this kind in Wolfius's Elementa Chronologiæ, apud Opera, tom. iv. p. 133.

It is plain, that whenever the fore-mentioned anticipation takes place, or it becomes necessary to set the golden numbers one day back in the calendar, the epact must be increased by an unit more than usual, *e.gr.* 12 must be added instead of 11, to the epact of the preceding, in order to form the epact of the current year; and thus the subsequent epacts, increasing constantly by 11, will be greater by unit than the corresponding epacts of the preceding 19 years. If the epacts were once properly prefixed in the calendar, to denote the days on which the new moons fall in those years, of which those numbers are the epacts, they might remain in the calendar without shifting their places; since the augmentation of each epact by an unit extraordinary would answer the purpose, and preserve the Julian account tolerably exact. But the Gregorian account is not so easily adjusted; for it will require more consideration to determine when the epacts are to be more than ordinarily augmented, and at what times they are to continue in their usual course; nay, to know when they are to be diminished by an unit, which will most commonly be the case; because, in every Gregorian solar year, consisting of any number of entire centuries not divisible by four, the equinox is supposed to have anticipated one whole day; and therefore the bissextile, or intercalary day, is omitted; consequently the preceding solar year, where one day was lost, exceeded the lunar year by 10 days only instead of 11.

Lord Macclesfield has given the following directions for this purpose:

In the years 1800, 2100, 2700, 3000, &c. where the number of centuries is divisible by 3 only, the Gregorian solar as well as the lunar year will have lost a day; and consequently the difference between them will be the same as usual; therefore in those years the epacts and golden numbers will remain unaltered; the former will go on in the same manner, and the latter stand prefixed to the same days in the calendar for another century as they did for the last. The case will be the same in the years 2000, 2100, 3200, &c. where the number of centuries is divisible by 4 only. But in the years 2400, and 3600, whose number of centuries is divisible both by 3 and 4, the Gregorian solar year remains as usual, and the lunar year has lost a day: the difference betwixt them being 12, the epact of the preceding year must be augmented by that number instead of 11, in order to form the epact of the then present year; and thus a new set of epacts will be introduced, each exceeding the precedent corresponding epacts by unit; and the golden numbers must be set one day back in the calendar. Again, in the years 1900, 2200, 2300, 2500, &c. where the number of centuries is divisible neither by 3 nor 4, the Gregorian solar year loses one day, and the lunar none; and the difference between them, *viz.* 10, and not 11, must be added to the epact of the preceding for that of the current year; and thus a new set of epacts will be introduced, less by unit than their precedent corresponding epacts; and the golden numbers must be set a day forwarder in the calendar. By this method the new moon might be pointed out, either by the golden numbers or the epacts placed in the calendar for that purpose; according to the Julian account for ever, and according to the Gregorian account till the year 4199 inclusive. Phil. Transact. vol. xlvi. p. 417. or N° 495, art. v.

Rule for finding the Gregorian Epact.

Divide the centuries of any year by 4; multiply the remainder by 17, and to this product add the quotient multiplied by 43 and the number 86, and divide this whole sum by 25; multiply the golden number by 11, from which product subtract the last quotient, and the remainder, rejecting the thirties from it, will be the epact.

Example for 1809.

1. $18 \div 4 = 4$ — Remr. 2.
2. $2 \times 17 = 34$.
3. $43 \times 4 + 34 + 86 = 292$.
4. $292 \div 25 = 11$.
5. 5 (G. N.) $\times 11 = 55$.
6. $55 - 11 = 44$. And,
7. $44 \div 30$.

leaves a remainder 14 for the epact required.

The reason of the operation may be evinced in the following manner.

If the new moons returned exactly at the same time after the expiration of 19 years, the product of the golden number, or year of the lunar cycle, multiplied by 11, would give the Gregorian epact; but we have already shewn, that they anticipate a day in 310.7 years, and, therefore, in a Julian

Julian century, they muſt anticipate $\frac{100}{310.7}$, or nearly $\frac{8}{25}$ of a day; and in a Gregorian common century, which is one day ſhorter than a Julian century, they happen 1 day $-\frac{8}{25}$, or $\frac{17}{25}$ of a day later; and $3\times\frac{17}{25}=\frac{51}{25}$ of a day in 3 common centuries; but in four Gregorian centuries, one of which is biſſextile, they will happen later by $\frac{51}{25}-\frac{8}{25}=\frac{43}{25}$ of a day; and in this proportion muſt the epacts be decreaſed. At preſent the Gregorian epact is 11 days ſhort of the Julian; but the quotient of the number of centuries divided by 4, which at this time is 4, multiplied (as the rule directs) by $\frac{43}{25}$, with the addition of the remainder 1 multiplied by $\frac{17}{25}$ amounts only to $\frac{189}{25}$, or 7 days $+\frac{14}{25}$; therefore, $\frac{86}{25}$ *i. e.* 3 days $+\frac{11}{25}$ muſt be added to complete the 11 days.

The epact may be found till the year 1900, by ſubtracting one from the golden number, multiplying the remainder by 11, and rejecting the thirties; becauſe the laſt quotient mentioned in the foregoing rule will be always 11 till the year 1900.

In the following table, the golden numbers, with their correſponding epacts, till the year 1900, may be ſeen at one view.

Gold. Numb.	Epact.	Gold. Numb.	Epact.	Gold. Numb.	Epact.	Gold. Numb.	Epact.
1	——	6	XXV	11	XX	16	XV
2	XI	7	VI	12	I	17	XXVI
3	XXII	8	XVII	13	XII	18	VII
4	III	9	XXVIII	14	XXIII	19	XVIII
5	XIV	10	IX	15	IV		

See Cycle, *Metonic.*

Epact, *to find Eaſter by the*, ſee Easter.

Epact, *to find the Moon's age by the*, ſee Moon.

EPAGOMENÆ. See Year, *Egyptian.*

EPAIGNE, or Espaigne, and *Eſpagne*, in *Geography*, a ſmall town of France, in the department of the Eure; 6 miles S. of Pontaudemer.

EPAIS, *Fr.* in the *Ancient Muſic*, denſe, cloſe, πυκνος. See Spissus.

EPAMINONDAS, in *Biography*, a famous Theban general, who was the ſon of Polymnis, diſtinguiſhed by his family and rank, and a native of Thebes in Bœotia. Although his deſcent was honourable his patrimony was ſmall, and was wholly exhauſted in procuring the means of every kind of inſtruction. Not ſatisfied with acquiring under the beſt maſters all the ſolid and ornamental accompliſhments, which diſtinguiſhed the poliſhed Grecian, he alſo habituated himſelf in early life to play on the harp and flute, to ſing and dance, and by the exerciſes of the palæſtra, to improve the vigour of his corporeal powers, and thus to qualify himſelf for encountering the toils of a military character. Having expended to the moſt important and uſeful purpoſes the ſlender pittance which he derived from his family, he exemplified, in an humble and indigent condition, the principles of philoſophy which he had imbibed. Superior to any temptations which affluence or ambition could offer, he maintained, during the whole courſe of his life, an uncorrupt mind, an invariable regard to truth, and an irreproachable rectitude of conduct. If we contemplate him in his public character, we cannot leſs than admire the ſublime philoſophy, which enlightened and directed all his actions; that genius, which was ſo rich in information and ſo fruitful in reſources; and thoſe plans which were concerted with ſuper-eminent prudence and executed with equal celerity. In private life, he was no leſs diſtinguiſhed above all his cotemporaries, by equanimity and ſelf-command, by the purity of his morals, by the dignity of his demeanour, and the ſuavity of his manners, by his mildneſs, benignity, and modeſty, and by the forbearance and patience with which he endured the injuſtice of the people and the unmerited ſeverity of ſome of his friends. Formed for friendſhip and ſociety by the amiableneſs of his diſpoſition, and the unaſſuming and condeſcending freedom with which he engaged in occaſional intercourſe with his companions, he engaged the eſteem and confidence of thoſe with whom he aſſociated. Although he had enriched his mind with every kind of knowledge, he choſe rather to hear than to ſpeak. His reflections were always juſt and profound. On occaſions of controverſy, when it was neceſſary to defend himſelf, his anſwers were prompt, energetic, and preciſe; and his converſation was peculiarly intereſting when it turned on philoſophical or political topics. Theſe traits of his character might be exemplified by a variety of inſtances that are furniſhed by the hiſtorians of his life. His houſe was leſs the aſylum than the ſanctuary of poverty. When Epaminondas was ſetting out on an expedition into Peloponneſus, he was obliged to borrow 50 drachmas (about 1*l.* 17*s.* 6*d.*) to purchaſe the neceſſary equipage; and yet it was about the ſame time that he indignantly rejected 50 pieces of gold, which a Theſſalian prince had ventured to offer him. When a young man announced to him the orders of Artaxerxes, king of Perſia, for delivering to him a conſiderable ſum, and informed him that he himſelf had been forced to accept five talents, Epaminondas receiving the meſſenger, ſaid to him, "Hear me, Diomedon, if the views of Artaxerxes be conſiſtent with the intereſts of my country, I do not need his preſents; if not, all the gold in his empire would not induce me to betray my duty. You have judged of my heart by your own; I forgive you this miſtake; but depart inſtantly from the city, leſt you ſhould corrupt the inhabitants." To the young man who had received the preſent he ſaid, "As for you, Mycithus, if you do not this moment return the money you have received, I ſhall deliver you up to the magiſtracy." When he was at the head of the army, and was informed that his ſhield-bearer had ſold a captive his liberty; "Give me back my buckler," ſaid Epaminondas; "ſince your hands are foiled with money, you are no longer worthy to follow me in dangers." But we muſt haſten to give a ſhort abſtract of his military exploits. Pelopidas, an affluent fellow-citizen, attached himſelf to Epaminondas by the moſt intimate friendſhip, and when he could not prevail with this illuſtrious youth to partake of his fortune, he reſolved to ſhare in the poverty of his friend and to form himſelf upon the model of his conduct. Accordingly they concurred in the noble deſign of raiſing the Theban republic to eminence among the ſtates of Greece: they began with jointly ſuccouring the Lacedæmonians, whilſt they were in alliance with the Thebans. In this ſervice a battle occurred in which Pelopidas and Epaminondas were both wounded; but when the former fell, the latter protected him and continued to fight over him againſt a hoſt of foes, till they were both reſcued by their friends. At a ſubſequent period the citadel of Thebes

Thebes was taken by the Lacedæmonians, and Pelopidas with others attached to liberty and independence were expelled, but Epaminondas was ſuffered to remain, as one whoſe poverty and philoſophy would prevent him from taking any part in political concerns. When the exiles, about four years afterwards, regained the city, they were joined by Epaminondas, and the Thebans regained their liberty. Theſe two friends concurred in improving the military diſcipline of their fellow-citizens; and Epaminondas in particular took pains by his counſel and example, in promoting among them that frugality and contempt of pleaſure which lie at the foundation of all manly exertions. By ſuch conduct he gained the confidence of the Thebans, and being raiſed to a high rank in the army, he was deputed as a delegate to Sparta for the purpoſe of negociating a peace. On this occaſion, when the other deputies were overawed by Ageſilaus, who guided the operations of the Lacedæmonians, Epaminondas aſſerted the dignity of his character as the repreſentative of an independent ſtate, and infiſted that the Thebans ſhould retain the ſame authority in Bœotia with that of the Spartans in Laconia. The Spartan king was incenſed, and war was immediately declared againſt the Thebans. The Lacedæmonians gave orders to their king Cleombrotus, to march into Bœotia at the head of an army conſiſting of 10,000 foot ſoldiers and 1000 horſe. The army of the Thebans was made up of only 6000 infantry and a ſmall body of cavalry; but Epaminondas commanded it, and under him was Pelopidas. The two armies met at Leuctra, a ſmall town of Bœotia, and on the 8th of July, B.C. 371, a battle was fought, which by the wiſdom and valour of Epaminondas terminated in the defeat of the Lacedæmonians, and the death of Cleombrotus. It afforded ſingular ſatisfaction to the victorious general that his father and mother had lived to witneſs the glory he now acquired. Two years after (B.C. 369) Epaminondas and Pelopidas were nominated Bæotarchs, or chiefs of the Bœotian league. The concurrence of circumſtances, mutual eſteem, friendſhip, and an uniformity of ſentiments and views, formed an indiſſoluble union between theſe two great men. With Pelopidas, the companion of his labours and his glory, Epaminondas entered Peloponneſus, ſpreading terror and deſolation through the ſtates in alliance with Lacedæmon, haſtening the defection of others, and breaking the yoke under which the Meſſenians had groaned for centuries. Seventy thouſand men of different nations marched under his orders with an equal confidence, and he led them on to Lacedæmon. Ageſilaus, appriſed of his approach, was anxious and alarmed; but ſuch was his reſiſtance, and the delay occaſioned by it, that Epaminondas thought it moſt prudent to retreat. After quitting the Spartan territories, he rebuilt the ancient city of Meſſene, and recalled its diſperſed inhabitants from the ſurrounding countries, in which they had long lived as aliens. It was the eſtabliſhed rule of the Bœotian league, that the chiefs ſhould hold their office only for a year, and then reſign to their ſucceſſors. Epaminondas and Pelopidas, however, retained their authority four months longer than the term preſcribed by law. For this they were accuſed, and judicially proſecuted. Pelopidas puſillanimouſly ſunk under the charge; but Epaminondas appeared before his judges with the ſame tranquillity as at the head of his army, and thus addreſſed them: "The law condemns me, I merit death, I only demand that this inſcription be engraven on my tomb: the Thebans have put Epaminondas to death, becauſe at Leuctra he forced them to attack and vanquiſh thoſe Lacedæmonians, whom they did not before dare to look in the face; becauſe his victory ſaved his country, and reſtored liberty to Greece; becauſe under his command the Thebans beſieg ed Lacedæmon, which deemed herſelf too fortunate to eſcape from ruin: and becauſe he rebuilt Meſſene, and ſurrounded it with ſtrong walls." The people preſent applauded this ſpeech, and the judges did not dare to condemn Epaminondas. In the next year Epaminondas marched again into Peloponneſus to aid the Arcadians againſt the Spartans; and having taken ſome towns and laid waſte the country, he marched to Corinth, which was ſucceſsfully defended againſt him. Upon his return, ſo uncertain is popular favour, he was deprived of his command, and reduced to the condition of a private citizen. After ſome time, an army being ſent to reſcue Pelopidas, who had been ſeized and impriſoned by the tyrant Alexander the Pheræan, Epaminondas ſerved in it as a private ſoldier, and in that humble rank preſerved the army from being utterly deſtroyed. His fellow-citizens reinſtated him in his command, and ſent him with freſh forces to recover his friend, whoſe life was ſuppoſed to be in imminent danger. Alexander was ſo intimidated that he acquieſced in a ceſſation of arms, on condition of releaſing Pelopidas and another deputy. Thebes had now arrived at ſuch a degree of importance among the Grecian ſtates, as to be preferred to Sparta and Athens by the Perſians, who, therefore, wiſhed to enter into a treaty with the Thebans. Pelopidas concluded the treaty, though the Theban allies demurred againſt it. Epaminondas was therefore deputed with an army to force the Achæans to continue the alliance; and in this buſineſs he ſucceeded, and a general peace ſoon followed. Epaminondas wiſhed to render his country as powerful by ſea as it was by land; and with this view he was deputed to negociate with the Rhodians, Chians, and other maritime people. The Thebans were ſtill purſuing their ambitious deſigns; and Epaminondas marched a powerful army into Peloponneſus: but, as a confederacy was formed againſt the Thebans, the troops of which aſſembled at Mantinea, Epaminondas, apprehending that Sparta would be left defenceleſs, made a ſudden march in order to ſurpriſe it. But Ageſilaus was ready to receive him. Informed by a deſerter of Epaminondas's march, he returned home with extraordinary celerity, and placed his ſoldiers in the moſt important ſtations. The Theban general ordered ſeveral attacks. He had penetrated to the forum, and made himſelf maſter of one part of the city, when Ageſilaus, then near 80 years of age, liſtening only to the dictates of deſpair, ruſhed into the midſt of danger, and ſeconded by the brave Archidamus his ſon, repulſed the enemy and compelled them to retire. Epaminondas was not moleſted in his retreat; but a victory was become neceſſary, that the failure of his enterpriſe might be forgotten. He therefore marched ſuddenly to Mantinea, expecting to find it unguarded; but here he was diſappointed. He determined, however, to riſk a battle for the purpoſe of retrieving his honour. The army of the Lacedæmonians and their allies conſiſted of more than 20,000 foot and near 2000 horſe; the army of the Theban league of 30,000 infantry and about 3000 cavalry. Never did Epaminondas diſplay greater abilities than on the preſent occaſion; ſo that the enemy, diſmayed at his appearance, betook themſelves to flight. But whilſt he was purſuing them with great ardour, they ſuddenly rallied, and poured upon him a ſhower of darts. At length one of them pierced his breaſt with a javelin, the point of which was left in his body. When he was carried off the ground to his tent, and had recovered his ſpeech, his firſt queſtion was, what was become of his ſhield? when it was brought him, he kiſſed it as the inſtrument of his labours and his glory. He then inquired concerning the event of the battle; and being informed

formed that the Thebans were victorious, he said, "It is well; I have lived long enough;" or, as others report his declaration, "I die unconquered. Advise the Thebans to conclude a peace." The javelin being then extracted, he expired, B. C. 363. Epaminondas was never married; and he seems to have regarded celibacy as most favourable to his philosophical pursuits in private life, and to his active services in a public station. On the plain where he fell, two monuments were raised to him, *viz.* a trophy and a tomb. Epaminondas is represented by Cicero as one of the greatest men that any age or nation ever produced: and why, it is said, should we not grant this honourable distinction to the general who perfected the art of war, who eclipsed the glory of the most renowned commanders, and who was never vanquished but by fortune; to the statesman, who gave to Thebes a superiority she had never possessed, and which she lost immediately upon his death; to the negociator who, in the general assemblies and congresses of Greece, always maintained a superiority over the other Grecian deputies, and found means to retain in the alliance of Thebes, his country, even the states who were jealous of the growth of this new power; to the man who equalled in eloquence the greater part of the Athenian orators, was no less devoted to his country than Leonidas, and perhaps more just even than Aristides? Travels of Anacharsis, vol. ii. Corn. Nep. Vit. Epam. Plutarch Vit. Pelop. & Agesil. Univ. Hist. vol. v. and vi.

EPANALEPSIS, Επαναληψις, called also *Epanadiplosis*, in *Rhetoric*, the repetition of the same word in the beginning of one sentence, and at the end of another. Thus Virgil,

"Ambo florentes ætatibus, Arcades ambo."

Such also is the expression of Plautus (Amph. Act ii. Sc. 2. v. 21.): "Virtue contains all things: he wants no good thing who has virtue." The figure is the same, though the principle is less honest, which occasions the advice given by the writer in Horace, (Epist. i. 1. 65.) "Get money, if you can, honestly; but, however, get money." This figure adds force to an expression, when the principal thing designed to be conveyed is thus repeated, so as to leave its impression last upon the mind. And the beauty is heightened, when the sentence has an agreeable turn arising from two opposite parts; as in Cicero's compliment to Cæsar, (Pro Marcell. c. 6.): "We have seen your victory terminated by the war: your drawn sword in the city we have not seen." Hermogenes (Sturm. de Univers. Eloc. p. 410.) calls this a *circle*, because the sentence returns again to the same word. See ANADIPLOSIS.

EPANAPHORA, Επαναφορα, the same with anaphora.

EPANA'STASIS, (from επι, and ανιστημι, *to excite*,) in *Surgery*, a tumour, or tubercle.

EPANASTROPHE, Επαναστροφη, in *Rhetoric*, the same with what is otherwise called anadiplosis.

EPANCYLO'TUS, (from επι, and αγκυλος, *crooked*), in *Surgery*, a bandage described by Oribasius.

EPANODOS, Επανοδος, in *Rhetoric*, an inversion of a sentence, or a repetition of the same words in an inverted order; thus:

"Nox brevis nimis, ah! nimis brevis nox." Voss. Rhet. lib. v. p. 298.

This figure comprehends both *anadiplosis* and *epanalepsis*; for it both begins and ends with the same word, and the same word is likewise repeated in the middle. This turn of expression has a beauty in it, and shews a readiness of thought. Minutius Felix has given an example of it, when he is exposing the folly of the Egyptian superstition. "Isis," says he, "with Cynocephalus, and her priests, laments, bemoans, and seeks her lost son; her attendants beat their breasts, and imitate the grief of the unhappy mother: in a little time the son is found, upon which they all rejoice. Nor do they cease every year to lose what they find, or to find what they lose. And is it not ridiculous to lament what you worship, or to worship what you lament?" This figure serves likewise to illustrate and enforce the sense by setting it in two opposite views. Such is the expression of the prophet (Is. v. 10.) "Wo unto them, who call good evil, and evil good: who put darkness for light, and light for darkness."

EPANORTHOSIS, or CORRECTION, in *Rhetoric*, a figure by which the orator revokes and corrects something before alleged, as too weak, and adds something stronger and more conformable to the passion by which he is agitated.

The word is formed of ορθος, *right, straight*; whence ορθοω, *I straighten*; ανορθοω, επανορθοω, *I redress, straighten, correct*, and επανορθωσις, *correction*. Accordingly the Latins call it *correctio* and *emendatio*.

This figure is used in different ways. Sometimes one or more words are recalled by the speaker, and others substituted in their room. At other times, without recalling what has been said, something else is introduced as more suitable, instances of both kinds follow.

Such, *e. gr.* is that of Cicero for Cœlius: "O stultitia! stultitiamne dicam, an impudentiam singularem? Oh folly! folly did I call it, or rather intolerable impudence?" And in the first Catilinarian: "Quanquam quid loquor? Te ut ulla res frangat? Tu ut unquam te corrigas? Tu ut ullam fugam meditare? Tu ut ullum exilium cogites? Utinam tibi istam mentem dii immortales donarent." Thus also Terence, in the Heautontimo-rumenos, introduces his old man Menedemus, saying.

"Filium unicum adolescentulum
Habeo. Ah! quid dixi habere me? imo habui, Chreme.
Nunc habeam necne, incertum est." "I have an only son, Chremes. Alas! did I say, that I have? I had indeed; but it is now uncertain, whether I have or not."

Cicero, in his defence of Milo, speaking to the judges concerning Clodius says; "Are you only ignorant, what laws, if they may be called laws, and not rather torches and plagues of the state, he was about to impose and force upon us?" Again, in his defence of Plancius he says; "What greater blow could those judges, if they are to be called judges, and not parricides of their country, have given to the state, than when they banished him, who, when prætor, freed the republic from a neighbouring war, and when consul from a civil one?" Here he is speaking of Opimius: but in commending the moderation of Lucius Mummius who did not enrich himself, but his country, by demolishing the wealthy city of Corinth, he thus recalls his whole expression, and by giving it a new turn, heightens the compliment he designed him. "He chose rather," says he, "to adorn Italy, than his own house, though by adorning Italy his house seems to have received the greatest ornament." De Off. l. ii. c. 22. Sometimes the correction is made by substituting something contrary to what had been said before: as in the following passage of Cicero (Philipp. iii. c. 2.): "Cæsar" (meaning Augustus), "though but a youth, by an incredible and surprising resolution and courage, when Antony was most enraged, and we dreaded his cruel and pernicious return from Brundisium, at a time when we neither asked, nor expected, nor desired it (because it was thought impossible) raised a very powerful army of invincible veterans, to effect which he threw away his whole estate. Although I have used ufed an improper word; for he did not throw it away, but employed it for the fafety of the government." At other times, as we have before obferved, the correction is made by adding a more fuitable word, without any repetition of the former. Thus Cicero, after he has inveighed againft the crimes of Verres (lib. ii. c. 29.) breaks out into this pathetic exclamation: "O the clemency, or rather wonderful and fingular patience of the Roman people!" The word *clemency* not being, in his apprehenfion, ftrong enough, he adds *patience*, as better anfwering his purpofe. The fudden and unexpected turn of this figure gives a furprife to the mind, and by that means renders it the more pathetic.

EPANTHE'SMA, or Epanthísma, (from επι, and ανθος, *a flower*), in *Surgery*, an efflorefcence; exanthema.

EPAPHÆ'RESIS, (from επι, importing *a repetition*, and αφαιρησις, *a removal*). In Galen it is employed in the fenfe of a repeated evacuation by bleeding.

EPARCHA, in the *Mufic of the Ancients*. Pollux, (Onomaft. lib. iv. cap. 9.) tells us, that the eparcha was one of the ftrains of the Citharian mode, according to the divifion of Terpander. It was probably the prelude, for that is the fignification of the word eparcha.

EPARCHUS, Επαρχος, an officer under the Greek emperors of Conftantinople, who had the command of the guards, or government of a province.

EPARER, in the *Manege*, is ufed to fignify the flinging of a horfe, or his yerking or ftriking out with his hind legs. In caprioles, a horfe muft yerk out behind with all his force; but in ballottades he ftrikes but half out; and in croupades he does not ftrike out his hind legs at all. All horfes that yerk are reckoned rude. See Yerking.

EPA'RGEMOS, (from επι, and αργεμον, fignifying a white ulceration, or opacity of the eye), in *Surgery*, an epithet applied to a perfon affected with the diforder called argemon.

EPARITA, in the *Materia Medica*, a name given by Paracelfus to a fort of fine earth, of a liver colour, feemingly the fame with the Tokay bole.

EPA'RMA, or Epa'rsis, (from επι, and αιρω, *to elevate*,) in *Surgery*, a tumour of any fort. The term, however, is ufually confined to a fwelling of the parotid gland.

EPARRES, in *Geography*, a fmall town of France, in the department of the Ifére, near Vienne.

EPAULE, or Espaule, in *Fortification*, the fhoulder of the baftion, or the angle made by the face and flank, otherwife called the angle of the epaule. See Bastion and Angle.

The word is pure French, and literally fignifies *fhoulder*.

Epaule *en dedans*, in the *Manege*, a leffon of late invention, which, rendered into Englifh, denotes that attitude in which, as the horfe goes forward, he is fo bent through his whole frame, that if he goes to the right hand, he muft crofs the right fore-leg over the left, and fo *vice verfâ*; or, in the language of the Manege, his inner fhoulder, or leg, over the outward. The old mafters worked their horfes upon circles, when they intended to fupple the fhoulders and haunches; but to this mode of working upon circles, it has lately been objected that it conftrains the fore-part too much, and throws the horfe upon his fhoulders. To remedy this evil, M. de la Guerriniere, an accomplifhed horfeman at Paris, invented the leffon called "epaule en dedans," and eftablifhed it in his Manege. This new method, however, differs very little from the old practice, to which it owes its origin, and from which it is extracted and formed. The only objection againft the circle is, that the horfe, when worked circularly, has his haunches too much at liberty, by which means the weight of his body is thrown upon his fhoulders, which are thereby impeded in their motion; and the animal compelled to work in a manner directly oppofite to what he fhould do. The blame, however, inftead of being laid on the circle, fhould have been afcribed folely to the falfe and fenfelefs manner in which horfes were formerly worked in it; when heavy large bitts and cavefons were ufed, with which the heads of horfes were loaded, and brought down to a level with their knees, fo that they carried them, like rams, when they fight, and batter one another with their foreheads. Had thefe old practitioners known the advantage, and, indeed, the neceffity of raifing the head, in order to prefs and bend the haunches, and of doing this by means of a fnaffle with double reins, one being tied over the withers, on the oppofite fide to which the horfe is to turn, the head would at once have been raifed, the outward fhoulder brought in, and the horfe bent from nofe to tail; but this difcovery was referved for fir Sidney Medows, who has made many important improvements in the art of horfemanfhip. Berenger's Hift. &c. of Horfemanfhip. vol. ii.

EPAULEMENT. In treating of the enfilade, we had occafion to notice this part of the defences of batteries expofed to a flanking-fire. The defignation is derived from the French word *epaule*, meaning "a fhoulder," to which the epaulement bears a ftrong refemblance. Wherever a work, whether on the defences, or in the approaches of the befiegers, is fubject to be enfiladed, and efpecially where that enfilade is *direct*, it becomes indifpenfibly neceffary to raife an epaulement, for the purpofe of warding off the fhot. The thicknefs of fuch a buttrefs muft always be proportioned to its height, which again muft be carried up fo far as may render the fartheft gun, upon the battery to be fecured, fufficiently fafe from the ordinary *lobs* of fhot fired en ricochet, as well as fuch as may enfilade by defcent. A general rule may be eafily formed; namely, that the epaulement fhould be full as thick as the parapet, be about ten feet, if practicable, beyond the prolonged line of the inner revetement of the terre-pleine, and be raifed high enough to make an angle of ten degrees from the horizontal; the farther end of the battery being the angular point formed by the meeting of the terre-pleine, with a line drawn from the creft of the epaulement. If this proportion be properly attended to, it will be almoft impoffible to enfilade the defences with effect; becaufe few ricochet fhots, fired at an angle of ten degrees, will rife more than eight at their fecond flight. This mode gives a kind of ftandard, which proportions the height of the buttrefs to the length of the battery it is to protect.

Where there is fpace for fuch a work, it is often found highly advantageous to raife cavaliers at the extremities of the baftions, &c. which by their height ferve as epaulements; but, as fuch defences, when they fall into the hands of the befiegers, not only afford a lodgment, but command the adjacent works, it is abfolutely neceffary they fhould be ruined; fo that they may be completely annihilated whenever they are wrefted from the defenders. It being a general rule, that the creft of the parapet fhould be full feven feet in height, very little elevation thereof will make a competent epaulement for a battery of fmall force, and efpecially where the cannon are placed as clofe up to the flank as circumftances may admit. This cannot be done fo eafily in faliant angles which are acute, that is, under 90°; but, in the flanked angles of baftions, &c. is generally very practicable. In the batteries and places of arms conftructed by the befiegers, the epaulements may be made within ten feet of the outer cannon, and may be run up to any height, provided they do not obftruct the operations of other batteries; which, indeed, can be the cafe only in very peculiar

fituations.

ſituations. The beſt engineers recommend, that the epaulement ſhould be merely temporary, except at the orillons on the extremities of the flanks of baſtions, where they are always requiſite to prevent ſuch ſhots as may paſs over the proximate baſtion, when its angle or face may be battered, from enfilading the battery or the face of that baſtion next to ſuch orillon. When made on emergency, ſand bags are found to anſwer admirably in the conſtruction of epaulements; but when intended to be permanent, the buttreſſes ſhould be made of the firmeſt ſoil, well compacted, and properly gazoned (*i. e.* turfed.) As we have remarked, while ſpeaking of enfilades, no maſonry ſhould be expoſed in the conſtruction of epaulements any more than in traverſes and parapets; on account of the incalculable miſchief done by the numerous ſplinters which are knocked off by ſuch ſhots as ſtrike thereon.

EPAULETTE, is a diſtinguiſhing ornament, worn upon the ſhoulders of commiſſioned and of non-commiſſioned officers of ſome deſcriptions. The epaulette is always made to correſpond in colour with the bindings and lace of the uniform: therefore where yellow binding is in uſe, gold embroidery, &c. are employed, and where white binding is adopted, ſilver embroidery only is ſuitable. The military ſervice is by no means uniform in this ornament, ſome being epaulettes of one, ſome of another pattern; according to the fancies of the commandants reſpectively. The general rule is, that all general and field officers, as well as all ſuperior ſtaff officers, wear two epaulettes, the reſt of the officers in a corps wearing but one. Though, as above ſtated, variety obtains, yet the generality conſiſt of a rich ſtrap, of gold or ſilver lace, cuſhioned below, to give it a ſquare appearance upon the ſhoulder, and ornamented at its lower extremity with rich bullion, and fringe of a correſponding deſcription; the upper end ordinarily faſtens under, or on the cape, to a button; ſome being moveable, for the purpoſe of admitting a belt to paſs underneath. The flank companies, *i. e.* the grenadiers and light infantry, generally wear wings, not altogether unlike creſcents as they fit on the ſhoulder; of theſe the edges are ornamented with ſhorter bullions and fringe than are uſed in epaulettes. Some wings have ſhoulder-ſtraps, others have none; and ſome are ribbed, or ſtriped with narrow lace; but the generality are plain. In the navy, only large gold epaulettes are worn; all captains having two, and all under that rank but one. Formerly ſhoulder-knots, preciſely reſembling thoſe in uſe among ſervants, were worn by many corps, eſpecially the artillery. Theſe originated in the uſe of chains, ſuſpended from the collar down the arms, for the purpoſe of warding off the cuts of ſabres; but they ultimately became merely decorative, and were from that period made of ſilver cords, plaited, looped, and tagged, which hung down generally in front of the ſhoulder. For the ſame purpoſe of defence, the cavalry have in ſome inſtances adopted a laminated epaulette, conſiſting of metal plates of various patterns, but commonly circular or oval, overlapping each other a little, ſo as to allow due play to the limb, yet forming no ſlight reſiſtance againſt a ſabre. It cannot be expected, that the ſhoulder ſhould altogether eſcape injury, even though the edge of the weapon ſhould be averted; ſince the ordinary force of an attempt to cut down the ſhoulder muſt prove extremely painful, and generally benumb the part for a while; or eventually cauſe a bruiſe of ſome conſequence.

It is evident, from what we have detailed, that the epaulette may be conſidered as the type of a certain portion of armour, in uſe not many years ago; but which has become leſs neceſſary ſince diſcipline has empowered infantry to reſiſt cavalry; and as the former laid aſide their broad-ſwords in deference to the adoption, and to the ſuperiority of the muſquet and bayonet.

Though, in ſome parts of the Britiſh ſervice, the corporals ſtill wear ſhort ſhoulder-knots, and the ſerjeants retain their epaulettes, both being of cotton, worſted, or ſilk, the generality of them now wear the diſtinguiſhing marks of their reſpective ranks, in the form of fleches, or angular lacings on their ſleeves. Some variation exiſts in this particular, according to the nature of their employ; but, in general, one, two, and three fleches are the ordinary indications of rank. Thus, where an order of merit is eſtabliſhed among the privates, ſuch as appertain thereto wear one fleche, the corporals having two, and the ſerjeants three. This mode does not, however, ſeem to carry ſo much notoriety with it as the epaulette, which can be ſeen both from before and from behind the individual wearing it; whereas the fleche can be diſtinguiſhed but in one particular point of view.

EPEE, in *Geography*, a port of Africa, in the country of Benin.

EPEMBOLE, Επεμβολη, in *Rhetoric*, the ſame with parembole.

EPENCRANIS, a name by which ſome of the old authors, particularly Eraſiſtratus, have called the cerebellum.

EPENDYTES, Επενδυτες, among the Greeks, a garment worn under the pallium, and above the interula or inner coat, called, in Greek, ὑποδυτης.

EPENTHESIS, formed of επι, εν, and τιθημι, *q. d.* επεντιθημι, *inſero*, *immitto*, in *Grammar*, the addition, or inſertion of a letter or ſyllable, in the middle of a word; as *relligio* for *religio*, *Mavors* for *Mars*, *alituum* for *alitum*. Virg. Æn. lib. vii. ver. 27.

In the Hebrew language, there are ſome letters which are called *epenthetic*, and they occur without any apparent neceſſity in the middle of words; ſuch are אהוין. Maſclef's Heb. Gram. v. i. p. 191.

EPERIES, in *Geography*, a town of Hungary, celebrated for its mines of ſalt; 20 miles N. of Caſchau.

EPERLANUS, in *Ichthyology*, a name ſometimes given, on account of its pearl colour, to the ſmelt. See Salmo *Eperlanus*.

EPERLEQUE, in *Geography*, a town of France, in the department of the Straits of Calais; 2 leagues N.W. of St. Omer.

EPERNAY, or Espernay, an ancient and handſome town of France, in the department of the Marne, chief place of the diſtrict of the ſame name, with a population of 4430 individuals. It is pleaſantly ſituated on the river Marne, 21 miles N.W. of Châlons ſur Marne, 18 miles S. of Rheims, and 88 miles E. by N. of Paris. N. lat. 49° 2'. The canton has a territorial extent of 110 kiliometres, 11 communes, and 13,958 inhabitants.

As chief place of a diſtrict, Epernay has a ſub-prefect, a ranger, a court of juſtice, and a regiſter office. There are ſeveral manufactures of woollen ſtuffs, hoſiery, cutlery, leather, and writing-paper; but the moſt remarkable is that of a ſort of glazed earthen-ware, which ſtands the hotteſt fire.

The diſtrict of Epernay has 10 cantons, 215 communes, and 87,413 inhabitants, on a territorial extent of $2592\frac{1}{2}$ kiliometres. Its ſoil is uncommonly fertile, and produces corn, but eſpecially that excellent red and white champaign of the very firſt quality, which is ſo much ſought for all over the world. Epernay is the centre of the beſt champaign wines; its own vineyards and thoſe of Ay produce the beſt; and the town has a great trade not only with

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thefe, but alfo with the famous wines of the hills of Hautvilliers, Pierry, and Cumieres, which are not far diftant.

EPERNON, a town of France, in the department of the Eure and Loire; 4 leagues N.E. of Chartres.

EPERON, in *Natural Hiftory*, the fpur-fhell, fo called from its refembling, in fome degree, the rowel of a fpur. It is a fpecies of fnail, of the round-mouthed kind, or clafs of the cochleæ lunares; all its volutæ are furrounded with double rows of prickles. See LUNARIS *Cochlea*.

EPERONNIER, in *Ornithology*. See PAVO *Bicalcaratus*.

EPERUA, in *Botany*. See DIMORPHA.

EPERVIER. See FALCO.

EPERVIERS, in *Natural Hiftory*; a name given by the French authors to a clafs of butterflies, which make the fixth in Reaumur's method. They have a way of poizing themfelves on the wing in the manner of kites, and other birds of prey; and always live upon the wing, never fettling themfelves upon the flowers they feed upon, but keep flying with a humming noife like a humble bee, while they thruft in their trunk and fuck the juices of the flower.

EPETIUM, in *Ancient Geography*, a town of Illyria, on the coaft of Dalmatia, between Salone and Pegentium, near the mouth of a river, now called Xarnouvriza. The town which has fucceeded to Epetium is named *Strobez*.

EPHA, a dry meafure in ufe among the Hebrews.

The epha was the moft common meafure they ufed, and that whereby the reft were regulated. It is commonly fuppofed that the epha, reduced to the Roman modius, contained four modii and a half. Now the Roman modius of grain or flour contained twenty libræ or pounds, confequently the epha weighed ninety pounds. Dr. Arbuthnot reduces the epha to three pecks three pints, Englifh meafure. See MEASURE.

EPHALGIA, in *Ancient Geography*, now *Elpifara*, a town of Afia, in Mefopotamia, upon the banks of the Euphrates, W.N.W. of Circefium.

EPHEBÆUM, Εφηβαιον, in *Antiquity*, the place where the ephebi or youth exercifed; or, as fome fay, where thofe who defigned to exercife met, and agreed what kind of exercife they fhould contend in, and what fhould be the victor's reward.

EPHEBI, Εφηβοι, among the Athenians, a defignation given to their young men when they arrived at eighteen years of age, at which time they had their names entered in a public regifter. Pott. Archæol. Grec. lib. 1. cap. 9. tom. i. p. 48.

EPHEDRA, in *Botany*, (εφεδρα is an ancient name for a climbing or parafitical plant, and expreffes a fitting upon any thing; hence it feems to allude to the fquat or decumbent and crowded habit of this fhrub.) Sea-fide Grape. Linn. Gen. 532. Schreb. 707. Willd. Sp. Pl. v. 4. 858. Mart. Mill. Dict. v. 2. Juff. 411. Clafs and order, *Dioecia Monadelphia*. Nat. Ord. *Coniferæ*.

Gen. Ch. Male, *Cal.* the fcales of a catkin, few, fingle-flowered, roundifh, concave, each the length of the perianth, which is of one leaf, cloven half way down, roundifh, inflated, compreffed, fmall and blunt. *Cor.* none. *Stam.* Filaments feven, united into an awl-fhaped column, cloven at the top, and longer than the calyx; anthers roundifh, turned outwards, four of them below the reft. Female, *Cal.* Perianth five-fold, one placed upon another fo that their fegments are alternate, forming an ovate figure; each is nearly ovate, of one leaf, cloven, the outer or lower ones fmalleft. *Cor.* none. *Pift.* Germens two, ovate, the fize of the innermoft perianth on which they ftand; ftyles two, fimple, thread-fhaped, fhort; ftigmas fimple. *Peric.* none; except the perianths, all become fucculent and thickened, conftituting a divided berry. *Seeds* two, ovate, acute, convex on one fide and flat on the other, compreffed by the perianth which inclofes them on every fide.

Eff. Ch. Male, Calyx the fcale of a catkin, in two fegments. Corolla none. Stamens feven. Anthers four inferior; three fuperior. Female, Calyx cloven, five-fold. Corolla none. Piftils two. Seeds two, inclofed in the pulpy calyx.

The fpecies known are but two.

1. E. *diftachya*. Linn. Sp. Pl. 1472. Duhamel Arb. t. 92. (Uva marina; Ger. emac. 1116. f. 1, and 1117. f. 2.) "Flower-ftalks oppofite. Catkins in pairs." Native of various parts of the fouth of Europe, in a fandy foil about the fhores of the fea or of lakes, flowering in June and July. It bears our climate, efpecially if led upright againft a wall. A fine bufh of this kind may be feen in the Oxford garden, ten or twelve feet high. It is a bufhy, fmooth, leaflefs fhrub, always green, with the habit of an *Equifetum*. The *catkins* are yellowifh. *Berries* fcarlet, fweetifh, vifcid, eatable but not agreeable.

2. E. *monoftachya*. Linn. Sp. Pl. 1472. (E. polygonoides; Pall. Roff. v. 1. t. 83.) "Flower-ftalks feveral. Catkins folitary." Native of Siberia. Linnæus fufpected this to be only a variety of the laft, and Pallas confirms his opinion.

EPHELÆUM, in *Anatomy*, is the place from the hypogaftrum, or lower part of the abdomen, to the fecret parts.

EPHE'LCIS, from επι, and ἑλκος, *an ulcer*, in *Surgery*, a fcab, or cruft, upon a fore.—Alfo, a fmall portion of blood, voided by coughing.

EPHELIS, from επι and ἡλιος, *fun*, a name ufed by the ancient writers on *Medicine*, for a diforder of the face, brought on by the fun and drying winds, and of the nature of what we call fun-burning. It was a certain roughnefs, hardnefs, and bad colour of the fkin.

The ephelis, or fun-burning, is removed by an application of refin, to which a third part of foffile falt, and a little honey are added; but all thefe diforders, as alfo the unnatural colour of cicatrices, are remedied by the following preparation, afcribed to Trypho the Elder:

Take equal quantities of myrobolans, crocomagna, cimolian earth of a blueifh colour, bitter almonds, the meals of barley and bitter vetch, dyer's weed (ftruthium album); all thefe are to be triturated together, and made up with the moft fharp honey. With this preparation the parts affected are to be anointed at night; and the medicine carefully to be wafhed off the next morning. James Med. Dict. See FRECKLES.

EPHEMERA, from ἐπὶ and ἡμερα, *a day*, in *Medicine*, the name given by the Greek writers to the mildeft form of fever, which runs through its courfe within the period of one day. By the Romans the fame fever was termed *diaria*, from *dies*, a day.

A fever which terminates in the courfe of twelve, eighteen, or twenty-four hours, is not a common occurrence in this climate; unlefs the flight difturbance of the fyftem, which fatigue, repletion, a fleeplefs night, &c. induce, is to be called an ephemeral fever: and fuch, indeed, appears to be the diforder to which the term ephemera has been applied by writers in general, and which conftitutes the ephemera fimplex, or legitima, in their nomenclature. When the febrile condition is more fevere, and therefore of longer duration, extending to the third or fourth day, by a folecifm in language, it has been denominated ephemera extenfa, or ephemera plurium dierum. Any flight fever, of three or four days duration, is occafionally called an ephemera at prefent; the flight derangement of the habit, from the operation of the caufes juft mentioned, being fcarcely deemed a difeafe worthy of a diftinct appellation.

The ephemera fimplex is a flight febrile paroxyfm, marked by languor, lofs of appetite, thirft, headache, and flight pains in the limbs, with fome heat of fkin terminating in a gentle perfpiration, and with drynefs of the tongue and fauces. Thefe fymptoms, from their mildnefs, imply a very flight derangement of any of the functions of the body: they originate from fome evident caufe of diforder in what have been abfurdly termed the non-naturals, and ceafe fpontaneoufly when the influence of thefe caufes no longer operates. The mildnefs of the fymptoms, and the nature of the evident caufes, are mentioned as the principal means of difcriminating the ephemera from the various forms of continued fever at their commencement. Among the caufes of the ephemera are enumerated the various paffions of the mind, when ftrongly excited, as grief, anger, joy, or care and anxiety, likewife lofs of fleep, exceffive heat of the weather, fatigue from labour or exercife, a fit of intoxication or of repletion, fudden expofure to cold, fafting, too great evacuations, &c. It is admitted, indeed, that many of thefe caufes occafionally give rife to continued fevers of long duration; but, in thefe cafes, the attack is preceded by cold chills and fhiverings, by languor and laffitude, loathing of food, &c. and is accompanied by more fevere diforders of the functions, as by violent headache, pains in the back and limbs, naufea or vomiting, with great anxiety and reftleffnefs. The prefence or abfence of thefe fymptoms, in the commencement, will enable us to anticipate the future progrefs of the difeafe, whether it will be a mere ephemera or a more ferious continued fever.

Befides the fimple ephemera, arifing from the caufes already enumerated, which Sauvages has included under the four heads of ephemera plethorica, ephemera naufeativa, ephemera à frigore, and ephemera à calore, thofe flight febrile derangements, connected with bruifes, diflocations, parturition, congeftion of milk in the breafts, dyfmenorrhœa, &c. have been alfo defignated by the term ephemera; which, in this cafe, is a fecondary or fymptomatic ephemera. Avicenna, among the ancients, and Foreftus, among the modern phyficians, have made a ftill more extenfive divifion of ephemera; namely, into as many fpecies as there are evident caufes which induce it. Hence they ufelefsly diftinguifh ephemera from grief, from joy, from hope, from fear, from thirft, from fafting, &c.

The original fignification of the term implied a completion of all the ftages of a fever, *viz.* the beginning, increafe, acmè, and decline, (in the language of the ancients,) within the compafs of a natural day. By this definition, Van Swieten obferves, the moft acute fevers, which often kill a patient in twenty-four hours, are excluded from the term; fince they do not arrive at their declenfion in that fpace of time, although they end in death. Yet Caius has defcribed that fatal epidemic, the *fweating ficknefs*, or *fudor Anglicus*, under the term of ephemera; becaufe, on the one hand, it often terminated in the fpace of twenty-four hours, by deftroying the patient; and, on the other, by a fweating, continued for the fame fpace of time, the patients were often cured. But in this cafe, though immediate danger was removed, yet great debility and other injuries to the functions ftill remained, for fome time afterwards; fo that the difeafe belonged to the clafs of continued malignant fevers. This difeafe, under the appellation of ephemera fudatoria, conftitutes the feventh fpecies of Sauvages. It has been alfo denominated ephemera Britannica, ephemera maligna, ephemera Anglica peftilens, &c. See SWEATING *Sicknefs*.

With refpect to the *cure* of the ephemeral fever, little remains to be faid. The term implies that its natural termination will occur within the period of a day, if left to itfelf: we here fpeak of the fimple ephemera, arifing from a flight temporary caufe. Abftinence alone, or the moft light and flender diet, with diluent drinks, is all that is required. The bowels may be opened by gentle aperients, as neutral falts, infufion of fenna, &c.: and this ought not to be omitted, where the difeafe has arifen from over-repletion, or intoxication; in which cafe, it will contribute directly to remove the exciting caufe of the diforder. Thin drinks, fuch as fpring-water, or barley-water, acidulated or not with the juice of lemons, tea, or the infufions of other grateful herbs, may be ufed, and animal food abftained from.

The fame treatment will be ufeful in the fecondary or fymptomatic forms of ephemera; in which cafes, however, the cure or alleviation of the original diforder muft be the firft ftep towards removing the ephemera. See Galen Method. Medend. lib. viii. De Febribus, lib. i. &c. Van Swieten, Comment. App. 728. Burferius Inftit. Med. tom. i. fect. 198. Sauvages Nof. Meth. clafs ii. genus 1.

EPHEMERA, in *Entomology*, a genus of the neuroptera order. This genus has the mouth deftitute of mandibles; feelers four, very fhort, and filiform; jaws fhort, membranaceous, cylindrical, and connected to the lip; antennæ fhort and fubulate; ftemmata too large above the eyes; wings erect; the lower fmaller; tail terminating in briftles.

The ephemeræ are proverbially a race of beings deftined to enjoy the functions of life for a much fhorter period than any other animals. This is a popular opinion, and, in a partial view of their hiftory, not altogether incorrect; but it muft be underftood only of the laft or winged ftate, after attaining which they exift but for a few hours. The duration of this period varies in different fpecies. It is devoted folely to the pleafures of fulfilling the ordinary purpofe of nature, the propagation of their kind; in the accomplifhment of which the ephemeræ may be obferved in myriads, during the fummer feafon, fporting on the wing, juft above the furface of the water. In the larva and pupa ftates the ephemeræ live one or two years; and fome fpecies, it is believed, live even three years from the time of hatching from the egg ftate, before they arrive at the perfect form. The larvæ are found in the water, wherein they conftantly refide, and are the favourite food of fifhes. They are active, furnifhed with fix legs, a tail, fix lateral fins or gills, and prey on fmaller infects. The pupæ, like the larvæ, are carnivorous, and refemble the former ftate, except in having the rudiments of the wings apparent. The ephemeræ are fo abundant in fome countries, that they are ufed for the purpofe of manure, the fpecies vulgata efpecially. This is the common practice with the hufbandmen in Carniola. They are alfo very numerous on fome parts of the Rhine, the Maes, and Ifel. The feafon of their appearance in fuch multitudes continues, however, only for about three days annually. The ephemeræ are arranged in two fections, according to the number of briftles at the extremity of the tail.

Species.

* *Tail with three hairs or briftles.*

VULGATA. Wings reticulated, and fpotted with brown; body yellowifh, fpotted with black. Scop. Donov. Brit. Inf., &c.

Inhabits

Inhabits watery places throughout Europe.

Lutea. Wings tranfparent, reticulated; body yellow. Fabr.

Native of Europe, and is found in Britain.

Marginata. Wings white; exterior margin fufcous; body black. Fabr.

Similar to E. vulgata, but fmaller.

Vespertina. Wings black; pofterior ones white. Linn.

Native of Sweden, and other parts of Europe.

Halterata. Wings two, white; abdomen whitifh, with fufcous tail. Fabr. *Phryganea caudâ trifeta*, &c. Degeer.

Inhabits ftagnant waters in the north of Europe.

Inanis. Wings hyaline; body black; fegments of the abdomen from the fourth to the feventh pellucid. Linn.

Native of Europe.

Maroccana. Wings white, immaculate; body yellowifh. Fabr.

Found in Morocco.

Brevicauda. Wings two, cinereous, with a black rib; abdomen pale; tail brown. Fabr.

A fmall fpecies, found in the vicinity of Paris.

** *Tail with two hairs or briftles.*

Bioculata. Wings white reticulated; head with two yellow tubercles; tail yellow. Fabr. Geoff., &c.

Native of European waters.

Renosa. Wings white reticulated; body brown. Fabr. Inhabits Denmark.

Nigra. Body black; wings blackifh; pofterior pair very fmall. Linn.

Defcribed by Linnæus as a native of Sweden; alfo inhabits other parts of Europe.

Culiciformis. Wings white; body brown. Linn.

Found in Greece by Pada; alfo in Sweden by Linnæus, and in France by Geoffroy.

Horaria. Wings white; thicker-margin blackifh. Linn. *Ephemera minima*, Swammerdam.

Very abundant in Europe.

Striata. Wings hyaline, ftriated; thorax fufcous; abdomen white. Fabr. *Ephemera mutica*, Linn. Fn. Suec.

An European fpecies.

Diptera. Wings two; coftal margin brown, with cinereous fpots. Linn.

The abdomen in this infect is marked with red lines. The fpecies inhabits Sweden.

Fuscata. Wings hyaline; abdomen brown, with the bafe whitifh; legs pale. Fabr.

Albipennis. Wings white, immaculate; abdomen pale at the bafe; tail blackifh. Fabr.

This and the preceding inhabit France, and other parts of Europe.

Notata. Yellow; wings white; abdominal fegments with a fufcous fpot each fide. Linn.

Ephemera notata and the three following are inhabitants of watery places in Europe.

Testacea. Wings brownifh; body brown teftaceous; foles of the feet fufcous. Linn.

Ferruginea. Wings yellowifh; body ferruginous. Linn.

Stigma. Wings brownifh; body pale yellow; thighs with a black dot in the middle.

Ephemera, is alfo applied among *Botanifts*, to a kind of flowers which open and expand themfelves at funrifing, and wither or clofe up again at his fetting. Such are the dent de-lion, vulgarly dandelion, and divers others.

EPHEMERIDES, in *Aftronomy*, tables calculated by aftronomers, fhewing the prefent ftate of the heavens for every day at noon; that is, the places wherein all the planets are found at that time.

It is from thefe tables that the eclipfes, conjunctions, and afpects of the planets are determined; horofcopes, or celeftial fchemes, conftructed, &c.

We have ephemerides of Regiomontanus from 1475 to 1506, of Engel from 1494 to 1500, of Staeffler from 1499 to 1531, of Origan from 1595 to 1654, of Kepler from 1617 to 1628, of Argoli from 1620 to 1700, of Heckerus from 1666 to 1680, of Wing from 1652 to 1671, of De la Hire from 1701 to 1703, of Manfredi from 1715 to 1750, of Parker, &c. S. Caffini has calculated ephemerides of the fidera medicæa, or fatellites of Jupiter, which are of good ufe in determining the longitude.

In England the Nautical Almanac or Aftronomical Ephemeris, publifhed annually by anticipation, under the direction of the Commiffioners of Longitude, is the moft confiderable. See Almanac.

In France they have preferved in the national library ephemerides of 1442; and celeftial ephemerides have been publifhed by M. Defplaces every ten years, from 1715 to 1745: they were afterwards continued by the abbé Caille, with many additions, from 1731 to 1774, of which an account may be feen in the Hiftory of the Academy of Sciences for 1743, &c.; they were further continued by Lalande from 1775 to 1810. The Academy of Sciences have likewife publifhed annually, from the year 1678, a kind of ephemeris, under the title of Connoiffance des Tems. This has been continued fince the revolution under the direction of the "Bureau des Longitudes." The two volumes for the years 8 and 9, edited under the infpection of M. Lalande, contain, befides other important articles, new catalogues of the ftars; tables of the moon's horary motion by Delambre; obfervations of Mercury by Videl, &c. They have alfo ephemerides at Bologna; thofe for 23 years from 1787 to 1810, being computed by C. Mateucci, affifted by Ifolani, Guglielmini, Sacchetti, Zanotti, and Canterzani. The ephemerides of Milan contain the refult of an important labour of C. Oriani, on the method of correcting the elements of the tables of Mercury by obfervation, and many interefting obfervations of C. Reggio and De Cefaris, &c. &c. The ephemerides of Berlin are now conducted by M. Bode, and contain many aftronomical obfervations and memoirs by German, French, and Englifh aftronomers. The aftronomers of Vienna commenced a fimilar work in 1757. The geographical ephemerides, undertaken by M. Von Zach, of Gotha, at the commencement of the year 1798, contain many curious obfervations; information refpecting new books and charts, new voyages and geographical maps, portraits of eminent philofophers, and, in a word, every thing that can be interefting to aftronomers, geographers, and navigators. The meteorological obfervations of the electoral Academy of Sciences at Manheim, from 1781 to 1792, are comprehended in 12 volumes 4to. under the title of "Ephemerides Societatis Meteorologicæ Palatinæ."

EPHEMERUM, in *Botany*, from ἐφήμερος, lafting but a day, in allufion to its tranfient bloffoms; fee Lysimachia. The name has alfo been given in ancient times to the hemlock, on account of the celerity of its deftructive action upon animal life.

EPHESIA, in *Mythology*, a feaft inftituted at Ephefus, in honour of Diana.

EPHESIANS, Epistle *to*. See Epistle.

EPHESIORUM Portus, in *Ancient Geography*, a port

port of Afia Minor, upon the Bofphorus of Thrace; the modern name of which is *Aphofiati*.

EPHESIUM, the name of a plafter, which is defcribed by Celfus.

EPHESIUS, in *Biblical Hiftory*, a manufcript of the gofpels written in 1166, and formerly in poffeffion of a bifhop of Ephefus, whence it has taken its name. It is noted 71 in the firft part of Wetftein's N. T. It is at prefent in the archbifhop's library at Lambeth, to which it was prefented by Trahern, together with the extracts which he had made from it. Thefe were inferted by Mill, in his collections of readings.

EPHESTIA, in *Mythology*, a feaft celebrated in honour of Vulcan, in which three young lads ran for a prize.

EPHESTRIA, were feafts celebrated at Thebes, in honour of Tyrefias.

EPHESUS, in *Ancient Geography*, a city of Afia Minor, in Ionia, formerly reputed the metropolis of Afia. Stephanus ftyles it "Epiphaneftata," or moft illuftrious. Pliny reprefents it as the ornament of Afia; and Strabo defcribes it as the largeft and moft frequented emporium of that continent. The ancient city, which was originally a fmall village, ftood about 50 miles S. of Smyrna, near the mouth of the river Cayfter, and the fhore of the Icarian fea, which is a bay of the Ægean; but its precife fituation cannot be afcertained, as it was often deftroyed and rebuilt. Some modern travellers maintain that the ancient city ftood more to the fouth than the prefent town, or rather village, which they infer from the ruins that ftill remain. It was known in ancient times by the names of Alopes, Ortygia, Morges, Smyrna, Trachæa, Samornion, and Ptela. Its name Ephefus is derived, according to Heraclides, from the Greek word *ephefus*, fignifying permiffion; becaufe Hercules, as he fays, permitted the Amazons to live and build a city in that place. Others allege, that Ephefus was the name of the Amazon that founded the city: for Pliny, Juftin, and Orofius unanimoufly affirm, that it was built by an Amazon; while others afcribe the honour to Androclus, the fon of Codrus, king of Athens, who was the chief of the Ionians that fettled in Afia. However this be, it is acknowledged, that the city, which in the Roman times was the metropolis of Afia, was founded by Lyfimachus; who, having caufed the ancient city to be demolifhed, rebuilt a new one, at a vaft expence, in a place more convenient, and nearer the temple. We learn from Strabo, that when the inhabitants manifefted a reluctance to quit their ancient habitations, this prince caufed all the drains, that conveyed the water into the neighbouring fens and the Cayfter, to be privately ftopped up: fo that the city on the firft violent rains that fell was in great part laid under water, and many of the inhabitants were drowned: and he thus conftrained thofe who remained to retire into the new city. This new Ephefus was greatly damaged by an earthquake in the reign of Tiberius, but that emperor repaired and adorned it with feveral ftately buildings, of which there are now fome few ruins that teftify its exiftence. The aqueduct, of which a part ftill fubfifts, is generally believed to have been the work of the Greek emperors; the pillars, that fupport the arches, are of fine marble, and they are higher or lower as the level of the water required. This aqueduct ferved to convey water into the city from the fpring of Halitee, mentioned by Paufanias. The gate, now called for fome unknown reafon the gate of perfecution, is remarkable for three bas-reliefs on the mould, of exquifite tafte. The port, of which many medals have been ftruck, is at prefent merely an open road, and not much frequented. The Cayfter was formerly navigable, and afforded a fafe place for fhips to ride in, but it is now almoft choaked with fand. Ephefus is now venerable for nothing but the ruins of palaces, temples, and amphitheatres. It is called by the Turks *Ajafaluk* (which fee), or the temple of the moon, from the magnificent ftructure formerly dedicated to Diana. The church of St. Paul, faid to have been founded by the apoftle, is wholly deftroyed; the little which remains of that of St. Mark is finking to ruin. The only church remaining is that dedicated to St. John, who refided here, and this is now converted into a Turkifh mofque. The town is merely a miferable village, the habitation of herdfmen and farmers, living in low and mean huts, fheltered from the extremities of weather by mighty maffes of ruinous walls; the pride and oftentation of former days, and the emblem in thefe of the tranfient vanity of human glory. All the inhabitants of this once famous city amount not to above 40 or 50 families of Turks, without one Chriftian family among them; fo ftrikingly hath the fcripture denunciation been fulfilled, that "their candleftick fhould be removed out of its place."

The ancient city, whether it was firft built by Androclus, who conducted the Ionians hither and drove out the Carians and Leleges, by whom this fituation was occupied before his arrival, or by one Crœfus or Ephefus, long before the Ionic migration, as others maintain, became foon the metropolis of Ionia. It was at firft governed by Androclus and his defcendants, who affumed the royal title, and exercifed regal authority over the new colony; whence, even in Strabo's time, the pofterity of Androclus were ftyled kings, and allowed to wear a fcarlet robe, with a fceptre, and all the enfigns of royal dignity. In procefs of time, a fenate was eftablifhed and a new form of government introduced, which continued to the time of Pythagoras, who lived before Cyrus the Great, and was one of the moft favage tyrants whofe name and character hiftory records; for having expelled the fenate and engroffed the whole power, he filled the city with blood and rapine, not fparing even thofe who fled for fhelter to Diana's temple. His fucceffor Pindarus governed the city with a milder fway; and in his time Ephefus was befieged by Crœfus, king of Lydia, who advifed the inhabitants to devote their city to Diana, and in confequence of their following his counfel, treated them with kindnefs, and reftored them to their former liberty. The other tyrants of Ephefus, mentioned in hiftory, are Athenagoras, Comes, Ariftarchus, and Hegefias; the laft of whom was expelled by Alexander, who, having defeated the Perfians on the banks of the Granicus, beftowed upon Diana all the tributes which the Ephefians had paid to the Perfians, and eftablifhed a democracy in the city. After his death, this city became the prey of his fucceffors. Lyfimachus took it, and afterwards Antigonus had poffeffion of it and plundered it. Ephefus for a little while was reftored to its ancient fplendour; but it was always fubject to the kings of Syria. In the war between Mithridates and the Romans, the Ephefians took part with the former, and by his order maffacred all the Romans that refided in the city; for which barbarity they were feverely fined, and reduced almoft to beggary by Sylla, but afterwards treated kindly and fuffered to live according to their own laws. It was under the reign of the emperor Alexius, father of Anne de Comnena, that the Mahometans made themfelves mafters of Ephefus. The Greeks retook it in 1206, but they loft it again 1283. At the commencement of the 14th century it became a part of the Turkifh dominions; and both the place itfelf and its vicinity exhibit melancholy traces of indolence and inactivity. The Ephefians were much addicted to fuperftition, forcery, and curious arts, as the Scripture ftyles them (Acts, xix. 19.); whence came the proverb "Ephefian letters," fignifying all forts of fpells or charms. By thefe Ephefian letters were meant certain obfcure words and incoherent fentences, which fuperftitious bigots ufed to write on their girdles, and even imprint on their feet, and other parts of their bodies. They were alfo noted for their luxury and lafcivioufnefs. See Ephef. v. 5.

Ephefus, in its relation to ecclefiaftical hiftory, may be confidered, firft of all, as the abode of many Jews, who obtained the privilege of citizens (Joseph. Cont. Appian. l. 2.), and afterwards, as the place where St. Paul took up his refidence for three years (Acts, xx. 31.), where he wrought miracles (Acts, xix. 11. 1 Cor. xvi. 9.), and was refifted by the Jews, (Acts, xx. 19.); and where Timothy was bifhop; and where John refided; and, moreover, as containing one of the feven churches, whofe character and doom are recorded in the book of Revelations, ch. ii.

Ephesus, *Temple of*. See Diana.

EPHETÆ, of ἐφίημι, *I fend forth*, in *Antiquity*, a fort of magiftrates among the Athenians, inftituted by king Demophoon, to take cognizance of murder, manflaughter, and chance-medley.

Their number was one hundred, whereof fifty were Athenians, and fifty Argians: they were not admitted to the poft till upwards of fifty years of age. Demophoon fubmitted to be tried by this court, for having unfortunately killed one of his fubjects by the turn of his horfe, as he was coming from Troy. It fubfifted for a confiderable time in the fame form; but at length Draco new-modelled it, excluded the Argians, and made it to confift of fifty-one Athenians, each above fifty years of age: Ubbo Emmius de Rep. Athen. fays, he transferred to them part of the jurifdiction of the Areopagites. See Areopagus.

The occafion of erecting this court and of admitting the Argives to fit as judges, is faid to have been as follows. Agamemnon, or, as others fay, Diomedes, returning with his forces from Troy, were driven one night into an Athenian port called Phalerus, and thinking themfelves in an enemy's country, began their ufual practice of ravaging and plundering; upon which the Athenians fell upon and killed a confiderable number of them. Next morning they found the palladium, or ftatue of Minerva, which was brought from Troy, lying upon the ground among the flain; by which circumftance they knew that they were their friends the Argives. The oracle having been confulted, ordered them to give the flain an honourable burial in the place where they fell, to build a temple there, dedicated to Minerva, and to fet up the palladium in it. Immediately after this tranfaction, it was ordered that this court fhould be erected to try all cafes of perfonal injury and property. It confifted of 50 members, who were to be above 50 years of age, men of fenfe and known probity, and who had power of life and death. Upon its firft inftitution Agamemnon infifting that there fhould be an equal number of Athenians and Argives, the Athenians readily agreed to the propofal.

EPHIALTES, ἐφιάλτης, in *Medicine*, from ἐπι, *upon*, and ἅλλομαι, *I leap*, is fynonymous with the Latin *incubus*, and the Englifh *night-mare*, which fee.

EPHIALTEUM, in *Ancient Geography*, the moft northern promontory of the ifle of Rhodes.

EPHIDROSIS, in *Medicine*, from ἐπι, and ἱδρώς, *fweat*, a term ufed by the ancient writers to denote the appearance of a fweat, whether critical or not, and whether general, or on the upper parts of the body only. The modern nofologifts have conftituted a *genus* of difeafe under this appellation; under which Sauvages comprifes every variety of morbid perfpiration that occurs as a fymptom of different maladies. He enumerates feventeen fpecies of ephidrofis. See his Nofol. Method, Clafs IX. Gen. 20. Cullen, Gen. 118.

EPHIELIS, in *Botany*, from ἐφιελις, *a little cup*, or fomething like it, in a crown or garland, which alludes, happily enough, to the nectary forming a fort of cup, or crown, within the circle of the corolla. Schreb. 253. Willd. Sp. Pl. v. 2. 328. (Mataiba; Aubl. Guian. v. 1. t. 128. Juff. 249.) Clafs and order, *Octandria Monogynia*. Nat. Ord. Near the *Sapindi*, Juff.

Gen. Ch. *Cal.* Perianth of one leaf, in five deep, fpreading, roundifh, acute fegments. *Cor.* Petals five, roundifh, fpreading, notched, with a fmall point, and having claws as long as the calyx. Nectary of ten roundifh hairy fcales, fmaller than the petals, two of them affixed to the bafe of each petal. *Stam.* Filaments eight, briftle-fhaped, longer than the corolla, inferted into a gland; anthers roundifh, with four angles. *Pift.* Germen ovate, encompaffed with the gland which bears the ftamens; ftyle none; ftigma obtufe. *Peric.* Capfule oblong, compreffed, with a furrow on each fide, of one cell and two valves. *Seeds* two, kidney-fhaped, one attached to the middle of each valve, one above the other.

Eff. Ch. Calyx in five deep fegments. Petals five, with claws. Nectary of ten fcales, two to each petal. Capfule compreffed, of one cell and two valves. Seeds two, attached to the valves.

The only known fpecies is E. *fraxinea*, Willd. a tree 50 or 60 feet high, with copious *branches*, of which the central ones are erect, the reft widely fpreading. *Leaves* alternate, pinnate, fmooth; leaflets four or fix, oppofite, oval, pointed, entire, bright green, fometimes eight inches long. *Flowers* on long axillary branching ftalks, very fmall, white. It grows in the forefts of Guiana, flowering in October. Juffieu fufpects this genus may be more akin to the *Leguminofæ* than to his *Sapindi*, but he obferves that the fruit requires further inveftigation.

EPHIPPIA, of ἐπι and ἵππος, *horfe*, denoted certain cloths or houfings, which were faftened on a horfe by a girth or furcingle, in ancient Greece, before the ufe of faddles were known. They were compofed of different materials, as leather, cloth, and the fkins of wild beafts, and fometimes adorned with gold, filver, and precious ftones. When thefe coverings were common, it was reckoned more manly to ride without them. Varro boafts of having rode, when a young man, without a covering to his horfe; and Xenophon reproaches the Perfians becaufe they placed more clothes on the backs of their horfes than on their beds, and gave themfelves more trouble to fit eafily than to ride fkilfully. Thefe coverings were, therefore, for a long time not ufed in war; and the old Germans, who confidered them as difgraceful, defpifed the Roman cavalry who employed them. (Cæf. de Bell. Gall. l. iv. 2.) Dion Caffius (l. lxiii. 14.) fays, that they were firft allowed to the Roman cavalry by Nero. But it has been fuggefted that this author alludes merely to reviews, at which the cavalry were probably obliged before this time to appear always without them. In the time of Alexander Severus, the horfes of the whole Roman cavalry had beautiful coverings. (Lamprid. Vit. Alex. Severi. c. 50.) Saddles were firft denominated ephippia, which originally fignified nothing more than a covering for a horfe. Beckmann Hift. Inv. vol. ii. Berenger's Art of Horfemanfhip, vol. i. p. 41. See Saddle.

EPHIPPITES. See Hippurites.

EPHIPPIUM, in *Anatomy*, the excavation in the upper furface of the fphenoid bone, called alfo fella turcica. See Cranium.

EPHOD,

EPHOD, אפד, derived from אפד, *aphad, to clothe*, a ſacerdotal garment, in uſe among the ancient Jews, ſuppoſed to have been a kind of linen alb, or ſurplice, wore by perſons of diſtinction, of various characters; the ſame with what the Latins call ſuper-humerale. 2 Sam. vi. 4. 1 Sam. xxii. 18. 1 Sam. ii. 18.

It is very hard to ſay preciſely what the ephod was; and there is room enough for the interpreters to be divided about it. The only point they are agreed upon is, that it was an upper garment worn over all the reſt, immediately under the pectoral or breaſt-plate. Some hold it had ſleeves, others deny it. The generality agree, that it was very ſhort, though ſome maintain that it hung down to the feet behind.

There were two kinds of ephods; the one, common to all who aſſiſted in the temple, being only made of common linen, mentioned in the firſt book of Samuel, ii. 18; the other, peculiar to the high-prieſt, mentioned Exod. xxviii. 6. 15. to be made of gold, of blue, and of purple, of ſcarlet, and fine twined linen, with cunning work; having two ſhoulder-pieces, with a curious girdle of the ſame matter, and two onyxes, with the names of the children of Iſrael engraved thereon, ſix upon each ſtone. Theſe onyxes were ſet in gold, and ſerved as buttons upon each ſhoulder. As for the ſhape of the ephod, the LXX call it ἐπωμὶς, which ſignifies that it was worn on the ſhoulders.

Joſephus ſays (Antiq. l. iii. § 5), that it was a cubit long. It conſiſted, as ſome ſuppoſe, of two parts, the one an oblong rectangular piece, hanging down behind from the ſhoulders to the feet; the other a ſhort rectangular piece, which hung down before, the length of a cubit. Theſe two pieces were joined together upon the ſhoulders, with ſome proper faſtening, as loops, buttons, or the like.

It is alſo expreſſed in the ſecond book of Samuel, vi. 14. that upon the removal of the ark of the covenant from the houſe of Obed-Edom, David danced for joy, girt with a linen ephod; whence ſome authors have concluded, that the ephod was alſo a regal garment, worn on ſolemn occaſions. It is probable that the peculiarity of the ephod of the high prieſt did not conſiſt in its being of a different ſhape from that which was worn by other perſons; but in the richneſs of the materials of which it was made, and the fine embroidery and jewels with which it was adorned.

EPHORI, Εφοροι, magiſtrates eſtabliſhed in ancient Sparta, to balance and check the power and authority of the kings; as at Rome, there were tribunes created to controul the power of the conſuls.

The word is formed of the Greek, ἐφοραω, *intueor*, formed of the prepoſition ἐπι, and the verb ὁραω, *to ſee*; whence ἐφορος, *q. d. inſpector, overſeer.*

Lycurgus, being ſenſible that a perfect underſtanding between the prince and the people was the baſis and foundation of both their happineſs, to maintain that good underſtanding, eſtabliſhed ephori, or inſpectors, as a kind of mediators, who ſhould have an eye to the meaſures and conduct on both ſides, and preſerve ſo equal a balance between them, that the regal power ſhould never decline into ſeverity and tyranny, or the liberty of the people run into licentiouſneſs and rebellion.

This is the account of their inſtitution given by Herodotus and Xenophon. (Her. lib. i. Xen. de Rep. Lacedæm.) The authority of the ephori was very great; they preſided in popular aſſemblies, collected their ſuffrages, declared war, made peace, treated with foreign princes, determined the number of forces that ſhould be raiſed, appointed the funds to maintain them, and diſtributed rewards and puniſhments in the name of the ſtate: they likewiſe held a court of juſtice, enquired into the behaviour of all magiſtrates, inſpected the education and conduct of youth, had a particular juriſdiction over the helotes, and by degrees drew the whole adminiſtration into their own hands. On certain occaſions, they expelled, and even put to death the kings; and aboliſhed or ſuſpended the power of the other magiſtrates, calling them to account at pleaſure. Ageſilaus, in the height of all his conqueſts, which even ſtruck terror on the great king of Perſia, ſtopped, and turned back, out of deference to the ephori, when they recalled him.

Some authors deny that the ephori were eſtabliſhed by Lycurgus, dating their origin 130 years after the time of that legiſlator.

Thus Plutarch, in his life of Cleomenes, aſcribes their inſtitution to Theopompus, king of Sparta, which is alſo confirmed by the authority of Ariſtotle. (Polit. lib. v.) The ephori were five in number, and annually choſen by the people out of their own body: though ſome have imagined, that they were at firſt appointed by the kings at their pleaſure, but that afterwards the people obtained the power of electing them. The year was denominated from the firſt election of theſe magiſtrates; and the Lacædemonian armies took their names from the principal ephori, as thoſe of Athens did from their firſt archon. The ephori did not riſe up at the entrance of the kings, as all the other magiſtrates did; and if even the kings offended againſt the laws, the ephori took cognizance of their conduct, and puniſhed them.

EPHORUS, in *Biography*, a Greek orator and hiſtorian, was a native of Cuma or Cyme in Æolia, and flouriſhed about the year 352 B. C. He was a diſciple of Socrates, at whoſe inſtigation he wrote hiſtory; which he commenced after the fabulous periods, with the return of the Heraclidæ into Peloponneſus, and brought down to the 20th year of Philip of Macedon. This work, which was divided into 30 books, was held in eſtimation by the ancients, and is frequently cited by Strabo and other writers; though the hiſtorian is charged with errors and miſrepreſentations, and plagiariſms. Beſides the hiſtory, the loſs of which is regretted, Ephorus wrote ſeveral other books on moral, geographical, and rhetorical ſubjects, none of which are extant. Bayle. Voſſ. Hiſt. Græc. Gen. Biog.

EPHRA, in *Ancient Geography*, a city of Judea, in the half-tribe of Manaſſeh, on this ſide of Jordan. It was ſituated on the frontiers of the tribe of Ephraim; ſuppoſed to have been the ſame with Ophrah. Judg. vi. 11.

EPHRAIM, *Tribe of*, ſo denominated from Ephraim, the grandſon of Joſeph by Aſeneth, the daughter of Potiphar, who was born in Egypt about A. M. 2294, occupied the ſouth ſide of Samaria, and extended, like that of Manaſſeh, from the Mediterranean on the weſt, and the river Jordan on the eaſt; bounded on the ſouth by the territory of Benjamin and part of Dan, and on the north by the half-tribe of Manaſſeh. The extent of this tribe from north to ſouth was about 7 leagues; and though ſome parts were mountainous and rocky, they were covered with trees and good paſture, and the low lands were rich and fertile, and even luxuriant. The cities and towns were numerous, large, and well-peopled. Joſhua was of this tribe; and the ark and tabernacle remained in it at Shiloh for a conſiderable time. After the ſeparation of the 10 tribes, the ſeat of the kingdom of Iſrael being in Ephraim, Ephraim is frequently uſed to ſignify the whole kingdom. The diſtrict belonging to this tribe is called Ephratah. Pſ. cxxxii. 6. (See alſo Judg. xii. 5. 1 Sam. i. 1.) Ephraim was led captive beyond the Euphrates, with all Iſrael, by Salmaneſer, king of Aſſyria, A. M. 3283. B. C. 721.

Ephraim, or *Ephræm*, a city of Ephraim, towards Jordan, whither Jesus is supposed to have retired before his passion. John, xi. 54.—Also, a city of Benjamin, 8 miles from Jerusalem, according to Eusebius, near the wilderness of Judea, in the way from Jerusalem to Jericho, not far from Bethel.—Also, a considerable mountain in the tribe of Ephraim, and extending to that of Benjamin, on which several towns were built.—Also, an extensive forest situated on the other side of Jordan, not far from Mahanaim, where David abode while the battle was fought, in which Absolom received the due reward of his unnatural rebellion.

EPHRATA, or Dunkard-*Town*, in *Geography*, a village of America, in Lancaster county, Pennsylvania, on the N.W. side of Calico creek, which, joining the Conestoga, falls into the Susquehanna; 12 miles N. of the town of Lancaster, and more than 40 W. of Philadelphia. It is situated in a romantic and sequestered vale, and inhabited by a community of religious people, called "Tunkers," who are mostly of German descent and believers in the doctrine of general redemption. They are very plain in their dress and language; and will neither swear, nor fight, nor go to law, nor take interest for the money they lend. They have many peculiarities; but their inoffensive manners have occasioned their being called the harmless Tunkers. This settlement is called "Tunkers' town," and consists of about 40 buildings, of which three are places of worship. They subsist by cultivating their lands, by attending a printing office, a grist-mill, a paper-mill, an oil-mill, &c. and the sisters by spinning, weaving, sewing, &c. Beside this congregation at Ephrata, there were, about 30 years ago, some few others of this sect in various parts of Pennsylvania, and in Maryland. The whole community, exclusively of those in Maryland, comprehended upwards of 2000 persons.

EPHRATAH. See *Tribe of* Ephraim and Bethlehem.

EPHREM, or Ephraim, denominated the *Syrian*, and honoured with the appellation of *Saint*, in *Biography*, was a native of Nisibis in Mesopotamia, and born during the reign of Constantine the Great. Devoting himself at an early period to the monastic life, he sedulously applied to his studies, and to the composition of various theological and moral works. Towards the close of his life he resided at Edessa, where he began to distinguish himself by his writings about the year 370, and was ordained deacon, determining not to accept of any higher ecclesiastical order. His works were all written in the Syriac language, and several of them were translated into Greek, with which he does not seem to have been acquainted, during his life. He was held in high estimation, on account both of his virtues and his writings. From Dr. Assemann we learn, that the Syrians gave him the titles of Doctor or Master of the whole world, and of their Prophet; and St. Jerome informs us, that his works were so much esteemed as to be publicly read in some churches after the Scriptures. Sozomen highly commends them both for style and sublimity of sentiment; which excellencies are said by this father, and also St. Jerome, to have been transfused into the Greek version of them. The subjects of these works were commentaries upon the Old and New Testaments; homilies, or sermons; exhortations to the monks; controversial pieces against Sabellius, Arius, Apollinaris, the Anomians, and the Novatians; treatises of morality; hymns to be sung in the churches; panegyrics, &c. of which we have an account by Cave, Du Pin, and Lardner. The most complete edition of the works of this writer was published at Rome, by Dr. Jos. Assemann, assisted by father Benedatti, a Jesuit, and Evodius Assemann, bishop of Apamea; which was begun in 1732, and finished in 1747, in 6 vols. folio, of which three are Syriac and Latin, and the other three Greek and Latin. St. Ephrem died about the year 378, under the reign of the emperor Valens; ordering his funeral to be conducted in a plain manner, and forbidding any eulogium to be delivered on the occasion, or any monument to be erected to his memory. With the acknowledged and applauded learning of Ephrem, a considerable degree of enthusiasm and fanaticism was blended; but his charitable disposition, which he manifested on a variety of occasions, endeared his name to survivors, and entitles him to honourable remembrance. Cave. Du Pin. Lardner. Jortin. Gen. Biog.

EPHREMI Codex, in *Biblical History*, a manuscript of the New Testament, written on vellum, and supposed to be of very high antiquity. It is "Codex Regius 1905," noted in the catalogue of MSS. in the royal library in Paris IX., and in all the four parts of Wetstien's Greek Testament by the letter C. It is particularly described by Griesbach in his "Symbolæ," p. iii.—liv. The first part of it contains several Greek works of Ephrem the Syrian, written over some more ancient writings, which had been erased, though the traces are still visible, and in most places legible. These more ancient writings were the whole Greek Bible. The New Testament has many chasms, which are specified by Wetstein. Besides these chasms, it is in many places illegible. Wetstein contends that this MS. was written before the year 542, though his arguments are not wholly decisive. Its readings, like those of all other very ancient MSS., are in favour of the Latin; but no proof can be given that this has been corrupted from the Latin version. It has been altered by a critical collector, who, according to Griesbach, must have lived many years after the time in which the MS. was written, and has probably erased many of the ancient readings. Kuster was the first who procured extracts from it, and he inserted them in his edition of Mill's Greek Testament. Wetstein has repeatedly collated it with very great accuracy; and the numerous readings, which he has quoted from it, greatly enhance the value of his edition. A fac-simile of the characters of this MS., which is written without accents, is given by Montfaucon in his "Palæographia Græca." It has many marginal notes, written in uncial letters without accents. In this MS. the disputed, or rather spurious verse, John, v. 4, is written, not in the text, but as a marginal scholion. Wetstein supposed, that this was one of the MSS. which were collated at Alexandria in 616 with the new Syriac version; but though this does not appear to have been the case, it is certainly as ancient as the seventh century. Wetstein argues, from a marginal note to Heb. viii. 7, that it was written before the institution of the feast of the purification of the virgin Mary, that is, before the year 542. March's Michaelis, vols. ii. and iii.

EPHREMOF, or Yephremof, in *Geography*, a town and district of Russia, in the government of Tula, situated on the river Metcha, falling into the Don.

EPHRON, in *Ancient Geography*, a place of Palestine, in the tribe of Judah, about 15 miles from Jerusalem, according to Eusebius and Jerome.—Also, a mountain of Palestine, on the confines of the tribes of Judah and Benjamin, according to the book of Joshua.—Also, a large and strong town of Judea, in the half-tribe of Manasseh, on the other side of Jordan, over-against Scythopolis. It was situated near the torrent of Jabok. This town was taken and sacked by Judas Maccabæus, and razed to its foundations.

EPHYDOR, Εφυδωρ, in *Antiquity*, an officer in the Athenian courts of justice, who was to provide the plaintiff and

and defendant with equal water hour-glaffes. When the glafs was run out, they were not permitted to fpeak any farther; and therefore we find them very careful not to lofe or mifpend one drop of their water. Whilft the laws quoted by them were reciting, or if any other bufinefs happened to intervene, they gave order that the glafs fhould be ftopped. Pott. Archæol. Græc. lib. i. cap. 21. lib. i. p. 118.

EPHYRA, in *Ancient Geography*, a town of Greece, in Thefprotia, a province of Epirus; mentioned by Velleius Paterculus and Strabo; the latter of whom fays, that it was afterwards called *Cichyrus*.—Alfo, a town of Greece, in the Pelafgiotide, a country of Theffaly. This town was alfo called *Cranon*. Steph. Byz.—Alfo, a town of the Peloponnefus, in Arcadia. Steph. Byz.—Alfo, a town of the Peloponnefus, in the territory of Elis, fituated on the river Selleis. This place was famous for the deadly poifons which it produced.

EPI, *Gr.* in *Mufic*, a prepofition, which, like *hyper*, fignifies *fupra*, above. We find one of thefe words frequently added to the Greek names of fome of the intervals of mufic; as

$$\text{Epi, or hyper,}\begin{cases}\text{Diapafon,}\\\text{Diapente,}\\\text{Diateffaron,}\\\text{Ditonum, \&c.}\end{cases}$$

When we meet with them thus in conjunction, they imply that the voice, in canons, is to follow the dux, or guide an octave, a fifth, a fourth, &c. below it. The third part is to obferve the fame rule with refpect to the fecond, and the fourth to the third, and fo on, whatever the number of parts may be.

EPIACUM, in *Ancient Geography*, a town of Albion, in the country of the Brigantes, according to Ptolemy. Camden places it at Elchefter, on the river Derwent; Horfley at Hexham, in Northumberland; and Baxter fuppofes it was originally written Pepiacum, and places it at Papcaftle, in Cumberland.

EPIALOS, from ηπιος, *gentle*, and αλς, *fea*, in the *Medical Writings of the Ancients*, the name of a fever, in which the patient labours under a preternatural internal heat, while he at the fame time fhivers with cold. It has by fome been called the fhivering-fever, and the Romans named it quercera. Galen fays, it proceeds from a putrified acrid phlegm. The word is, by fome, alfo applied to any gentle fever, or feverifh complaint; and by others, to the cold or fhivering fit preceding a fever. Hippccrates calls by this name that peculiar fever which attends young women, whofe menfes are ftopped by taking cold, or other accidents.

EPIAULIA, a name which the Greeks gave to the Miller's Song. It is conftantly confirmed, in inquiries after Greek mufic, that every profeffion, trade, and occupation, had its peculiar *nome*, tune, or fong. Rouffeau, fo often fatirical and farcaftic, but who feldom aims at pleafantry, has condefcended to be jocular upon the Greek name for the miller's tune, by afking whether the burlefque word *piauler*, (whimpering, whining,) was not derived from the Greek; as the whimpering, whining, and fqualing of women and brats, who cry and complain a long time in the fame tone, fufficiently refemble the fong or noife of a mill, and, by a metaphor, the miller?

EPIBATÆ, Επιϐαται, among the Greeks, marines or foldiers who ferved on board the fhips of war. They were armed in the fame manner as the land-forces, only that more of them wore full or heavy armour. Pott. Archæol. Grec. tom. ii. p. 140.

EPIBATERION, a poetical compofition, in ufe among the ancient Greeks. When any perfon of condition and quality returned home after a long abfence or journey, into another country, he called together his friends and fellow-citizens, and made them a fpeech, or rehearfed them a copy of verfes, wherein he returned folemn thanks to the immortal gods for his happy return; and ended with an addrefs by way of compliment to his fellow-citizens.

Thefe verfes made what the Greeks call επιβατηριον, *epibaterium*, of επιβαινω, *I go abroad*. At going away they had another, called *apobaterium*.

EPIBATERIUM, in *Botany*, from the Greek adjective επιβατηριος, *climbing*. Forft. Gen. 54. Schreb. 640. Willd. Sp. Pl. v. 4. 397. Juff. 285. Clafs and order, *Monoecia Hexandria*. Nat. Ord. *Menifperma*, Juff.

Gen. Ch. Male, *Cal.* Perianth double, deciduous; outer minute, flat, of fix leaves; inner thrice as large, of three ovate fpreading leaves. *Cor.* Petals fix, fmaller than the inner calyx, roundifh; three of them external, placed between the calyx-leaves; three internal. *Stam.* Filaments fix, capillary, incurved, the length of the petals; anthers roundifh. Female, (on the fame plant,) *Cal.* and *Cor.* as in the male. *Pift.* Germens three, fuperior, nearly globofe; ftyles three, minute, incurved; ftigmas fpreading, compreffed. *Peric.* Drupas three, roundifh, pointed with the permanent ftyles. *Nut* kidney-fhaped, compreffed, flightly furrowed.

Eff. Ch. Male, Calyx double; the outermoft of fix, the inner of three leaves. Petals fix, in two feries. Stamens fix. Female, Calyx and Corolla as in the male. Styles three. Drupas three, globular, pointed. Nuts folitary, kidney-fhaped.

E. *pendulum* is the only fpecies defcribed, a native of the ifland of St. Jago. The *ftem* is fhrubby, climbing, with long pendulous branches. *Leaves* alternate, pointing one way, on fhort foot-ftalks, oblong, entire, obtufe with a point, fmooth and without ribs, about an inch long. *Flowers* minute, pale, on folitary, axillary, fimple ftalks.

EPIBOMEUM, the name of a canticle in the Greek mufic, which was fung before the altar.

EPIC POEM, an heroic poem, or a poem reciting fome great and fignal tranfactions of a hero; called alfo *epopœia*. This kind of poem is univerfally allowed to be, of all poetical productions, the moft dignified, and, at the fame time, the moft difficult in execution. To contrive a ftory which fhall pleafe and intereft all readers, by being at once entertaining, important, and inftructive; to fill it with fuitable incidents; to enliven it with a variety of characters, and of defcriptions; and to maintain, in the courfe of a long work, that propriety of fentiment, and that elevation of ftyle, which the epic character requires, is unqueftionably the higheft effort of poetical genius. Hence it is that fo few have fucceeded in the attempt, and that ftrict critics will hardly allow any other poem to bear the name of epic, except the Iliad and the Æneid.

An epic poem, according to Boffu, is a difcourfe invented with art, to form the manners, by inftructions difguifed under the allegory of an important action related in verfe, in a probable, entertaining, and furprifing manner.

This definition, it has been obferved, would fuit Æfop's fables, if they were extended, and put into verfe. Accordingly the critic draws a parallel between the conftruction of one of Æfop's fables and the plan of Homer's Iliad. The firft thing, he fays, which a writer of fables, or of heroic poems, does, is to choofe fome maxim or point of morality, defigned to be inculcated in the work. He next invents a general ftory, or a feries of facts, without any names, fuch as he conceives moft proper for the illuftration of of his intended moral. Laſtly, he particularizes his ſtory; that is, if he be a fabuliſt, he introduces his dog, his ſheep, and his wolf; and if he be an epic poet, he draws from ancient hiſtory ſome proper names of heroes to be applied to his actors; and thus his plan is completed. This, ſays Dr. Blair, is one of the moſt frigid and abſurd ideas that ever entered into the mind of a critic; nor can any perſon of juſt reflection and taſte ever imagine, that Homer could have proceeded in this manner. No one, indeed, can entertain a doubt that the firſt objects which ſtrike an epic poet are, the hero whom he is to celebrate, and the action, or ſtory, which is to be the ground-work of his poem. "He does not ſit down, like a philoſopher, to form the plan of a treatiſe of morality. His genius is fired by ſome great enterpriſe, which to him appears noble and intereſting; and which, therefore, he pitches upon as worthy of being celebrated in the higheſt ſtrain of poetry. There is no ſubject of this kind, but will always afford ſome general moral inſtruction, ariſing from it naturally. The inſtruction, which Boſſu points out, is certainly ſuggeſted by the Iliad; and there is another which ariſes as naturally, and may juſt as well be aſſigned for the moral of that poem; namely, that Providence avenges thoſe who have ſuffered injuſtice; but that when they allow their reſentment to carry them too far, it brings misfortunes on themſelves. The ſubject of the poem is the wrath of Achilles, cauſed by the injuſtice of Agamemnon. Jupiter avenges Achilles, by giving ſucceſs to the Trojans againſt Agamemnon; but by continuing obſtinate in his reſentment, Achilles loſes his beloved friend Patroclus."

An epic poem is in its nature the recital of ſome illuſtrious enterpriſe in a poetical form. This definition is ſufficiently exact; and hence it appears to comprehend ſeveral other poems beſides the Iliad of Homer, the Æneid of Virgil, and the Jeruſalem of Taſſo; which are, perhaps, the three moſt regular and complete epic works that were ever compoſed. But to exclude all poems from the epic claſs, which are not formed exactly upon the ſame model as theſe, is, ſays Dr. Blair, the pedantry of criticiſm. This writer, therefore, does not ſcruple to claſs ſuch poems, as Milton's Paradiſe Loſt, Lucan's Pharſalia, Statius's Thebaid, Oſſian's Fingal and Temora, Camoen's Luſiad, Voltaire's Henriade, Cambray's Telemachus, Glover's Leonidas, Wilkie's Epigoniad, under the ſame ſpecies of compoſition with the Iliad and Æneid. They are all, undoubtedly, epic; that is, poetical recitals of great adventures, and conſequently belonging to this denomination of poetry.

The epic poem is diſtinguiſhed from comedy, in that the action of the latter is not important, nor is related by the poet, but acted by the perſons introduced for that purpoſe; which circumſtance, likewiſe, diſtinguiſhes it from tragedy. It differs alſo from tragedy in the event, or concluſion; which, in the latter, is generally unfortunate, but ſeldom or ever ſo in the former. See Action.

Nor is it a philoſophical poem, as that of Lucretius, or the Creation of ſir R. Blackmore; nor a treatiſe of agriculture, or the like, as the Georgics of Virgil; thoſe poems not being intended to form the manners: beſide, that the inſtructions they contain are naked, ſimple, and direct, without any diſguiſe or allegory. Which ſecond circumſtance likewiſe diſtinguiſhes it from a treatiſe of morality, written in verſe; or a ſimple hiſtory in verſe: add, that its being confined to one important action, diſtinguiſhes it from a poem which relates all the actions of a perſon's life.

M. de la Motte, indeed, in his controverſy with madam Dacier, on the ſubject of Homer, maintains, that the whole life of a hero may juſtly be made the ſubject of an epic poem: and even that the Lutrin of M. Boileau might paſs for an epic poem; but he ſeemed afterwards to return to the common ſentiment. In effect, the queſtion is not as to the ſenſe which may be annexed to the words epic poem, but the ſenſe which cuſtom has actually annexed to them.

If we had only regard to the etymology of the word epic, of ἐπος, *verſe, poetry*, from ἐπω, *dico, I ſpeak (relate)*, all poems wherein the poet ſpeaks or rehearſes things himſelf, without making the perſons of his poems ſpeak, except at ſecond-hand, as he relates what they ſpoke on this or that occaſion, would be properly epic poems; and ſo there is not an epigram, ſonnet, or madrigal, but would come under that denomination: but this were wild.

In effect, the term epic poem is only attributed to a compoſition whoſe ſubject is great, inſtructive, and ſerious; that only comprehends one ſingle principal event, to which all the reſt refer; which principal action is to be terminated in a certain ſpace of time, ordinarily about a year. It is true, all this is arbitrary; but the ſenſe of all words is ſo too; and in matters of language we muſt be guided by cuſtom.

If M. de la Motte had only pretended, that one might make a fine inſtructive poem on the whole life of a hero, or an agreeable and diverting poem on ſome humorous adventure, all the world would have been on his ſide. But it is enough that cuſtom has not thought good to apply the term epic either to ſubjects of too much extent, and that are crowded with too many incidents no-way connected together; or to burleſque poems, as the Batrachomyomachia of Homer, the Secchia Rapita of Taſſoni, the Défaite de Dulot, the Lutrin of Boileau, the Hudibras of Butler, the Rape of the Lock of Mr. Pope, or the Diſpenſary of Dr. Garth.

Dr. Blair cannot allow with Boſſu and others, that it is the eſſence of an epic poem to be wholly an allegory, or a fable contrived to illuſtrate ſome moral truth; nevertheleſs, he admits, that no poetry is of a more moral nature than this. The effect, however, in promoting virtue is not to be eſtimated by any one maxim or inſtruction, which reſults from the whole ſtory, like the moral of one of Æſop's fables; but from the impreſſion which the parts of the poem ſeparately, as well as the whole taken together, make upon the mind of the reader; from the great examples which it ſets before us, and the high ſentiments with which it warms our hearts. Its propoſed end is to extend our ideas of human perfection, and thus to excite admiration; an end, which can be accompliſhed only by proper repreſentations of heroic deeds and virtuous characters. Epic poems muſt, according to this ſtatement of their object, be favourable to virtue. Moreover, the general ſtrain and ſpirit of epic compoſition ſufficiently mark its diſtinction from the other kinds of poetry. In paſtoral writing, the reigning ideas are innocence and tranquillity; compaſſion is the great object of tragedy; and ridicule the province of comedy. But the predominant character of the epic is admiration excited by heroic actions. It is ſufficiently diſtinguiſhed from hiſtory, both by its poetical form, and the liberty of fiction which it aſſumes. It is a more calm compoſition than tragedy. It admits, nay, requires the pathetic and the violent on particular occaſions; but the pathetic is not its general character. It requires more than any other ſpecies of poetry, a grave, equal, and ſupported dignity. It takes in a greater compaſs of time and action than dramatic writing admits; and thereby allows a more full diſplay of characters. Dramatic writing diſplays characters chiefly by means of ſentiments

ments and passions; epic poetry chiefly by means of actions. The emotions which it excites are, therefore, not so violent, but they are more prolonged. These, says Dr. Blair, are the general characteristics of this species of composition.

The epic poem may be considered under three heads; first, with respect to the subject, or action; secondly, with respect to the actors, or characters; and lastly, with respect to the narration of the poet.

The action must possess the following properties; it must be one, and entire, great, and interesting. (See ACTION and EPISODE. See also ÆNEID, ILIAD, PARADISE LOST, &c.) The actors or personages introduced in an epic poem must be discriminated by appropriate and well-supported characters; which is denominated by Aristotle giving manners to the poem. See CHARACTER, in *Poetry*.

If we examine the characters of Milton, we shall find that he has introduced all the variety which his fable was capable of receiving. The whole species of mankind was restricted to two persons at the time to which the subject of his poem relates. We have, however, four distinct characters in these two persons. We see man and woman in the highest innocence and perfection, and in the most abject state of guilt and infirmity; the two last characters are, indeed, very common and obvious, but the two first are not only more magnificent, but more novel than any characters either in Virgil or Homer, or indeed in the whole circle of nature. Milton was so sensible that the subject of his poem afforded him but few characters, as to be led to introduce two actors of a fictitious nature, in the persons of "Sin" and "Death," by which means he has wrought into the body of his fable a very beautiful and well invented allegory. However, it has been thought, that persons of such a chimerical existence are not proper actors in an epic poem; because there is not that measure of probability annexed to them, which is requisite in writings of this kind.

There is one circumstance, relating to the principal actors of the Iliad and Æneid, that merits particular notice, because it gives a peculiar beauty to these two poems, and was, therefore, contrived with very great judgment. This is the choice for their heroes of persons nearly related to the people for whom they wrote. Achilles was a Greek, and Æneas the remote founder of Rome. Their countrymen were thus rendered particularly attentive to all the parts of their story, and sympathized with their heroes in all their adventures. Milton's poem is also admirable in this respect; since it is impossible for any of its readers, to whatever nation, country, or people he may belong, not to be related to the persons who are the principal actors in it; but what is still infinitely more to its advantage, the principal actors in this poem are not only our progenitors, but our representatives. We have an actual interest in every thing they do, and no less than our utmost happiness is concerned, and lies, as it were, at stake in their whole behaviour.

Besides human actors, there are personages of another kind, that usually occupy no small place in epic poetry; such are the gods, or supernatural beings. This constitutes what is called the machinery of the epic poem; and it is the most nice and difficult part of the subject. About the necessity and use of machinery in an epic composition, critics have been divided. The French critics consider it as essential to the constitution of an epic poem; and they allege that a poem, though it should possess every other requisite, has no pretension to be ranked in the epic class, unless the main action be carried on by the intervention of the gods. This decision seems to be principally, if not solely, founded on a superstitious reverence for the practice of Homer and Virgil. But, although these poets very properly embellished their respective story by the traditionary tales and popular legends of their own country, according to which, all the great transactions of the heroic times were intermixed with the fables of their deities; does it hence follow, that in other countries, and in other ages, which do not possess a similar advantage of current superstition, and popular credulity, epic poetry must be confined to antiquated fictions, and fairy tales? Lucan has composed a very spirited poem, certainly of the epic kind, where neither gods nor supernatural beings are at all employed. The author of Leonidas has also succeeded in an attempt of the same kind; and, without doubt, wherever a poet gives us a regular heroic story, well connected in its parts, adorned with characters, and supported with proper dignity and elevation, though his agents be every one of them human, he has fulfilled the chief requisites of this kind of composition, and has a just title to be classed with epic writers. Dr. Blair, whilst he cannot admit that machinery is indispensibly necessary or essential to the epic plan, differs from those critics of considerable name, who are for wholly excluding it, as inconsistent with that probability and impression of reality, which, as they conceive, should prevail in this kind of writing. (See Elem. of Criticism, ch. 22.) In epic poetry, where admiration and lofty ideas are supposed to reign, the marvellous and supernatural find, if any where, their proper place. They both enable the poet to aggrandize his subject, by means of those august and solemn objects which religion introduces into it; and they allow him to enlarge and diversify his plan, by comprehending within it heaven, and earth, and hell, men and invisible beings, and the whole circle of the universe.

In the use, however, of this supernatural machinery, a poet should be prudent and temperate. The system of the marvellous, which he introduces, should have some foundation in the popular belief, so that events, which are most contrary to the common course of nature, may derive from it an air of probability; and he should guard against excess in the use of it. As to allegorical personages, fame, discord, love, and the like, they form, says Dr. Blair, the worst machinery of any; and though they may serve for embellishment, they should not be permitted to bear any share in the action of the poem.

With regard to the narration in an epic poem, it is not of any great moment, whether the poet relate the whole story in his own character, or introduce some of his personages to relate any part of the action that had passed before the poem opens. Homer follows one method in his Iliad, and the other in his Odyssey. Virgil has, in this respect, imitated the conduct of the Odyssey; Tasso that of the Iliad. Where the subject is of great extent, and comprehends the transactions of several years, as in the Odyssey and the Æneid, the latter method seems preferable. When the subject is of smaller compass, and shorter duration, as in the Iliad and the Jerusalem, the poet may, without disadvantage, relate the whole in his own person. It is of very considerable importance in the course of the narration, that it be perspicuous, animated, and enriched with all the beauties of poetry. No sort of composition requires more strength, dignity, and fire, than the epic poem. "It is the region," says Dr. Blair (Lectures on Rhetoric, &c. vol. iii.) "within which we look for every thing that is sublime in description, tender in sentiment, and bold and lively in expression;" and, therefore, though an author's plan should be faultless, and his story ever so well conducted, yet, if he be feeble, or flat in style, destitute of affecting scenes, and deficient in poetical colouring, he can have no success. The ornaments which epic poetry admits must all

all be of the grave and chaste kind. Nothing that is loose, ludicrous, or affected, finds any place there. All the objects which it presents ought to be either great, or tender, or pleasing. Descriptions of disgusting or shocking objects should as much as possible be avoided; and, therefore, the fable of the Harpies, in the third book of the Æneid, and the allegory of Sin and Death, in the second book of Paradise Lost, had been better omitted in these celebrated poems. Mr. Addison, in his critique on the Paradise Lost (Spectator, vol. iv.), has introduced several pertinent remarks on this subject. The sentiments, which in an epic poem are the thoughts and behaviour ascribed by the author to the persons whom he introduces, should be conformable to the respective characters of these persons, and when this is the case they are said to be *just*. The sentiments have likewise a relation to *things* as well as to *persons*, and they are then perfect, when they are adapted to the subject. If in either of these cases the poet endeavours to argue or explain, to magnify or diminish, to raise love or hatred, pity or terror, or any other passion, we ought to consider whether the sentiments he makes use of are proper to those ends. Homer is censured by the critics for his defect as to this particular in several parts of the Iliad and Odyssey; but candour ascribes this defect to the times in which he lived. Virgil has excelled all others in the propriety of his sentiments. Milton is likewise commended in this respect; and he claims peculiar praise from the consideration, that most of his characters lie out of nature, and were to be formed purely by his own invention. The loves of Dido and Æneas are merely copies of what has passed between other persons. Whereas Adam and Eve, before the fall, are a different species from that of mankind, who are descended from them; and no one but a poet of the most unbounded invention, and the most exquisite judgment, could have introduced into their conversation and behaviour so many apt circumstances during their state of innocence. An epic poem should abound not only with such thoughts as are natural, but also with such as are sublime. In this respect Virgil is inferior to Homer. Indeed, Virgil seldom rises into sentiments that are astonishing, where he is not fired by the Iliad. He every where charms and pleases us by the force of his own genius; but seldom elevates and transports us where he does not deduce his hints from Homer. Milton's chief talent, and distinguishing excellence, lie in the sublimity of his thoughts. In the greatness of his sentiments he triumphs over all the poets both ancient and modern, Homer only excepted. As sentiments that are natural and sublime are always to be pursued in an heroic poem, there are two kinds of thoughts, which should be carefully avoided; the first are such as are affected and unnatural, and the second such as are mean and vulgar. In Virgil we meet with little or nothing that resembles the first kind of thought: none of those trifling points and puerilities that often occur in Ovid, none of the epigrammatic turns of Lucan, none of the swelling sentiments that are so frequent in Statius and Claudian, and none of the mixed embellishments of Tasso. Every thing is just and natural. Milton has sometimes erred in this respect; and it is urged as his apology, that he was infected by the taste and practice of the age in which he lived. Mean and vulgar thoughts have rendered Homer obnoxious to censure; but his advocates have imputed sentiments of this kind to the age in which he wrote, and to that which he described, rather than to any imperfection in that divine poet. No blemish of this kind is observable in Virgil, and Milton is seldom chargeable with it.

We have already observed, that the language of an heroic poem should be both perspicuous and sublime. In proportion as either of these two qualities are wanting, the language is imperfect. See farther of the nature of the epic poem under FABLE. For its matter, see ACTION. For its form, see NARRATION. For its versification, see HEXAMETER. See also MANNERS, CHARACTERS, MACHINE, &c. See also ÆNEID, ILIAD, TASSO's *Jerusalem*, CAMOENS' *Lusiad*, FENELON's *Telemachus*, VOLTAIRE's HENRIADE, and MILTON's PARADISE *Lost*.

EPICAIROS, in *Ancient Geography*, a town of Palestine, E. of Jordan. Ptolemy.

EPICARIA, a town of Illyria, in Dalmatia. Ptol.

EPICAU'MA, (from επι, and καιω, *to burn*). See ENCAUMA.

EPICEDION, Επικηδιον, formed of επι, *upon*, and κηδος, *funeral*, in the *Greek and Latin Poetry*, was a funeral eulogy, or a composition in prose or verse, delivered over the corpse of a friend or neighbour, commemorative of the virtues of the deceased. In celebrating the obsequies of distinguished persons three kinds of funeral discourses were used on the occasion. One, delivered when the friends were assembled to perform the last mournful offices for the dead, was termed *epicedium;* another, at the rogus, bustum, or funeral pile, *nænia;* and that inscribed on the tomb or cenotaph, *epitaphium*. In the early ages of society, the epicedium was generally an extemporaneous effusion of some near relative or affectionate friend, expressive of the sentiments he felt at the loss, and calculated to excite the common sympathy of the surrounding attendants. Beautiful specimens are given of this species of postobituary respect by Virgil in the Æneid: the one (lib. ix.) on the death of Euryalus, and the other (lib. xi.) on the death of Pallas. But in subsequent periods, when wealth and luxury had supplanted the simplicity of nature, and truth of feeling had been obliged by fashion to yield to the flattery of pomp; the custom, though preserved, materially differed in its character and form. What once had been the proper expression of undissembled esteem, was changed into a degrading system of pageantry and venality. In most public funerals, but more especially in those called *vindictivi*, the corpse, previous to interment, was carried into the forum, attended by a vast train of invited or hired followers, when one of the relatives, or some orator of eminence, ascended the rostrum, and harangued the audience in praise of the departed friend or hero. The origin of this custom is attributed to Valerius Publicola, after the expulsion of the regal title. He having honoured the obsequies of his colleague with a funeral oration, so pleased the vanity of the Roman people, that it soon became fashionable to celebrate the funerals of great or distinguished characters with panegyrics, or encomiastic orations. The practice became at length so popular, that the younger Pliny, in his epistle, lib. ii. ep. 1. considers it as the last, but not the least addition to the happiness of a great and good man, to have had the enviable honour of being commended at his funeral by the eloquence of the consul, Tacitus. Nor was this privilege exclusively confined to men; for Livy relates that the Roman matrons, having been extremely liberal and active in raising a collection of gold to enable the government to deliver the city from the hands of the Gauls, were allowed, by an act of the senate, to have the privilege of epicedia being pronounced at the celebration of their obsequies, equally with the other sex. The abuses to which this custom was liable, and to which it actually became in time subservient, are made the subjects of just complaint, and pointed animadversion, both by Cicero and Livy; as tending, by the fulsomeness of flattery, to weaken the motives to virtue, and by the greater attention which those posthumous orators paid to the blandishments of eloquence, than to the accurate statement of facts, to falsify the page, and corrupt the source of history. For on such occasions the orator did not fail to extol the deceased in the most unqualified terms of praise, to emblazon his virtues in the most brilliant colours, and to place to his credit noble actions which he had never achieved. Particularly when the orator entered on an investigation of the lineage of the party, he seldom failed to ally him to some patrician family, or dignify his pedigree, by associating with his name some of the most renowned characters in the commonwealth to illustrate and confirm the descent, so that gradually, by means of these misrepresentations being recorded, the epicedia tended to obliterate the just distinctions of consanguinity, and throw down the barriers of property. From this heathen custom are derived obituary masses, oraisons funebres, and funeral sermons.

EPICERASTICS, Επικεραστικα, formed of επι and κεραννυμι, *I moderate*, in *Medicine*, remedies which, by their temperate moisture, soften the acrimony of a humour, and assuage the painful sensation of a part irritated or afflicted by it; such are the roots of althæa, mallows, liquorice; leaves of lettuce, mallows, water-lily, purslain; the seeds of flax, poppy, &c. See EMOLLIENTS.

EPICHARMUS, in *Biography*, a native of the island of Cos, who flourished in the 5th century, B. C. His father removed him at an early age to Megara, and afterwards to Syracuse, where he became a disciple in the Pythagorean school. Being prevented, by the tyranny of Hiero, from assuming the public profession of philosophy, he chiefly applied himself to the study of dramatic poetry, and offended the Pythagoreans, by introducing the doctrines and precepts of Pythagoras upon the stage. His comedies were numerous, of which Suidas assigns to him 52; but only some few fragments remain. He taught a school at Syracuse, and is said to have invented the two Greek letters θ and χ. He also wrote commentaries upon physical and medical subjects. We have no accurate account of his philosophical tenets: but some of his apophthegms deserve to be recorded; such are the following: "To die is an evil; but to be dead is no evil." "Every man's natural disposition is his good or evil dæmon." "He who is naturally inclined to good is noble, though his mother was an Ethiopian." "Be sober in thought, be slow in belief; these are the sinews of wisdom." "The gods set up their favours at a price, and industry is the purchaser." "Live so as to be prepared either for a long life or a short one." According to Lucian, the life of Epicharmus was prolonged to the age of 97 years. Laert. l. viii. § 78. Suidas. Fabr. Bib. Græc. v. i. p. 676. Brucker's Phil. by Enfield, vol. i.

EPICHIREMA, Επιχειρημα, in *Logic*, an argumentation, consisting of four or more propositions, some of which are proofs of others.

Thus, that oration of Cicero for Milo may be reduced to the epichirema: "Those who way-lay a man to kill him, it is lawful for him to kill, as is allowed by the laws of nature and nations, and by the practice of the best men; but Clodius way-laid Milo with that view, as appears from his forming an ambuscade before his country-house, and from his provision of weapons, soldiers, &c." Therefore it was lawful for Milo to kill Clodius.

EPICHIROTONIA, among the Athenians. It was ordained by Solon, that once every year the laws should be carefully revised and examined; and if any of them were found unsuitable to the present state of affairs, they should be repealed. This was called επιχειροτονια των νομων, from the manner of giving their suffrages, by *holding up their hands*. See a farther account of this custom in Pott. Archæol. Græc. lib. i. cap. 26. tom. i. p. 142.

EPICHORDIS, from χορδη, *an intestine*, in *Anatomy*, a name given by some to the mesentery.

EPICHUS, or TACAPE (*Gabs*), in *Ancient Geography*, a town of Africa, on the coast of the Mediterranean sea, S. of Tephrura. See GABS.

EPICITHARISMA, in the *Ancient Music*, an air for the cithara, said to be played at the end of dramatic pieces; which, consequently, must have been to Greek plays what a terminating ballet is now to an opera.

EPICLEROS, Επικληρος, among the Athenians, a daughter that had no brothers, and therefore inherited her father's whole estate. See EPIDICASIA.

EPICŒNE, Επικοινοι, in *Grammar*, a term applied to nouns, which, under the same gender and termination, mark, indifferently, two kinds of sexes. See GENDER.

Such in Latin, are *aquila*, *vespertilio*, &c. which signify equally a male or a female eagle, or bat.

Grammarians distinguish between epicœne and common. A noun is said to be common of two kinds, when it may be joined either with a masculine or a feminine article; and epicœne, when it is always joined to some one of the two articles, and yet signifies both genders.

EPICOLIC REGION, in *Anatomy*, from επι, *upon*, and κοιλιον, *the colon*, that part of the abdomen which is above the colon.

EPICRANIUS, a thin and broad muscle, covering the superior arched portion of the cranium, and called also fronto-occipitalis, and occipito-frontien; or described as two muscles by the names of frontalis and occipitalis.

If we describe this as a single muscle, which we consider as the most natural and correct method, it will belong to the class of digastric muscles, or of such as possess a middle tendon, with fleshy fibres connected to its two ends. The aponeurosis is a very broad but thin plane, made up of tendinous fibres, variously interwoven, covering the upper part of the cranium, and hence called by Soemmerring galea cranii aponeurotica. It is separated, along the middle, by a narrow interval from the opposite muscle, and it extends externally as far as the semicircular line, to which the temporal fascia is affixed. Its outer surface adheres closely to the scalp, while the inner is much more loosely connected, by a yielding cellular substance free from fat, to the pericranium. Its edges are insensibly continued into the neighbouring cellular substance.

The frontal portion is a thin flattened layer of muscular fibres, commencing by a semilunar edge from the front of the aponeurosis, and descending in a straight course to the eyebrow. Internally it is continuous with the opposite muscle, and detaches a portion of fibres along the side of the nose, to join the compressor narium, and levator labii superioris and alæ nasi. It then terminates by joining the orbicularis palpebrarum, through the whole of its upper convexity, and it is also connected with the corrugator supercilii. The external surface of this muscle is covered by the integuments of the forehead; and its inner surface lies on the frontal bone and os nasi.

The occipital portion is not so broad as the preceding. Arising from the back edge of the aponeurosis, it is inserted into the upper part of the external transverse ridge of the occipital bone. It covers the occipital and a little of the temporal bone, and is covered by the scalp.

It is very obvious that the occipito-frontalis cannot affect the bones of the head; but it moves the integuments in different directions, in consequence of the connection between its

its tendon and the fcalp. When the frontal and occipital portions act alternately, they draw the common tendon backwards and forwards, and thereby impart confiderable motion to the whole hairy fcalp. If they act together, they will render the aponeurofis tenfe. When the frontal acts feparately, it draws up the eyebrow and fkin of the forehead, and throws the latter into tranfverfe wrinkles. Hence it is concerned in the expreffion of the countenance, and acts more efpecially in the gay and joyful emotions, directly antagonifing the corrugator fupercilii, which throws the forehead, and particularly the eyebrows, into longitudinal wrinkles. It contributes alfo, by means of its connection with the upper eyelids, to the opening of the eyelids, when we carry that to as great an extent as poffible. The feparate action of the occipital can only produce a flight effect on the integuments of the back of the head. Its contraction, however, fixes the aponeurofis, and renders it a firm point for the contraction of the frontal in raifing the eyebrow and eyelid. This mufcle, on the whole, is ftrongly analogous to the panniculus carnofus of quadrupeds.

EPICRASIS, in *Medicine*, is a gradual evacuation of ill humours in the blood.

EPICRISIS, Επικρισις, in *Rhetoric*, a clear and brief declaration of the fpeaker's judgment concerning the fubject in hand. Thus, "ego fic ftatuo, in optimo imperatore quatuor has res ineffe oportere, &c." Voff. Rhet. lib. vi. p. 495.

EPICTETI, in *Ancient Geography*, a people, who, according to Strabo, bounded Bithynia on the eaft. Hence the weftern part of Phrygia obtained the appellation of "Phrygia Epictetus." In this territory was the fource of the river Hermus, and the town of Ancyra was fituated in it, on the frontiers of Myfia.

EPICTETUS, in *Biography*, an eminent Stoic philofopher, no lefs diftinguifhed for his virtues than his wifdom, was born in a fervile condition at Hierapolis in Phrygia, and flourifhed in the firft century of the Chriftian era. At an early age he was fold as a flave to Epaphroditus, a celebrated freedman of Nero, to whom Jofephus infcribed moft of his works, and who was afterwards put to death by Domitian. Epictetus was lame; and of this infirmity various caufes have been affigned by different writers. Celfus relates, that when his mafter, in order to torture him, fqueezed his leg very hard, the philofopher betrayed no fymptoms of fear, but faid very calmly to his tormentor; "You will break my leg;" and when it was broken, he only faid with a fmile, "Did I not tell you that you would break it." Some fay, that he was born lame; and others afcribe his lamenefs to the heavy chains with which his mafter loaded him. Epictetus, having, by fome means which are not recorded, obtained his freedom, retired to a fmall hut within the city of Rome, where, in an indigent condition, he devoted himfelf to the ftudy of philofophy. Having in his retirement acquired a competent knowledge of the principles of the Stoic fect, and having alfo received inftructions in rhetoric from Rufus; he became, notwithftanding his poverty, a popular preceptor of morals. He was an acute and judicious obferver of manners; his eloquence was fimple, majeftic, nervous, and penetrating: his doctrine inculcated the pureft morals; and his life was an admirable pattern of fobriety, magnanimity, and the moft rigid virtue. His reprehenfions of vice were bold and animated; his inftructions and precepts impreffive and conciliating; and they were communicated without that dogmatifm, vanity, and rudenefs, which were too generally affected by the philofophers. He was accuftomed to obferve, that the fum of moral inftruction may be comprifed in two words, ανεχε και απεχε, *i. e.* endure and abftain, or bear and forbear. Aulus Gellius reprefents him as the greateft man the fect of the Stoics ever produced. The tyranny of Domitian, notwithftanding his extreme poverty and fingular merit, included him in the number of thofe philofophers who were banifhed from Italy; and to the arbitrary decree of this monfter, he calmly fubmitted, confidering himfelf as a citizen of the world, and fully apprifed, that wherever he went he carried his beft treafure along with him. At Nicopolis in Epirus, which he chofe as the place of his refidence, he purfued his defign of correcting vice and folly by the precepts of philofophy. The wifdom and eloquence of his difcourfes were held in fuch high eftimation, that his hearers were very numerous, and it became a common practice among them to commit his inftructions to writing. It is not certain whether he returned to Rome after the death of Domitian; but the refpect which Adrian entertained for him renders it probable, that he fpent the latter part of his life in that city. Here, however, he obtained no favours, that could induce him to abandon that humble condition of contented and independent poverty, which he had felected, and in which he determined to remain. Of the time and manner of his death we have no certain account. Themiftius and Suidas affert that he lived till the time of the Antonines; but from the mention that is made of him by Aulus Gellius and Marcus Aurelius, it is probable that he died towards the clofe of the reign of Adrian. His name and memory were fo much refpected after his deceafe, that, according to Lucian, the earthen lamp, by which he ufed to ftudy, was fold for 3000 drachmas, or more than 90*l.* of our money. The teftimony of Suidas, who afferts that Epictetus wrote many books, is not fupported by any ancient author; however this be, the only remains of this philofopher are his beautiful moral manual, entitled "Enchiridion," and his "Differtations," felected by Arrian, which were drawn up from notes taken by his difciples from his lips. Arrian's account of his life and death is not now extant. Simplicius has left a commentary upon his doctrine, in the eclectic manner. There are alfo various fragments of his wifdom preferved by Antoninus, Gellius, Stobæus, and others. Although the doctrine of Epictetus is lefs extravagant than that of any other Stoic, his writings every where breathe the true fpirit of Stoicifm. The tenet of the immortality of the foul was adopted and maintained by him with a degree of confiftency fuited to a more rational fyftem than that of the Stoics, who inculcated a renovation of being in the circuit of events, according to the inevitable order of fate; and his exhortations to contentment and fubmiffion to Providence are enforced on much founder principles than thofe of the Stoics. He alfo ftrenuoufly oppofed the opinion held by the Stoics in general, concerning the lawfulnefs of fuicide; and his whole fyftem of practical virtues approaches nearer than that of any other inftructor, unenlightened by revelation, to the purity of Chriftian morality. We have various editions of the remains of this philofopher, publifhed at Leyden in 1670, in 8vo. cum notis variorum; at Utrecht in 1711, in 4to.; at Oxford, in 1740, in 8vo. by Jofeph Simpfon, together with the Table of Cebes, &c.; at London in 1742 by J. Upton, in two volumes 4to. which is the moft valuable of all. The Enchiridion was publifhed by C. G. Heyne, in 1776, in 8vo. and, together with Cebes's table, by Schweighaufer, in 1798, 8vo. Thefe have been tranflated into various languages; but the moft efteemed verfion in our country is that by Mrs. Carter, publifhed in 1758, with notes. Fabr. Bib. Græc. v. iii. Aul. Gell. l. i. c. 2. Arrian, l. i. iii. Lucian in Pereg. t. iv.

t. iv. Adv. Indoct. lib. ement. t. ii. Brucker's Hist. Phil. by Enfield, vol. ii.

EPICUREANS, a sort of ancient philosophers, who adhered to the doctrines and opinions of Epicurus. See EPICURUS.

The doctrines of Epicurus, as they are stated in a just, comprehensive, and elaborate detail by Brucker in his "History of Philosophy," translated and abridged by Dr. Enfield, are arranged under the distinct heads of Philosophy in general, canons or rules of philosophising, Physics, and Ethics. Philosophy is the exercise of reason in the pursuit and attainment of a happy life; whence it follows, that those studies which conduce neither to the acquisition nor the enjoyment of happiness are to be dismissed as of no value. The end of all speculation ought to be, to enable men to judge with certainty what is to be chosen, and what to be avoided, to preserve themselves free from pain, and to secure health of body and tranquillity of mind. Accordingly, the young should apply to the study of it without delay, nor should the old be ever weary in the pursuit of it. As nothing ought to be dearer to a philosopher than truth, he should prosecute it by the most direct means, devising no fictions himself, nor suffering himself to be imposed upon by the fictions of others, neither poets, orators, nor logicians; making no other use of the rules of rhetoric or grammar, than to enable him to speak or write with accuracy and perspicuity, and always preferring a plain and simple to an ornamented style. A wise man will embrace such tenets, and only such, as are built upon experience, or upon certain and indisputable axioms. Philosophy consists of two parts:—physics, which respect the contemplation of nature; and ethics, which are employed in the regulation of manners. Of these, the latter is the most important; the knowledge of nature being only necessary as a means of promoting the happiness of life. Philosophers have added a third part, dialectics; which ought to be rejected, as only productive of thorny disputes, idle quibbles, and fruitless cavilling. In order to facilitate the pursuit of knowledge, a few plain maxims and rules may be useful. Truth is of two kinds; that which respects real existence, and that which consists in a perfect agreement between the conception of the mind and the nature of things. In order to judge rightly concerning truth, it is necessary to use some criterion, or instrument, of judging. This criterion will vary according to the nature of the object which the mind contemplates. In judging of natural and moral objects, the three instruments employed are sense, preconception, and passion. The maxims, or canons, pertaining to sense, are four: First, that the senses can never be deceived, and consequently, that every perception of an image, or appearance, is true; that is, that the perception, or simple apprehension, and its efficient cause, the species or image flowing from the object, really agree. Secondly, opinion, or judgment, is consequent upon perception, and admits of truth or falsehood. Perceptions, or sensations, are the effect of real external *phenomena*; but when the mind judges concerning these appearances, the opinion may be either right or wrong. Thirdly, every opinion is to be admitted as true, which is attested, or not contradicted, by the evidence of the senses, after a careful and deliberate examination of every circumstance which can be supposed to affect the question. Fourthly, an opinion contradicted, or not attested by the evidence of the senses, is false. Thus, the opinion of a *Plenum* must be false, because it contradicts the evidence of the senses, which attest, that there is such a thing as motion. Concerning the second instrument of judgment, *viz.* πρόληψις, or pre-conception, four canons may be laid down. First, that all pre-conceptions are derived from the senses, either by immediate impression, as of an individual man; by enlargement or diminution, as of a giant or dwarf; by resemblance, as of an unknown city to one which has been seen; or by composition, as of a centaur. Secondly, pre-conception is necessary to enable us to reason, inquire, or judge of any thing. Thirdly, pre-conceptions, or universal notions, are the principles of all reasoning and discourse; and we easily refer to these in comparing one thing with another. If these notions be agreeable to nature, and distinctly conceived, artificial reasoning will be unnecessary. Fourthly, truths, not self-evident, are to be deduced from manifest pre-conceptions; or, where the relation of ideas is obscure, it is to be made evident by the intermediate use of some acknowledged principle. The third instrument, passion, or affection, which comprehends pleasure and pain, admits of the following four evident maxims. First, all pleasure, to which no pain is annexed, is for its own sake to be pursued. Secondly, all pain, to which no pleasure is annexed, is for its own sake to be avoided. Thirdly, that pleasure, which either prevents the enjoyment of a greater pleasure, or produces a greater pain, is to be shunned. Fourthly, that pain, which either removes a greater pain, or procures a greater pleasure, is to be endured. As to the use of words, two canons are sufficient. First, in speaking, use terms in common use, and in the sense in which they are commonly understood. Secondly, in hearing, or reading, attend carefully to the signification which the speaker or writer affixes to his terms. Attention to these maxims would prevent much obscurity and confusion, and terminate many disputes. By these rules Epicurus undertook to conduct his followers into the secrets of nature, and to lay open to them the origin of things.

The physical doctrine of Epicurus was as follows: Nothing can ever spring from nothing, nor can any thing ever return to nothing. The universe always existed, and will always remain; for there is nothing into which it can be changed. There is nothing in nature, nor can any thing be conceived, besides body and space. Body is that which possesses the properties of bulk, figure, resistance, and gravity: it is this alone which can touch and be touched. Space, or *vacuum*, destitute of the properties of body, incapable of action or passion, is the region which is or may be occupied by body, and which affords it an opportunity of moving freely. The existence of bodies is attested by the senses. Space must also exist, in order to allow bodies place in which to move and exist; and of their existence and motion we have the certain proof of perception. Besides body and space, no third nature can be conceived. But the existence of qualities is not precluded, because these have no subsistence except in the body to which they belong. The universe, consisting of body and space, is infinite. Bodies are infinite in multitude; space is infinite in magnitude. The universe is immoveable, because there is no place beyond it into which it can move. It is also eternal and immutable, since it is liable to neither increase nor decrease, to production nor decay. Nevertheless, the parts of the universe are in motion, and are subject to change. All bodies consist of parts, which are either themselves simple principles, or may be resolved into such. These first principles, or simple atoms, are divisible by no force, and therefore must be immutable. The existence of such atoms is indisputable, because it is impossible that any thing which exists should be reduced to nothing. A finite body cannot consist of parts infinite either in magnitude or number; and therefore divisibility of bodies *in infinitum* is inconceivable. All atoms are of the same nature,

nature, without any difference in effential qualities; and yet it appears, from their different effects upon the fenfes, that they differ in magnitude, figure, and weight. Atoms exift in every poffible variety of figure; and yet on account of their folidity, they are infrangible, or incapable of actual divifion. Gravity is an effential principle of atoms; for being perpetually in motion, or making an effort to move, they muft be moved by an internal impulfe, which may be called gravity. By this internal force, atoms are carried forward in a direction, which is nearly rectilinear; and whilft they pafs through free fpace, their declination from a right line occafions a cafual concurrence of corpufcles of different forms. Thus various kinds of curvilinear motion will be produced. Moreover, when one atom is reflected from another, and again repelled by a third, it will acquire a kind of vibratory or tremulous motion. Hence an univerfal agitation will enfue. The principle of gravity, being effential to the primary corpufcles or atoms, thefe muft have been inceffantly, and from eternity, in actual motion; and with a velocity, when no obftacle intervenes, which will caufe them to pafs through the greateft imaginable fpace in the fmalleft imaginable portion of time. All atoms are alfo fuppofed, whilft they pafs without refiftance through the fame empty fpace, to move with equal velocity; and though, by collifion, their direction may be changed, their velocity is not diminifhed. Atoms are the elements from which all things are compounded, and into which they are refolved; and the energy, or principle of motion, which effentially belongs to them, is the fole agent in the operations of nature. Action originates in atoms, and from thefe proceeds to compound bodies. All the changes which take place in the figure, and other properties of bodies, confift in local motion. Bodies are more or lefs rare, in proportion to the fize of the vacuities which intercept the folid atoms of which they are compofed. Tranfparency depends partly upon the fame caufe, and partly upon the pofition of the vacuities between the particles: for rays of light will pafs eafily through a denfe body, as glafs, if its vacuities be placed in a ftraight line. Hardnefs and foftnefs, flexibility, ductility, and other qualities, may be explained in a fimilar manner. The weight of a body is the refult of the weight of all its atoms; and fince gravity is an effential property of all atoms, all bodies muft be heavy; and the only reafon why fome bodies appear to have the contrary principle of levity is, that they are driven upwards by the denfer mafs in which they are placed. Heat is the influx of certain fmall, round, foft corpufcles, which infinuate themfelves into the pores of bodies in continual fucceffion, till by their perpetual action, the parts are feparated, and at length the body diffolved. The fenfe of heat is the perception of the feparation of parts, which were before contiguous. Cold is the influx of certain irregular atoms, whofe motion is flower than that of thofe which occafion heat, and their effect the reverfe of the former. Pleafure and pain, motion and reft, and even time, are actions of bodies. Production and diffolution are nothing more than a change of the pofition of atoms, or an increafe or diminution of the particles of which bodies are compofed. The world is finite and terminable, and muft have fome figure, though this cannot poffibly be afcertained. It is not eternal, but began at a certain time to exift; for fince every thing in the world is liable to viciffitudes of production and decay, the world itfelf muft partake of them. This may alfo be inferred from the fhort date of hiftory, and the late invention of arts.

The formation of the world may be conceived to have happened in the following manner: a finite number of that infinite multitude of atoms, which, with infinite fpace, conftitutes the univerfe, falling fortuitoufly into the region of the world, were in confequence of their innate motion collected into one rude and indigefted mafs. In this chaos, the heavieft and largeft atoms, or collections of atoms, firft fubfided, whilft the fmaller, and thofe which from their form would move moft freely, were driven upwards. Thefe latter, after many reverberations, rofe into the outer region of the world, and formed the heavens. Thofe atoms, which by their fize and figure were fuited to form fiery bodies, collected themfelves into ftars: thofe which were not capable of rifing fo high in the fphere of the world, being difturbed by the fiery particles, formed themfelves into air. At length from thofe which fubfided was produced the earth. By the action of air, agitated by heat from the heavenly bodies upon the mixed mafs of the earth, its fmoother and lighter particles were feparated from the reft, and water was produced, which naturally flowed into the loweft places. In the firft combination of atoms, which formed the chaos, various feeds arofe, which, being preferved and nourifhed by moifture and heat, afterwards fprung forth in organized bodies of different kinds. Of the animal productions of the earth, fome may be conceived to have been produced imperfect, and therefore incapable of life, but others would come forth more perfect. Thefe, after the earth was exhaufted of its feminal virtues, would refpectively continue their fpecies. The world, thus formed, would be preferved by the fame mechanical caufes which produced it; but by the inceffant motion of atoms, which alone are folid and incorruptible, it would gradually tend to diffolution. In procefs of time nothing will remain but feparate atoms and infinite fpace. As atoms are infinite, the number of worlds may alfo be infinite. The earth occupies the middle part of the world; but no point within it is properly the centre of gravity, for all heavy bodies fall in nearly parallel lines. The doctrine of Antipodes, according to the Epicurean philofophy, is falfe. The figure of the earth is a circular plane; and it is preferved from falling towards the lower region by the air, with which it is congenial, and upon which therefore it does not prefs; their mutual action deftroying the effect of gravity. Earthquakes are caufed by the agitation of internal winds and water, or by the decay or fudden fall of columns, that fupport portions of the earth's furface. Or, the internal winds may be converted into fires, which may caufe fudden and violent eruptions, as in mount Ætna. Waters paffing out of the fea into the crevices of the earth, undergo a filtration, by which the particles of falt received by them from the bed of the fea are feparated. Foffils and plants are produced by the motion of atoms, that caufe the continual tranfpofition, accretion or diminution of individual bodies. Having no vital principle, they can only be faid analogically to live or die. Animals having been once formed, at the beginning of the world, by the cafual conjunction of fimilar atoms, the production of animal bodies is ftill continued in a confiftent and determinate order. The parts of animals were not originally framed for the ufes to which they are now applied; but, having been accidentally produced, they were afterwards accidentally employed. The eye, for example, was not made for feeing, nor the ear for hearing, but the foul, being formed within the body at the fame time with thefe organs, and connected with them, could not avoid making ufe of them in their refpective functions. The foul is a fubtle corporeal fubftance, compofed of the fineft atoms; which, by the extreme tenuity of its particles, is able to penetrate the whole body, and to adhere to all its parts. It is compofed

of

of four diftinct parts; fire, which caufes animal heat; an ethereal principle, which is moift vapour; air; and a fourth principle, which is the caufe of fenfation. Thefe four parts are fo perfectly combined as to form one fubtle fubftance, which, whilft it remains in the body, is the caufe of all its faculties, motions, and paffions, and which cannot be feparated from it, without producing the entire diffolution of the animal fyftem. Different fenfations are the cafual effects of the different organs, which the foul in its union with the body is capable of employing, and of the different properties and qualities of external objects. Thefe become fenfible by means of certain fpecies, or images, which are perpetually paffing like thin films from bodies, in form fimilar to the furfaces of the bodies themfelves, and ftriking upon organs fitted to receive them. The mind, or intellect, which is endued with the power of thinking, judging, and determining, is formed of particles moft fubtle in their nature, and capable of the moft rapid motion. This intellect is a portion of the foul, forming with it one nature, and yet retaining its diftinct character, which is the power of thinking; the fuppofed feat of it is the middle of the breaft, or the heart, which we perceive to be the region of thofe affections which are excited by cogitation. Thought is produced by fubtle images, which find their way through the body, and, when they arrive at the intellect, move it to think. The affections and paffions of the foul may be reduced to two, pleafure and pain. Voluntary motion is the effect of images conveyed to the mind, by which pleafurable or painful conceptions are formed, and fubfequent defires or averfions are produced, which become the immediate fprings of action. Sleep is produced, when the parts of the foul, which are at other times diffufed through the body, are expreffed or feparated by the action of the air, or of food. Dreams are the effect of images cafually flying about, which from their extreme tenuity penetrate the body and ftrike upon the mind, exciting an imaginary perception of thofe things, of which they are images. Death is the privation of fenfation, in confequence of the fep ration of the foul from the body; in which cafe, the foul is difperfed into the corpufcles or atoms of which it was compofed, and therefore can no longer be capable of thought or perception. The knowledge of things, which belong to the regions above the earth, whether aërial or celeftial, is to be purfued only for freeing the mind from imaginary fears, and fettling it in a ftate of tranquillity. In the heavens, or ethereal regions, the fun, moon, and ftars appear to be fiery bodies; or they may be fmooth mirrors, from which bright fiery particles flowing through the ethereal regions are reflected to the earth; or they may be deep veffels, containing fires; or they may be circular plates heated like mortar, or ftones in a furnace. The apparent motion of the heavenly bodies may arife from the revolution of the whole heaven in which they are fixed, like nails in a folid body: or by the revolution of the bodies themfelves through the heaven as a fluid and permeable medium. The caufe of this motion may be, either an internal neceffity in the natures of the bodies themfelves, or the external preffure of fome ethereal fluid.

In the univerfe there are, according to Epicurus, without contradiction, divine natures: becaufe nature itfelf has impreffed the idea of divinity upon the minds of men. The notion is univerfal, nor is it eftablifhed by cuftom, law, or any human inftitution; but it is the effect of an innate principle, producing univerfal confent, and therefore it muft be true. This univerfal notion has probably arifen from images of the gods, which have cafually made their way into the minds of men in fleep, and have afterwards been recollected. But it is inconfiftent with our natural notions of the gods, as happy and immortal beings, to fuppofe that they encumber themfelves with the management of the world, or are fubject to the cares and paffions which muft attend fo great a charge. Hence it is inferred, that the gods have no intercourfe with mankind, nor any concern with the affairs of the world. Neverthelefs, on account of their excellent nature, they are objects of reverence and worfhip. In their external fhape the gods refemble men; and though the place of their refidence is unknown to mortals, it is without doubt the manfion of perfect purity, tranquillity, and happinefs.

Upon a review of the preceding fummary of the Epicurean fyftem, furnifhed chiefly by Laertius and Lucretius, it muft appear to be a feeble and ineffectual effort to explain the phenomena of nature upon mechanical principles. With this view Epicurus adopts a variety of wild and fanciful hypothefes, which evince his incapacity of folving the grand problem concerning the origin and formation of the world. But the greateft defect of this fyftem is the attempt of its author to account for all the appearances of nature, even thofe which refpect animated and intelligent beings, upon the fimple principles of matter and motion, without introducing the agency of a Supreme Intelligence, or admitting any other idea of fate, than that of blind neceffity inherent in every atom, by which it moves in a certain direction. Hence he leaves unexplained thofe appearances of defign, which are fo manifeft in every part of nature, and abfurdly fuppofes, that the eye was not made for feeing, nor the ear for hearing. Befides the idea which he gives of the nature of the gods, whofe exiftence he admits, as fimilar to man; and of their condition, as wholly feparate from the world, and enjoying no other felicity except that which arifes from inactive tranquillity, falls infinitely fhort of the true conception of Deity, as the intelligent Creator and Governor of the world.

The doctrine of Epicurus concerning nature differs from that of the Stoics, (fee Stoics,) chiefly in the following particulars: while the latter held God to be the foul of the world, diffufed through univerfal nature, the former admitted no primary intelligent nature into his fyftem, but held atoms and fpace to be the firft principles of all things; and whilft the Stoics conceived the active and paffive principles of nature to be connected by the chain of fate, Epicurus afcribed every appearance in nature to a fortuitous collifion and combination of atoms. See Atomical and Corpuscular *Philofophy*.

The ethics of Epicurus are much lefs exceptionable than his phyfics; of which we may judge from the following fummary. The end of living, or the ultimate good, which is to be fought for its own fake, according to the univerfal opinion of mankind, is happinefs: which men generally fail of attaining, becaufe they form wrong notions of the nature of happinefs, or do not ufe proper means for attaining it. The happinefs, which belongs to man, is that ftate in which he enjoys as many of the good things, and fuffers as few of the evils incident to human nature as poffible, paffing his days in a fmooth courfe of permanent tranquillity. Perfect happinefs cannot poffibly be poffeffed without the pleafure that attends freedom from pain, and the enjoyment of the good things of life. Pleafure is in its nature good, and ought to be purfued; and pain is in its nature evil, and fhould be avoided. Befides, pleafure or pain is the meafure of what is good or evil in every object of defire or averfion. However, pleafure ought not in every inftance to be purfued, nor pain to be avoided; but reafon is to diftinguifh and compare the nature and degrees of each, that the refult may be a wife choice of that which fhall appear to be, upon the whole, good. That pleafure is the firft good appears from the inclination which every animal, from its firft birth, difcovers to purfue pleafure and avoid pain; and is confirmed by the univerfal experience of mankind, who are incited to action by no other principle, than the defire of avoiding pain, or obtaining pleafure. Of pleafure there are two kinds; one confifting in a ftate of reft, in which both body and mind are free from pain: the other arifing from an agreeable agitation of the fenfes, producing a correfpondent emotion in the foul. Upon the former of thefe, the enjoyment of life chiefly depends. Happinefs may, therefore, be faid to confift in bodily eafe and mental tranquillity. It is the office of reafon to confine the purfuit of pleafure within the limits of nature, fo as to attain this happy ftate; which neither refembles a rapid torrent, nor a ftanding pool, but is like a gentle ftream, that glides fmoothly and filently along. This happy ftate can only be attained by a prudent care of the body, and a fteady government of the mind. The difeafes of the body are to be prevented by temperance, or cured by medicine, or endured tolerably by patience. Againft the difeafes of the mind philofophy provides fufficient antidotes; the virtues are its inftruments for this purpofe; the radical fpring of which is prudence, or wifdom, and this inftructs men to free their underftandings from the clouds of prejudice; to exercife temperance and fortitude in the government of themfelves: and to practife juftice toward all others. In a happy life, pleafure can never be feparated from virtue. A prudent man will confult his natural difpofition in the choice of his plan of life. Temperance is that difcreet regulation of the defires and paffions, by which we are enabled to enjoy pleafures without fuffering any confequent inconvenience. They who maintain fuch a conftant felf-command, as never to be enticed by the profpect of prefent indulgence to do that which will be productive of evil, obtain the trueft pleafure by declining pleafure. Sobriety, as oppofed to inebriety and gluttony, teaches men that nature is fatisfied with a little, and enables them to be contented with fimple and frugal fare: thus health is preferved; the offices of life are performed with alertnefs and activity; and the occafional varieties of a plentiful board acquire an excellent relifh, and a perfon is prepared to meet every reverfe of fortune without the fear of want. Continence, which is a branch of temperance, prevents the difeafes, infamy, remorfe, and punifhment to which thofe are expofed, who indulge themfelves in unlawful amours. Mufic and poetry, which are often employed as incentives to licentious pleafure, are to be cautioufly and fparingly ufed. Gentlenefs, as oppofed to an irafcible temper, greatly contributes to the tranquillity and happinefs of life, by preferving the mind from perturbation, and arming it againft the affaults of calumny and malice. Moderation in the purfuit of honours or riches, is the only fecurity againft difappointment and vexation. A wife man will, therefore, prefer the fimplicity of ruftic life to the magnificence of courts. As the events of futurity are uncertain, he neither will be elated with confident expectation, nor depreffed by doubt and defpair; the one and the other being equally deftructive of tranquillity. It will contribute to the enjoyment of life, to confider death as the perfect termination of a happy life, which it becomes us to clofe like fatisfied guefts, neither regretting the paft, nor anxious for the future. Fortitude, by enabling us to endure pain and banifh fear, is of great ufe in producing tranquillity. Philofophy inftructs us to pay homage to the gods, not through hope or fear, but from veneration of their fuperior nature. It enables us alfo to conquer the fear of death, by teaching us, that it is no proper object of terror; fince, whilft we are, death is not, and when death arrives, we are not; fo that it concerns neither the living nor the dead. The only evils to be apprehended are bodily pain and diftrefs of mind. It becomes a wife man to endure the former with patience and firmnefs, becaufe, if it be flight it may be eafily borne; and if it be intenfe, it cannot laft long. Mental diftrefs commonly arifes, not from nature, but from opinion; a wife man, will, therefore, arm himfelf againft this kind of fuffering, by reflecting that the gifts of fortune, the lofs of which he may be inclined to deplore, were never his own, but depended upon circumftances which he could not command. If, therefore, they happen to leave him, he will endeavour as foon as poffible to obliterate the remembrance of them, by occupying his mind in pleafant contemplation, and engaging in agreeable avocations. Juftice refpects man as living in fociety, and is the common bond without which no fociety can fubfift. This virtue, like the reft, derives its value from its tendency to promote the happinefs of life. It is the intereft of every individual in a ftate of fociety to conform to the laws of juftice, for in fociety, the neceffity of the exercife of mutual juftice, in order to the common enjoyment of the gifts of nature, is the ground of thofe laws by which it is prefcribed. Nearly allied to juftice are the virtues of beneficence, compaffion, gratitude, piety, and friendfhip. He who confers benefits upon others, procures to himfelf the fatisfaction of feeing the ftream of plenty fpreading around him from the fountain of his own beneficence; at the fame time he enjoys the pleafure of being efteemed by others. The exercife of gratitude, filial affection, and reverence for the gods, is neceffary, in order to avoid the hatred and contempt of all men. Friendfhips are contracted for the fake of mutual benefit; but by degrees they ripen into fuch difinterefted attachment, that they are continued without any profpect of advantage. A true friend will partake of the wants and forrows of his friend, as if they were his own; if he be in want, he will relieve him; if he be in prifon, he will vifit him; if he be fick, he will come to him; nay, fituations may occur, in which he would not fcruple to die for him. It cannot then be doubted, that friendfhip is one of the moft ufeful means of procuring a fecure, tranquil, and happy life.

From the preceding fummary of the ethics of Epicurus, we may be enabled to refute the cenfures which many writers have paffed upon him, as the preceptor of luxurious and licentious pleafures. Thefe cenfures have originated in a mifconception of the nature of that pleafure which he recommends and juftifies, and which, in his fyftem, is only another name for happinefs. Whilft the Stoics taught that virtue itfelf is happinefs, Epicurus maintained, that the motive by which men are induced to practife virtue is the defire of happinefs. Both taught, that it is impoffible to be happy without virtue, and both fuppofed virtue to confift in a conformity to nature. Whatever errors and abfurdities may be juftly charged on the Epicurean fyftem, it muft be allowed that, when candidly and fairly interpreted, it afforded no encouragement to immoral conduct. However, it cannot be denied by its moft zealous advocates, that by the erroneous reprefentations of the gods, and the difbelief of providence and the immortality of the foul, which this fyftem propagated, it ferved very much to relax the obligations and enfeeble the fanctions and motives of virtue. This was actually the cafe both at Athens and at Rome, where thofe who belonged to the fchool of Epicurus, partly diffeminating his genuine doctrine and partly perverting it, difgraced the fyftem to which they adhered by the laxity and diffolutenefs of their manners. Some indeed have expreffed preſſed a doubt, whether Epicurus himſelf diſbelieved the immortality of the ſoul. (See the notes upon "Cudworth's Intellectual ſyſtem of the Univerſe," ſubjoined by Dr. Moſheim to his Latin tranſlation of that learned work, vol. i. p. 66. 500. vol. ii. p. 1174.) His followers, however, ſeem to have been more explicit on this ſubject; and Moſheim aſſerts (Eccl. Hiſt. v. i. p. 167.) that towards the cloſe of the ſecond century of the Chriſtian era, of all the philoſophers, the Epicureans enjoyed the greateſt reputation, and had undoubtedly the greateſt number of followers, becauſe their opinions tended to encourage the indolent ſecurity of a voluptuous and effeminate life, and to baniſh the remorſe and terrors that haunt vice, and naturally incommode the wicked in their ſenſual purſuits. Hence it is certain, that in the common uſe of the appellation, Epicurean has been underſtood to ſignify an indolent, effeminate, and voluptuous perſon, who only conſults his particular and private pleaſure, without concerning himſelf with any thing ſerious. Accordingly it has been maintained, that there were always two kinds of Epicureans, the rigid and the remiſs. The rigid Epicureans were thoſe who were ſtrictly attached to the ſentiments of Epicurus, and who placed their whole happineſs in the true pleaſures of the mind, reſulting from the practice of virtue. The looſe or remiſs Epicureans, taking the words of that philoſopher in a more groſs ſenſe, placed all their happineſs in corporeal gratifications and pleaſures, in eating, drinking, &c. Thoſe of the former claſs, who were the genuine Epicureans, called the others the "Sophiſts of their ſect." In the "Nouveau Dictionaire Hiſtorique" the reader may find a ſhort account of modern Epicurean ſchools in France, the members of which were more diſtinguiſhed by their literary refinement, poliſhed manners, and luxurious indulgence, than their culture of the genuine doctrine of the Greek philoſopher.

Before we cloſe this article, we ſhall briefly trace the ſubſiſtence and progreſs of the Epicurean ſchool, after the death of its founder. From Epicurus the charge of it devolved upon his friend Hermachus; and it was continued in ſucceſſion by Polyſtratus, Baſilides, Protarchus, and others. The ſect ſubſiſted, in a depraved and degraded ſtate, till the decline of the Roman empire. It entered Rome, indeed, in conſequence of the oppoſition excited againſt it by the Stoics in Greece, under a heavy load of obloquy. This was much increaſed by the vehemence with which Cicero, (De Fin. l. ii. Tuſc. Qu. l. 1. 3. Fam. Ep. xiii. 1. Orat. in Piſon. c. 22.) inveighed againſt this ſect, and by the eaſy credit which he gave to the calumnies induſtriouſly circulated againſt its founder. It was, however, patronized by ſeveral perſons of diſtinction in Rome, and particularly by Atticus, the boſom friend of Cicero. Nevertheleſs, the true doctrine of Epicurus was not fully ſtated by any Roman writer, till Lucretius, with much accuracy of conception and clearneſs of method, as well as with great ſtrength and elegance of diction, unfolded the Epicurean ſyſtem in his poem, "De Rerum Naturâ," "On the Nature of Things." The Epicurean ſect, though much degenerated from the ſimple manners of its founder, continued to flouriſh through a long courſe of years under the Roman emperors. This was owing in part to the freedom of manners which it permitted, and in part to the boldneſs with which it combated ſuperſtition; but principally to the ſtrict union which ſubſiſted among the members of this ſchool, and the implicit deference which they unanimouſly agreed to pay to the doctrines of their maſter. The ſucceſſion of diſciples in this ſect was, as Laertius atteſts (l. x. § 9.) uninterrupted, even when other ſchools began to fail. In many places the doctrine of Epicurus was publicly taught, and at Athens the Epicurean ſchool was endowed with a fixed ſtipend. Among the learned men of this period there were ſome, whoſe whole concern was to tranſmit the tenets and maxims of Epicurus uncorrupted to poſterity; and others, who held the memory of Epicurus in high eſtimation, and in many particulars adopted his doctrine, and who, therefore, may not improperly be ranked in the claſs of Epicureans. The principal of theſe are Pliny the elder, Celſus, Lucian, and Diogenes Laertius. After the revival of letters at a much later period, there were not wanting ſeveral learned men, who, finding little ſatisfaction in the obſcure and ſubtle ſpeculations of metaphyſics, had recourſe to the doctrine of Epicurus, as the true key to the myſteries of nature. The firſt reſtorer of the Epicurean ſyſtem among the moderns was Daniel Sennert, an eminent phyſician of Wittemburg, who flouriſhed at the beginning of the 17th century. Sennert, however, confounded the corpuſcles of the more ancient philoſophers with the atoms of Democritus and Epicurus, and held that each element has primary particles peculiar to itſelf. The ſame doctrine was taught, with ſome inconſiderable variations, by Chryſoſtom Magnenus, profeſſor of medicine in the univerſity of Pavia, who, in the year 1646, publiſhed "A treatiſe on the Life and Philoſophy of Democritus." His ſyſtem is rendered obſcure by an attempt to unite the incompatible dogmas of Epicurus and Ariſtotle. The ableſt and moſt ſucceſsful attempt towards the revival of the phyſical and moral philoſophy of Epicurus was made by Peter Gaſſendi, who, beſides a variety of other learned treatiſes, wrote a life of Epicurus, in which he undertakes to reſcue that philoſopher from the load of calumny under which his memory had lain for many ages, as well as to give a fair and impartial repreſentation of his doctrine. The moſt celebrated followers of Gaſſendi were Francis Bernier, a phyſician of Montpelier, who wrote an "Abridgement of Gaſſendi's Philoſophy," Par. 1678, and Walter Charlton, an Engliſhman, who wrote a treatiſe, entitled "Phyſiologia Epicuro-Gaſſendo-Charletoniana," Lond. 1654, in which he attempts to eſtabliſh natural ſcience upon atomic principles. Indeed, the doctrine of atoms and a vacuum has been embraced by the moſt eminent philoſophers. Huygens applies it to explain the cauſe of gravitation, and Newton admits it into his theory of natural philoſophy. (See Atomical *Philoſophy*.) Diogenes Laertius. l. x. Lucretius de Rerum Natura. Stanley's Hiſt. Phil. part. xiii. Gaſſendus de Vita et Moribus Epicuri. Bayle. art. *Epicurus*. Brucker's Hiſt. Phil. by Enfield.

EPICURUS, in *Biography*, the founder of the ſyſtem deſcribed in the preceding article, was an Athenian, of the Ægean tribe, the ſon of Neocles and Chæreſtrata, perſons of honourable deſcent but reduced condition, and born at Gargettus in the vicinity of Athens, at the beginning of the third year of the 109th olympiad, B. C. 342. Neocles, being reduced to poverty, was ſent with a colony of 2000 Athenian citizens to the iſland of Samos, where he occupied a ſmall farm, and took up the profeſſion of a ſchool-maſter; and where his wife Chæreſtrata performed the arts of incantation and luſtration, for the purpoſe of curing diſeaſes and driving away ſpectres, in which, it is ſaid, ſhe was aſſiſted by her ſon, Epicurus, who furniſhed her with luſtral ſongs for her ſolemn rites. Epicurus remained at Samos and in the neighbouring iſland of Teos, till he was 18 years of age, and then removed, with a view to farther advantage for improvement, to Athens. Upon the death of Alexander, he left Athens, and went to his father at Colophon. Soon afterwards he removed to Mitylene, and after paſſing one year in that city, he reſided for 4 years at Lampſacus. In the 36th year of his age, he returned to Athens. From his

his 14th year to this time, he was induftrioufly employed in the ftudy of philofophy. At Samos he was inftructed in the Platonic philofophy by Pamphilus, as Cicero informs us (De Nat. Deor. l. i. c. 26.), and, as we learn from Clement of Alexandria (Strom. l. i.); he attended in his early years upon Naufiphanes a Pythagorean, and Pyrrho the fceptic. During his abode at Athens he could not fail to derive confiderable benefit from Xenocrates, who taught in the Academy, and from Theophraftus, who delivered lectures in the Lyceum. His fyftem of philofophy, however, was the refult of his own reflections, after comparing the doctrines of other fects. About the 32d year of his age, he opened a fchool, firft at Mitylene, and afterwards at Lampfacus; but not fatisfied with thefe obfcure retreats, he determined to make his appearence on the more public theatre of Athens; and purchafed for his own ufe, at the expence of 80 minæ, a pleafant garden, where he taught his fyftem of philofophy. From this circumftance the Epicureans were denominated "the philofophers of the garden." During the fiege of Athens by Demetrius, when Epicurus was 44 years of age, and while the city was diftreffed with famine, he is faid to have fupported himfelf and his friends on a fmall quantity of beans, which he fhared equally with them. The period in which he introduced his philofophy was peculiarly favourable for his purpofe: for in the room of the Socratic philofophy nothing remained but the fubtlety and affectation of Stoicifm, the unnatural feverity of the Cynics; or the doctrine of indulgence taught and practifed by the followers of Ariftippus. The younger citizens were, therefore, difpofed to liften to a preceptor who fmoothed the ftern and wrinkled brow of philofophy, and, under the notion of conducting his followers to enjoyment in the bower of tranquility, led them, unawares, into the paths of moderation and virtue. This circumftance rendered his fchool popular, fo that difciples flocked into the garden, not only from different parts of Greece, but from Egypt and Afia. Seneca, though a Stoic philofopher, bears this teftimony to Epicurus (Ep. 21.): "I the more freely quote the excellent maxims of Epicurus, in order to convince thofe who became his followers from the hope of fcreening their vices, that to whatever fect they attach themfelves, they muft live virtuoufly. Even at the entrance of the garden they will find this infcription: "The hofpitable keeper of this manfion, where you will find pleafure the higheft good, will prefent you liberally with barley cakes, and water from the fpring. Thefe gardens will not provoke your appetite by artificial dainties, but fatisfy it with natural fupplies. Will you not then be well entertained?" The difciples of Epicurus were fo cordially attached to one another, that each individual cheerfully fupplied the neceffities of his brother. The friendfhip fubfifting in the Epicurean fraternity is defcribed by Cicero (De Fin. l. i. c. 20.) as unequalled in the hiftory of mankind; and Valerius Maximus (l. i. c. 8.) relates a memorable example of indiffoluble friendfhip between Polycrates and Hippoclides, two philofophers of the garden. Epicurus, that he might not be interrupted in the profecution of his ftudies, lived in a ftate of celibacy; and he exhibited an example of that temperance and continence, which he inculcated on his difciples. Towards the clofe of his life, however, his conftitution was enfeebled, and he was afflicted with the ftone. When he perceived his end approaching, he wrote a will, in which he bequeathed his garden and its appurtenances to Hermachus, and in fucceffion to the future profeffors of his philofophy. On the laft day of his life, he informs his friend Hermachus, that his pain was extreme: but he adds, "All this is counterbalanced by the fatisfaction of mind, which I derive from the recollection of my difcourfes and difcoveries." He concludes with intreating his friend by the affection which he had always manifefted to him and to philofophy to take care of the children of Metrodorus. The emperor Marcus Antoninus confirms this account, and further fays, that Epicurus, in his ficknefs, relied more upon the recollection of his excellent life, than upon the aid of phyficians, and inftead of complaining of his pain, converfed with his friends upon thofe principles of philofophy which he had before maintained. At length, finding nature juft exhaufted, he ordered himfelf to be put into a warm bath, where, after refrefhing himfelf with wine, and exhorting his friends not to forget his doctrines, he expired. His death happened in the fecond year of the 127th olympiad, or B. C. 271, and in the 72d year of his age. He is faid to have written a greater number of original works than any other Grecian philofopher; but none of them are extant, except a compendium of his doctrine preferved by Laertius, and fome few fragments difperfed among ancient authors. His memory was held in high eftimation, not only by his immediate followers, but by eminent writers, who difapproved his philofophy, but entertained a refpect for his perfonal merit. Neverthelefs his character and his philofophy have been feverely cenfured; and the accufations againft the Epicurean fchool have been more or lefs confirmed by men diftinguifhed for their wifdom and virtue: Zeno, Cicero, Plutarch, Galen, and a long train of Chriftian fathers. But a candid examination of his doctrine and character will obviate many of thofe charges that have been alleged againft them, and prove, that though in fome refpects this philofopher is highly cenfurable, in others he has been unjuftly and too feverely condemned. The charge of impiety admits of no refutation. The doctrine of Epicurus concerning nature not only militated againft the fuperftitions of the Athenians, but againft the agency of a fupreme deity in the formation and government of the world, and he divefted the Deity of fome of his primary attributes. Whilft he profeffed the utmoft contempt for popular fuperftitions, the gods, whofe exiftence he allowed, were deftitute of many effential characters of divinity, and his piety was of a kind very different from that which is infpired by juft notions of Deity. Befides, it has been fuggefted, that his fentiments concerning the gods were adopted and profeffed for the purpofe of avoiding the odium and difgrace which would have attended a direct avowal of atheifm. Epicurus has alfo been charged with infolence and contempt towards other philofophers: but this feems to be fcarcely compatible with the general air of gentlenefs and civility, which appears in his character. The charge of intemperance and incontinence is unqueftionably an atrocious calumny. That he was eminent for the contrary virtues has been amply attefted by Laertius, and alfo by thofe who were adverfe to his doctrine, particularly Cicero, Plutarch, and Seneca. Epicurus has been with equal injuftice reprefented as uninftructed and an enemy to liberal fcience. "We ought to be thankful to nature," fays this philofopher, cited by Stobæus, "for having made thofe things which are neceffary, eafy to be difcovered, and thofe things which are difficult to be known, not neceffary."

The temper and character of Epicurus were altogether the reverfe of thofe of Zeno and the Stoics; his mode of inftruction was very different; and his fchool was eftablifhed in direct oppofition to that of the Stoics; and, therefore, we need not wonder, that he fhould become the object of detraction and calumny. Befides, the defign of his philofophy and its general principles were very different, and they endeavoured to to fecure their own declining popularity by mifreprefenting his principles and character, and holding him up to the public as an advocate for infamous pleafures. For thefe, and fimilar reafons, Epicurus encountered the violent oppofition of the Stoics; and yet he had many friends and followers during his life, and his memory was venerated after his death. His three brothers, Neocles, Chæredamus, and Ariftobulus, devoted themfelves to the ftudy of philofophy, and were fupported by his liberality. Of his intimate friends the moft celebrated were Metrodorus, Polyænus, and Hermachus. After his death his birth-day was celebrated by his followers as a feftival; and they preferved his image in their rings or cups, or in pictures, which they either carried about their perfons, or hung up in their chambers. Their reverence for his authority was fuch, that they committed his maxims, and fome of them the whole body of his inftructions, to memory; and for a long period, it was deemed a kind of impiety to innovate upon his doctrine: fo that the Epicureans formed a philofophical republic, regulated by one judgment, and animated by one foul. Laertius, l. x. Brucker's Hift. Phil. by Enfield, vol. i.

EPICYCLE, formed of the Greek επι, *upon*, and κυκλος, *circle*, q. d. *a circle on a circle*, in the *Ancient Syftem of Aftronomy*, was a fubordinate orbit, or circle, which moved on the circumference of a larger one, which latter was called the *deferent*. By means of this epicycle, one motion, apparently irregular, was refolved into two that were circular and uniform; and when the obferved motion was fo irregular and complicated as not to be reprefented by one epicycle, the method was to add others, till a nearer approximation was obtained. This fyftem owed its origin to a prejudice that feems to have been extremely ancient, in favour of uniform and circular motion; and the problem that chiefly occupied the aftronomers in thofe times, was to affign the proper proportion of the deferent and epicycle which fhould approximate neareft to the actual obfervations.

The reprefentation made by this concentric theory of the folar inequalities in longitude, was as follows:

Let C (*Plate* XII. *Aftronomy*, *fig.* 105.) be the centre both of the earth and of the circle F B D, and let H G K be a fmaller circle, called an epicycle, whofe centre B moves uniformly in the circumference F B D from weft to eaft, or in confequentia, while the fun moves alfo uniformly, and with the fame velocity, in the circumference of the epicycle, in antecedentia in the upper part, but in confequentia in the lower. If the point G of the epicycle, called the apogee, as being moft diftant from the earth, be fuppofed, at the beginning of the anomaliftical revolution, to be placed in the point A of O F produced; and if when it comes to G the arch G H be taken fimilar to F B, the point H will be the place of the fun when the centre of the epicycle has moved from F to B. If then in O F, to which B H is parallel, we take O E = B H, and on E, as a centre, with the diftance E A = C F, defcribe the circle A H P, the fun would be feen from E to move in this circle equably; for the angle A E H is equal to the angle F C B; but feen from C, the centre of the earth, he will appear to move in it inequably, for the angle A C H in the firft femicircle of anomaly, that is, in the paffage of the fun from A to P, is always lefs than A E H or F C B: and his true place H will be lefs advanced in longitude than his mean B. When, again, the centre of the epicycle, or the mean place of the fun, having defcribed a femicircle of the epicycle, will be found in P, the perigée of the orbit A H P, and his mean and true places B and H, will be feen from C to coincide as they did in A, the apogee; but in the fun's paffage from P to A, that is, in the fecond femicircle of anomaly, his true place H, as feen from C, will be always more advanced in longitude than his mean place B; for in this femicircle the angle P C H is always greater than P E H in D C B. The angle E H C, or B C H, which is the difference between the mean and true places of the fun, is called the equation of the orbit, as being that quantity which, added to the true motion A C H of the planet in its orbit A H P, in the firft femicircle of anomaly, and fubtracted from it in the oppofite femircircle, will render it equal to the mean motion A E H or F C B; and it is evident that the equation, or difference, will be greateft in N or M, where the centre B of the epicycle is 90° diftant from either apfis. Any lines drawn from E, the centre of the orbit A H P, to the true place of the fun in H, and from C the centre of the earth, and of the deferent F B D, to the mean place of the fun in B, are equally called the line of the mean motion of the fun, becaufe thefe lines are always parallel, and mark the fame point in the zodiac; and any line drawn from C to the true place of the fun is the line of the fun's true motion.

It was thus that the ancients originally proceeded in their reprefentation of the folar inequalities, and the reprefentation feemed to be fufficiently juftified by obfervation; at leaft till the days of Tycho Brahe no obfervations had been made with fufficient accuracy to fubject it to fufpicion. Their fuccefs alfo, while no lunar inequality, except the fimple anomaliftical one, was difcovered, was equal in the application of the fame concentric theory to the motions of the moon; and having in two cafes thus fuccefsfully, by means of one fubordinate fphere, or epicycle, reconciled apparent inequality of motion with real uniformity, it was natural to fuppofe that other inequalities, though more various and complicated, might be explained in a fimilar manner, and required only the addition of other epicycles. The fame method of procedure, therefore, was continued, and every new inequality which obfervation difcovered was accounted for by a new fphere, or epicycle, producing it, till the whole number employed in the fyftem amounted to 34. Ariftotle, on narrower examination, found thefe infufficient, and added to them 22: but ftill they were deemed infufficient, and the number was at laft increafed to 72; but though it was not till long after the days of Ariftotle that the theory was carried to fuch a degree of extravagance, the multiplication of epicycles rendered it, even in his time, almoft as intricate and complex as the appearances which it was intended to explain. Some examples of this kind occur on the revival of it by Copernicus and Tycho Brahe; and when Hipparchus and Ptolemy introduced eccentric orbits, and by means of them fomewhat diminifhed the multiplicity of the fpheres employed by their predeceffors, they were thought to do a fignal fervice to aftronomy. See EXCENTRIC *Theory*.

What was principally required in thefe theories was to afcertain in the one the ratio of the excentricity; in the other, the ratio of the femi-diameter of the epicycle to the femi-diameter of the deferent. If we make the radius of Jupiter's deferent circle to that of the epicycle as 52 to 10, the epicyclical motion arifing from this conftruction will very nearly agree with obfervation: only we may obferve, that the oppofitions which fucceed each other near the conftellation Virgo, are lefs diftant from one another than thofe obferved in the oppofite part of the heavens; fo that the centre of the epicycle feems to move flower in the firft cafe than in the laft. To reconcile this with the perfect uniformity of the motion of that centre in the circumference of the deferent circle, the ancient aftronomers faid that the earth was not exactly in the centre of the deferent, but fo placed that the equable motion of the centre of the epicycle appeared flower, becaufe it is then more remote, and after various trials they fixed on a degree of excentricity for the deferent, which accorded better than any other with the obfervations, and really differed very little from them. Copernicus fhews that their hypothefis for Jupiter never deviates more than half a degree from obfervation, if it be properly employed. They found that the epicycle moved round the deferent in 4332⅓ days, with an equation gradually increafing to near fix degrees; fo that if the place of the epicycle be calculated for a quarter of a revolution from the apogee, at the mean rate of 5′ a day, it will be found too far advanced by near ten days' motion. See Dr. Small's account of Kepler's difcoveries, where this fubject is treated at great length.

EPICYCLOID, in *Geometry*, denotes a curve generated by the revolution of a point of the periphery of a circle, along the convex or concave part of another circle.

A point of the circumference of a circle, proceeding along a plane in a right line, and at the fame time revolving on its centre, defcribes a cycloid. And if the generating circle, in lieu of moving on a right line, moves along the circumference of another circle, whether equal or unequal, the curve defcribed by any point in its circumference is called an epicycloid. Indeed the common cycloid has been fometimes reprefented as an epicycloid formed by the revolution of a finite circle on an infinite circle.

If the generating circle proceeds along the convexity of the periphery, it is called an upper, or exterior epicycloid; if along the concavity, a lower, or interior epicycloid.

In an epicycloid, the part of the circle the generating point moves along, is called the bafe of the epicycloid: thus in *Plate* V. *Analyfis*, *fig.* 9. D C is the bafe of the epicycloid; V its vertex; V B its axis; D P V half of the exterior epicycloid, made by the revolution of the femicircle V L B (which is called the generant) along the convex fide of the bafe D B; as D P U is the interior epicycloid, formed by the generant's revolving along the concave fide of the bafe.

The length of any part of the curve, which any given point in the revolving circle has defcribed from the time it touched the circle whereon it revolved, is to double the verfed fine of half the arc which all that time touched the quiefcent circle, as the fum of the diameters of the circles to the femidiameter of the quiefcent circle; provided the revolving circle moves upon the convex fide of the quiefcent circle; but if upon the concave fide, as the difference of the diameters to the femidiameter. Otherwife: the circumference of the epicycloid G E F (*fig.* 10.) is to four times the diameter of the generating circle B E, as the fum of the diameters of the two circles is to that of the bafe, in the former of the cafes above mentioned; but in the fecond, *e.g. f e g*, in the fame figure, as the difference, &c. In the firft cafe, if the generating circle be fuppofed to have its diameter equal to half that of the bafe, the epicycloid F H E G is equal to 6 B E. In the fecond cafe, when F I is a quarter of F G, the curve F *e g* will be found equal to 3 F I. When the generating circle is half the bafe-circle, as in *fig.* 11, the epicycloid degenerates into a right line, or the diameter of the bafe. Hence it appears, that in order to deduce the known property of the common cycloid, or that its circumference is equal to four times the diameter of the generating circle, we need only fuppofe the bafe-circle to be infinite; an infinite, augmented or diminifhed by a finite quantity, being always the fame.

Dr. Halley gives us a general propofition for the meafuring of all cycloids and epicycloids: thus, the area of a cycloid, or epicycloid, either primary, or contracted, or prolate, is to the area of the generating circle; and alfo the areas of the parts, generated in thofe curves, to the areas of analogous fegments of the circle; as the fum of double the velocity of the centre, and velocity of the circular motion, to the velocity of the circular motion. The demonftration hereof, fee in Phil. Tranf. N° 218.

The areas of epicycloids may be determined by the following proportion: as the radius of the circle of the bafe to three times that radius together with twice that of the generating circle, fo is the circular fegment *b* H to the epicycloidal fector *b* H F, or the whole generating circle to the whole area of the epicycloid F E G B. As to the tangents, it is known from the time of Des Cartes, that the line H *b*, drawn from any point H, to that of the bafe which touches the circle, whilft this point is defcribed, is perpendicular to the curve, and confequently to the tangent. Maupertuis in difcuffing this fubject, conceived a polygon to revolve upon another, the fides of which are refpectively equal, one of the angles defcribed a curve, the periphery of which is formed of arcs of circles, and the area is compofed of circular fectors and right-lined triangles. He determined the proportion of the area and of the periphery of this figure to thofe of the generating polygon. He moreover fuppofed thefe polygons to become circles, the figure defcribed to become an epicycloid; and the above-mentioned proportion, modified agreeably to this fuppofition, gave him the area and the periphery of the epicycloid. Mem. de l'Acad. 1727.

The invention of epicycloids is afcribed to M. Roemer, the celebrated Danifh aftronomer, during his refidence at Paris, about the year 1674. Thefe curves appeared to him to be fuch as beft fuited the teeth of wheels, conftructed fo as to diminifh their mutual friction, and to render the action of the power more uniform; hence he was led to confider them, and to this purpofe they have been applied. However, M. de la Hire in his "Traité des Epicycloides," printed in 1694, makes no mention of Roemer, and feems to claim the merit of this geometrical and mechanical invention. But M. Leibnitz, who refided at Paris in 1674 and the two following years, fays, that the invention of epicyloids, and their application to mechanics, were the work of this Danifh mathematician, and that he was efteemed the author of it. It does not appear that any writer publifhed an account of epicycloids before the celebrated Newton, who, in the firft book of his "Principia" propofed a general and very fimple method of rectifying thefe curves. After him J. Bernouilli, during his refidence at Paris, fhewed how, by means of the integral and differential calculus, to determine their area, rectification, &c. Many of his "Leçons du calcul integral" are devoted to this object. In 1694, M. de la Hire publifhed his "Traité des Epicycloides;" and in the "Memoires of the Academy for 1706" he communicated to the public an extenfive and elegant treatife on thefe curves.

Spherical epicycloids are formed by a point of the revolving circle, when its plane makes an invariable angle with the plane of the circle on which it revolves. Meffrs. Bernouilli, Maupertuis, Nicole, and Clairaut, have demonftrated feveral properties of thefe epicycloids, in Hift. Acad. Sc. for 1732.

Epicycloids, *Parabolic*, *Elliptic*, &c. If a parabola be made to revolve upon another equal to it, its focus will defcribe a right line perpendicular to the axis of the quiefcent parabola; the vertex of the revolving parabola will alfo defcribe the ciffoid of Diocles; and any other point of it will defcribe fome one of Newton's defective hyperbolas, having a double a double point in the like point of the quiefcent parabola. In like manner, if an ellipfe revolve upon another ellipfe equal and fimilar to it, its focus will defcribe a circle, whofe centre is in the other focus, and confequently, the radius is equal to the axis of the ellipfe; and any other point in the plane of the ellipfe will defcribe a line of the 4th order. The fame may alfo be faid of an hyperbola, revolving upon another, equal and fimilar to it; for one of the foci will defcribe a circle, having its centre in the other focus, and the radius will be the principal axis of the hyperbola; and any other point of the hyperbola will defcribe a line of the 4th order. Concerning thefe lines, fee Newton's Principia, lib. i. De la Hire's Memoires de Mathematique, &c. where he fhews the nature of the epicycloid and its ufe in mechanics. See alfo Maclaurin's Geometria Organica. For the method of forming the epicycloidal teeth of wheels, fee Wheel.

EPICYEMA, from κυω, *I conceive*, a word ufed by Hippocrates to fignify a fœtus, or a falfe conception, or mole coming on after the conception of a former or regular fœtus.

EPIDAMNUS, in *Ancient Geography*, a town of Illyria, upon a fmall promontory between Nymphæum and Petra, built by the Corcyreans. Its name, which the Romans confidered as inaufpicious, was afterwards changed into Dyrrhaicum, now *Durazzo*, which fee.

EPIDAURIA, Επιδαυρια, in *Antiquity*, a feftival celebrated by the Athenians, in honour of Efculapius. See Æsculapius.

EPIDAURUS, in *Ancient Geography*, a town of Greece, in the ancient kingdom of Argos, mentioned by Homer in the enumeration of its fhips, and which he reprefents as fertile in the production of vines. It was fituated on the eaftern coaft of the peninfula of the Argolide, near the Saronic gulf, and oppofite to the ifland of Ægina. This town was celebrated among the ancients for the temple of Æfculapius, fituated about a mile from the river, whither the inhabitants of moft parts of Europe and Afia reforted for the cure of all diftempers. It is pretended that this was the birth-place of Efculapius. (See Æsculapius.) Antoninus Pius, after having been adopted by Adrian, conftructed in this place a temple dedicated to the deities called "Epidotes," and another dedicated to the goddefs of health, to Efculapius, and to Apollo, furnamed the "Egyptian." He moreover built a houfe, for the accommodation of perfons who inhabited the diftrict confecrated to Efculapius, and alfo for lying-in women. He alfo re-eftablifhed the portico of Cotys, which had been demolifhed. The grove of Efculapius near this town was enclofed by two mountains, one called "Titthion," and the other "Cynortion," upon which was conftructed a temple dedicated to Apollo Maleates, and upon its fummit another dedicated to Diana Coryphæa. In a rotundo near this town were preferved fome curious pieces of painting, the performances of Paufias, a famous painter of Sicyone, and contemporary of Apelles. The Epidaurians had a beautiful theatre in the temple of Efculapius, conftructed by Polycletus, who alfo built the rotundo at the entrance of the town. Bacchus and Venus had alfo temples in this town. Epidaurus was alfo famous for its temple of Diana the Huntrefs, and a grove confecrated to her, in which was a ftatue of Epione, fuppofed to be the wife of Efculapius. In this grove was a fuperb fountain, fplendidly ornamented. In the citadel of the town was a very beautiful ftatue of wood, which reprefented Minerva, denominated by the Epidaurians "Ciffea." The temple, dedicated to Juno, was on the fide of the port, on a promontory which commanded a view of the fea. The Dorians, having been driven from this town by Deiphon and the Argians, united with the Ionians and with them inhabited the iflands of Samos and Chios. Epidaurus is now a fmall place, called "Pidavra."

Epidaurus *Limera*, or *Epidaurus Malvafia Vecchia*, *i. e.* the ancient Malvoifia, is a port of Laconia, feated on the gulf of Argos, now "Golfo di Napoli," S. E. of Zarex. It is pretended that this place was founded by a colony of Epidaurians from the Argolide. Having embarked, as it is faid, for the ifland of Cos, they were driven by contrary winds on this coaft of Laconia. They were cautioned in a dream from fettling here; but a ferpent which they brought with them left the fhip and conducted them to the land. This fable was credited in the country, and the worfhip of Efculapius was eftablifhed along this whole coaft. The Epidaurians thus contrived to obtain a confiderable part of the wealth which fuperftition had accumulated in the Epidaurus of the Argolide: and hence the new town acquired the appellation annexed to it. It was denominated *Limera*, *i. e.* famifhed, a name which was not improperly applied to a town, the inhabitants of which contrived to exift at the charge of another. It was built upon an eminence, at the bottom of a fmall gulf; it was well-peopled, and was famous among other things for its excellent wine, called Malvesfy or Malmefy, which grew round the vicinity of it, and with which it fupplied other parts of Greece. The moft remarkable objects of this place in the time of Paufanias were two temples; one of Venus, another of Efculapius, with a ftatue of this god. Its port was honoured with the appellation of the "Port of Jupiter Confervator."

Epidaurus, a town of Illyria, in Dalmatia, according to Ptolemy and Pliny, the latter of whom gives it the title of a colony; in whofe time it was joined to the continent, though, as he fays, it had formerly been an ifland. It is now "Ragufi-Vecchio."

EPIDELICUM, a town of Laconia, on the Argolic gulf, S. E. of Epidaurus.

EPIDELOS, a word ufed by Hippocrates for a youth in the time of his growth, from the age of feven to that of fourteen. The fame author alfo ufes it in a very different fenfe, expreffing by it the obfervable days in a difeafe, fuch as the fourth, eighth, and eleventh, which indicate what fort of crifis is to be reafonably expected on the great critical day.

EPIDEMIA, Επιδημια, in *Antiquity*, feafts of Apollo, at Delphos, and Miletus; and of Diana, at Argos.

Thefe feafts bore the name epidemia (from επι, *in*, and δημΘ-, *people*,) becaufe thefe gods were imagined to be prefent on thofe days among the people. Accordingly, on the laft day of the epidemia they fung an hymn called αποπεμπτικος, to bid them adieu, and fet them forwards on their journey.

As thofe gods could not be every where, and yet were honoured in many different places, there were times allowed them to pafs from one place to another, to receive the vows of their adorers. See Scaliger, Poet. lib. iii. cap. 114.

Epidemia were alfo private feftivals, and times of rejoicing, when a friend or relation had returned from a journey. Pott. Archæol. Græc. lib. ii. cap. 20. tom. i. p. 394.

EPIDEMIC Diseases, from επι, and δημος, *the people*, are thofe difeafes which prevail extenfively, at different times and feafons, among the inhabitants of cities, or countries: when they occafion great mortality among the perfons feized; they are termed *peftilential*.

The diseases, which are liable to occur epidemically, or to attack a great number of individuals about the same time, or in rapid succession, are principally those of the acute or febrile class. Thus the plague, the sweating sickness, the yellow fever, contagious fever, or typhus, intermittent and remittent fevers, scarlet fever, small-pox, measles, dysentery, catarrh, (denominated influenza under such circumstances,) ophthalmia, hooping cough, &c. are the diseases which have at different times spread over extensive districts epidemically, some of them occasioning the most destructive mortality. Of these the influenza, or epidemic catarrh, appears to be the most extensive in the range which it takes, and the most independent of local causes: in some instances, as in the years 1781 and 1782, this disease appears to have originated in China, and thence to have spread through Asia, to Europe, and in the year following to have visited America.

The other fatal epidemics, such as the plague, yellow fever, and small-pox have been in general the calamities more particularly, though not exclusively, connected with large towns, camps, or other congregations of men. Some of these diseases, as the plague and sweating sickness, are scarcely known except as epidemical; and are altogether unknown, but as diseases of a malignant and fatal tendency: but many of the others, as small-pox, measles, scarlet fever, and typhus, are common and familiar appearances, which seldom cease to exist among us; but which, nevertheless, only occasionally assume those fearful and fatal characters, which belong to them as epidemics.

No circumstance, connected with diseases, has been the subject of more general inquiry, among the physicians of all ages, than this variation in their tendency to spread at one time to multitudes of individuals, to put on a malignant character, and to prove generally destructive; whilst at others they exist in milder forms, affecting few, and destroying scarcely any. Yet the most comprehensive views of the concomitant circumstances, in regard to the obvious conditions of the seasons, and of the moral and political state of the districts, where epidemic diseases arise or disappear, continued with the most minute observation during a succession of seasons, have failed to elucidate satisfactorily this interesting topic. Hippocrates, who has noted with accuracy the peculiarities of various years, together with the prevalent species of disease, attributes the variation of the maladies to a divine something, τὸ θεῖον; which some of his commentators consider as signifying merely the atmosphere at large; but others, among whom is Galen, suppose that he intended to express a latent and inscrutable cause in the air, which produced these surprising effects. (See Hippoc. lib. i. de Prognost. Galen in Com,—also, Sennert. lib. iv. cap. ii. de Causis Pestilentiæ.) Galen observes, in his commentary upon this point, "non quæcunque causas habent abditas et obscuras, *divina* vocamus; sed ubi admirabilia videntur duntaxat." The modern Hippocrates, Sydenham, states, that he had observed with the utmost diligence the different peculiarities of different years, as to the obvious changes and conditions of the atmosphere, with a view to ascertain the causes of the great varieties of epidemic disorders; but that he had not made the smallest approximation to such a discovery; on the contrary, that he had remarked, that seasons of the most decided similarity, in respect to the manifest qualities of the air, were infested by diseases altogether dissimilar; and *vice versâ*. "For the *constitutions* of different years are various;" he says, "yet they do not depend upon the degree of heat or cold, of dryness or humidity, which accompanies them; but probably originate from some occult and inexplicable changes, wrought in the bowels of the earth itself, by which the atmosphere is contaminated with certain effluvia, which predispose the bodies of men to one or other form of disease. This predisposition continues during the prevalence of the same constitution, which, in an uncertain period of time, is superseded by another." (Sydenham, sect. i. cap. 2. De Morbis Epidem. See also Van Swieten Comment. ad Aph. 1408.)

From a consideration of the same facts, several writers have attempted to account for these supposed occult changes in the qualities of the atmosphere, which induce epidemic diseases, by tracing them to some of the obvious phenomena of nature, by which such changes may be supposed to be effected. Thus a coincidence has been attempted to be traced between the appearance of comets and of meteors, the occurrence of earthquakes, the eruptions of volcanoes, the conjunction of certain planets, &c.; by all of which it is presumed that some important operations are accomplished in the condition of our atmosphere. Of the effects of planetary influence, indeed, in inducing or diminishing the morbific qualities of the air, nothing is to be found in the writings of the present times: the hypothesis originated and has gone by with the age of astrology. But a very late writer has filled two volumes with evidence, which he believes goes far to prove the existence and operation of some general agent, or *pestilential principle*, throughout the physical world. To this agent he ascribes the origin of earthquakes, and volcanoes, and meteors; and he seems to consider it as the medium by which comets affect the earth, producing tempestuous seasons, great heats, and great colds. (See a brief History of Epidemical and Pestilential Diseases, by Noah Webster, 1800.) This, as a mere hypothesis, would be scarcely less visionary and futile, than the supposition of planetary influence, just noticed. Mr. Webster, therefore, has collected, with great industry, an historical account of the various epidemic and pestilential visitations on record, which have successively occurred to different countries, and has connected with it a chronological view of the appearance of comets, the eruptions of volcanoes, the commotions of the earth, and of the various atmospheric phenomena, which have been described by authors in order to prove their coincidence. "It is certain," we are told, "that comets have a very sensible effect on the weather;" (loc. cit. vol. ii. p. 122.) and Aristotle, Pliny, and Seneca, are quoted to prove that great heat, tides, and winds, are among the general concomitants of comets. "All the comets," Mr. W. affirms, "which have approached this earth, in their passage to and from the sun, especially those which have passed very near us, have been preceded, attended and followed by most extraordinary effects, as great heat and drought in summer, and severe cold in winter; deluging rains, violent tempests, and unusual tides. They occur so uniformly, with the appearance of these bodies, and for some months preceding and following, as to leave no room to question the influence from which they proceed." Ibid. Whatever may occasion extreme variations in the condition of the atmospheric temperature, produce inundations, dearth, &c. will thus remotely, no doubt, induce epidemic diseases, as will be shewn in the sequel. A great number of records are quoted by Mr. Webster, to prove the connection of earthquakes with epidemics (an opinion which many writers have adopted); and also to shew that sensible vapours have issued from the earth, contaminating the atmosphere, about these periods, or sometimes without any earthquakes. From these sensible exhalations an inference is readily drawn of the existence of vapours incognizable by our senses, according to the conjecture of Sydenham. It appears, however, that great pestilence, even when occurring within

within a ſhort period of earthquakes, has generally appeared *before* the earthquakes: nor does it occur in the ſeat of the earthquakes. Thus *after* the plague in London, in 1665, ſhocks are ſaid to have been felt *on the continent*. But Mr. Webſter does not conceive this to be any objection to the hypotheſis. He believes "that peſtilence and earthquakes depend on one common cauſe; which excites into action the internal fires." But he ſuppoſes that "the action or fermentation may precede, for months, and even years, the exploſion in earthquakes and volcanoes; and by means of an inſenſible vapour or heat, or electrical diſcharges, the elements of water and air may be eſſentially affected in ſuch a manner as to impair the principle of animal and vegetable life." P. 137.

This hypotheſis, which was held by the ancients, (as Claudian writes,

"In cœlo nunquam ſpectatum impune cometam,")

has been adopted by Horſtius, Riverius, and echoed by ſeveral other writers on the ſubject of peſtilence; but, like many other ſuppoſitions upon the ſame ſubject, it is altogether gratuitous, and has been received only in the abſence of all poſitive knowledge of the real ſources of peſtilential diſeaſes. The ſame obſervation applies to the ſuppoſed influence of earthquakes, and diſtant volcanic eruptions; more particularly, as the former are allowed to have often followed the effect aſcribed to them, and the countries immediately in the vicinity of volcanoes are admitted to have been not more liable to epidemic diſeaſes than other regions.

Two other points have been generally ſtated as proving the exiſtence of a *peſtilential principle*, which is diffuſed through the atmoſphere at large: one is, that trees and vegetables are affected with mildew, and other diſeaſes; the other, that the animal creation alſo often ſuffers, when peſtilence is committing ravages among mankind. A *rubigo*, or mildew, *i. e.* "a dew impregnated with highly corroſive powers," (ſee Hird on Peſtilence, p. 91.) was anciently deemed one of the cauſes of epidemic diſeaſes. The Romans, appriſed of the pernicious effects of theſe mildews, inſtituted what they denominated *Feſta rubigalia*, and worſhipped an imaginary god, under the name of Robigus. The appropriated ſacrifice was a ſucking whelp; whence Columella,

"Hinc mala rubigo, virides ne torreat herbas,
Sanguine lactentis catuli placatur et extis."

Hoffmann mentions ſuch a dew, "ros valde corroſivus," as having infeſted vegetables in 1693-4, whence the cattle died in multitudes. (Tom. i. de Temp. Ann. Inſalub.) And Ramazzini aſcribes an epidemic to ſimilar dews; at which time the vegetables, corn, and fruit became black, being affected with a "lues rubigalis." (Conſtitut. Epidem.) The ſame year was remarkable for the ſcarcity of honey; and moſt creatures that live upon what they extract from vegetables died, or languiſhed. Probably ſimilar occurrences led many of the ancient writers to mention the ſilence of the graſshopper, and the drooping inactivity of the bee and the ſilk-worm, among the preſages of impending peſtilence. As to the ſpots, which are ſaid to have aſſumed various forms, eſpecially thoſe of *cruciculæ*, or little croſſes, and to have appeared ſuddenly on garments, utenſils, &c. as they are recorded chiefly on the authority of monks, whoſe writings are highly tinged with ſuperſtition, they are ſcarcely worthy of ſerious conſideration.

The exiſtence of epidemic diſeaſe among cattle is neceſſarily much connected with the diſeaſed condition of vegetables; and epidemics among cattle ſeem to have moſt commonly occurred after exceſſive humidity. (Webſter.) The calamity among brutes has ſometimes proved the forerunner of peſtilence among mankind; ſometimes its follower; and at other times, they have raged concomitantly: but, in general, their appearance has been remote and unallied. (Hird, loc. cit.)

It is curious, again, and not eaſily explicable on the principle of a peſtilential effluvium, unfriendly to every form of life, pervading the atmoſphere, that, while vegetables droop and are mildewed, the graſshopper is ſilent, the bee and the ſilk-worm are idle, and cattle die, from its influence, ſwarms of inſects and creatures of other ſpecies are ſaid to be among the precurſors and attendants of peſtilence. It is ſurely an abſurdity to contend for the exiſtence of a poiſonous atmoſphere, deſtructive to the life of both animals and vegetables; and at the ſame time to deſcribe the myriads of noxious inſects, frogs, mice, locuſts, ſnails, ſerpents, and other animals, which appear during an epidemic peſtilence! Is one kind of life poſſeſſed by man and the animals uſeful to him, and another by thoſe which are noxious? This contradiction in the hypotheſis appears to be very general among writers. The author, whom we have already often quoted, obſerves, "one thing is very evident, that what I denominate a *peſtilential principle* does, at certain times, pervade not only the element of air, but the water alſo. The proofs of this are abundantly numerous and convincing. In all the great plagues which have afflicted the human race, other animals, as horſes, cattle, ſheep, ſometimes cats, dogs, and fowls, together with the fiſh in rivers and the ocean, and even vegetables, have borne their ſhare in the calamity. The peſtilential principle has extended to every ſpecies of life. The beaſts of the field periſh with deadly epidemics; the fiſh die on the bottom of rivers and the ſea, or become lean and ſickly; while corn is blaſted on the moſt fertile plains, and the fruits in gardens and orchards wither, or fail to arrive at their uſual ſtate of perfection." (Webſter, Hiſt. of Epidemics, vol. ii. p. 153.) And immediately afterwards (p. 166.) we are called upon to "attend to the effects of a peſtilential" (*i. e.* univerſally deleterious) "ſtate of air, and in the *production* of inſects and ſmall animals. This is one of the moſt remarkable ſymptoms of a *ſickly* ſtate of the elements, &c."

It is only againſt ſuch hypotheſes that we have any objection. The fact, that myriads of inſects have ſometimes been produced, about the time when epidemics prevailed, cannot, we apprehend, be queſtioned; although probably many of the accounts tranſmitted to us on this point are much exaggerated. In ſome inſtances, ſuch a profuſion of inſect life may be a reſult of the ſame cauſe with the epidemic, *viz.* extraordinary heat, or heat and moiſture: in others, it may contribute to produce the epidemic, by deſtroying grain and fruits, the food of man; or graſs and herbs, the food of cattle, fowls, and other animals which conſtitute a part of his ſubſiſtence. It proves nothing in reſpect to any occult quality pervading the atmoſphere.

Beſides, the inſtances of the copious generation of inſects and ſmall animals have not been univerſal, but partial: ſome particular ſpecies have been generated in profuſion; and, therefore, the origin of them muſt be aſcribed to ſome partial, and not to a general cauſe. In the plague of Lauſanne, in 1613, according to Diemerbroeck, flies were produced in an incredible abundance; as well as during or preceding that of Holland, in 1635. The approach of the plague at Dantzick, in 1709, is ſaid to have been announced by an immenſe number of ſpiders in the preceding year. The year 1633, which produced a peſtilential fever among the ſettlers at Plymouth, in America, was remarkable for ſwarms of large flies, which filled the woods with their humming ſounds. (Webſter.) We cannot but conſider, therefore, that the ſtatement above quoted of the univerſal failure of animal and vegetable life, on the one hand, or the general diſpoſition in the air to generate noxious animals, on the other, as equally erroneous, inconſiſtent, and abſurd. How the individual ſpecies of inſect or animal is generated, in ſuch caſes, or what connection the production of them may have with the peſtilence, which ſometimes concurs in point of time, we cannot eaſily aſcertain. But where the means of obſervation fail us, gratuitous hypotheſes add nothing to our knowledge.

There are, however, ſeveral circumſtances which are open to our obſervation, which, if they do not abſolutely produce epidemics of the moſt peſtilential kind, certainly contribute to give them birth, and to aggravate them when produced, and are notoriouſly the ſource of epidemics of a leſs deſtructive ſpecies. Of theſe obvious cauſes of the origin or aggravation of epidemic diſeaſes, ſome contribute directly to excite diſeaſe; others to induce, what is ſcarcely leſs neceſſary to their occurrence, a prediſpoſition to them. In fact, the operation of ſome general agent, inducing a prediſpoſition to be affected by contagion, or other exciting cauſe of diſeaſe, would appear to be the principal ſource of the predominance of ſome epidemics. For if the exciting cauſe never, or ſcarcely ever, ceaſes to exiſt, its occaſional activity in inflicting diſeaſe among multitudes can only be aſcribed to the caſual operation of ſome general prediſpoſing cauſe, which renders them temporarily ſuſceptible of its influence. This is particularly exemplified with reſpect to contagious diſeaſes. The contagion of ſmall-pox, meaſles, and ſcarlet-fever perpetually exiſts among us; yet it is only at particular times that theſe diſeaſes attack ſo many individuals, as to be called epidemic. In crowded towns, like this metropolis, the infection of typhous fever is perpetually generated in the cloſe, dirty, and unwholeſome habitations of the poor: yet there has been no epidemic typhus in London for ſeven years paſt. Nay, even the plague itſelf exiſted year after year in this city, without ſpreading generally. It muſt not be imagined that the diſeaſe was accidentally imported juſt at the periods when it raged ſo extenſively, and with ſo much deſtruction. The principal plague-years of the ſeventeenth century were 1603, 1625, 1636, and 1665; in which the number of deaths from the plague, independent of thoſe from other diſeaſes, are reported in the bills of mortality to have been 36,269, 35,417, 10,400, and 68,596, reſpectively. But ſo far was the diſeaſe from being extinct in the intermediate periods, that from the year 1603, when the regiſter begins, till 1667, the bills of mortality exhibit only three years entirely free from the plague. It is obvious, therefore, that the preſence of infectious matter, or other exciting cauſe, is not alone ſufficient to produce an epidemic diſeaſe. Some concurrent circumſtances are likewiſe neceſſary, to give a prediſpoſition to the human body to be readily acted upon by ſuch cauſe. Now, ſome of theſe circumſtances have been well aſcertained, namely, particular ſeaſons, marſhy and other effluvia, a crowded and filthy population, deficient or depraved aliment, certain paſſions of the mind, exhauſtion of the conſtitution by fatigue, &c. We ſhall illuſtrate the operation of each of theſe prediſpoſing cauſes by a few obſervations.

1. *Seaſons.*—The influence of certain ſeaſons, in favouring the propagation of epidemic diſeaſes, has been obſerved and confirmed by all the medical writers on the ſubject, from the days of Hippocrates downwards, and was noticed by the earlieſt poets, even before the time of that great phyſician; eſpecially the influence of the heats of ſummer and autumn, and of the ſultry ſouth winds, which blow at thoſe ſeaſons. In many paſſages of the Iliad, Homer has alluded to theſe cauſes of peſtilential diſeaſes. Thus, in book v.

> " As vapours blown by Auſter's ſultry breath,
> Pregnant with plagues, and ſhedding ſeeds of death,
> Beneath the rage of burning Syrius riſe." Pope, 1058.

And again in book xxii. 37.

> " Not half ſo dreadful riſes to the ſight,
> Through the thick gloom of ſome tempeſtuous night,
> Orion's dog (the year when autumn ſways),
> And o'er the feebler ſtars exerts his rays:
> Terrific glory! for his burning breath
> Taints the red air with fevers, plagues, and death."

In the firſt book, peſtilence is alſo aſcribed to the anger of Apollo, an allegorical expreſſion for the extreme heat of the ſun. (See Pope's verſion, lines 83, and 87.)

Theſe poetic ſtatements accord moſt accurately with the obſervations of Hippocrates, who frequently mentions epidemic fevers as common in the ſummer and autumn, and as prevailing moſt extenſively when wet ſprings with ſoutherly winds were ſucceeded by hot and cloſe ſummers. A remarkable conſtitution of this kind, which continued for two years, is deſcribed in his treatiſe on Epidemics, (De Morbis Vulgaribus, lib. iii.) at which time ardent remitting and intermitting fevers of a bad kind prevailed, attended with fluxes, parotids, and eruptions of a peſtilential nature. The autumn and ſpring were wet, cloſe, and cloudy, without wind, the breezes from the ſouth; and theſe continued during the hot and ſultry ſummer, when the uſual refreſhing Eteſian winds did not blow.

Exceſſive heat of the ſummer, without moiſture, has occaſionally accompanied an epidemic ſeaſon. Thus in the year of Rome 325, there was a moſt grievous famine, occaſioned by a ſevere drought, in all the Roman territory. " Siccitate eo anno plurimum laboratum eſt; nec cœleſtes modo defuerunt aquæ, ſed terra quoque, ingenito humore egens, vix ad perennes ſubſecit amnes;" the cattle thronged in multitudes round the arid fountains, and periſhed with thirſt, diſeaſes followed among the cattle, from which they were propagated by contagion among men (" vulgatique contactu in homines morbi"), the peaſantry firſt ſuffering, then the lower claſſes, and at length the whole city was infected. (Tit. Liv. lib. iv. 30.) In more modern times, great droughts have been accompanied by epidemic diſeaſes, eſpecially in cities ſituated in low and damp countries. In the autumn of 1652, Bartholine informs us that a malignant fever appeared at Copenhagen, after an unuſually hot and dry ſummer. And a ſimilar fever raged at Leyden in the year 1669, as deſcribed by Silvius de la Boe. The ſpring and beginning of ſummer were cold, but the remainder of ſummer, and the autumn, were unuſually hot, with little or no rain, and with a conſtant calm or ſtagnation of the air. (See Pringle on Dif. of the Army, p. iii. claſs 4.)

But epidemic diſeaſes are ſtill more fatal in thoſe ſeaſons, in the damp countries of the ſouth, where the heats are longer and more intenſe, and much moiſture is combined. In ſome parts of Italy, and in other tracts of the ſame latitude, epidemic fevers have appeared with ſuch alarming ſymptoms, as not only to have been called peſtilential, but confounded with the plague itſelf. In this ſenſe we are to underſtand Celſus, (De Medicina, lib. i. cap. 10. lib. iii. cap. 8.) in the terms *peſtilentia* and *febris peſtilentialis*, which he deſcribes as peculiar to the " grave anni tempus," and the " graves regiones." His meaning is, that this bad fever is the diſeaſe of the latter part of ſummer, and of autumn, when the air is thickeſt and moſt foggy, and that is moſt frequent in low and marſhy countries. Rome was always liable to theſe fevers. Galen calls the *hemitritæa* the epidemic of that city, and ſpeaks of its moiſt air. (De Temperament. lib. ii.)

In fact the chief malignancy of the worſt epidemic diſeaſes, and of the plague itſelf, has always been felt in the ſummer and autumn; as the hiſtories of that diſeaſe in all the large towns in Europe will teſtify. Diemerbroeck has juſtly obſerved, that when the plague has been excited out of its proper ſeaſon, it has not ſpread: and Dr. Ruſſell tells us, that in the winter time, when infected perſons have come to places about Aleppo, ſome of whom have died in the families where they lodged, the diſtemper by ſuch means was not propagated. In the four great plagues of London, during the ſeventeenth century, the mortality invariably increaſed, as the ſeaſon advanced, reaching its acmè in Auguſt and September, and thenceforth gradually declining. (See the Bills of Mortality.—See alſo Dr. Heberden, jun. on the Increaſe and Decreaſe of Diſeaſes, 1801.). Thus in the laſt plague in London, in the year 1665, the mortality of the reſpective months was as follows; in the ſpring very few perſons had died of the plague, in June 590 perſons died of it, in July, 4,129, in Auguſt, 19,046, in September, 26,230, in October, 14,372, in November, 3,349, and in December a few hundreds. (See Plague.) The progreſs, in the other three inſtances, was exactly ſimilar.

Again, the regular decreaſe of peſtilential diſeaſes, with the declining ſummer, equally demonſtrates the neceſſity of the preſence of the hot ſeaſon for their propagation; which may operate either by rendering the contagion more virulent, by producing certain pernicious effluvia from the earth in moiſt places, or by inducing a prediſpoſition in the human body to receive the influence of thoſe exciting cauſes. At Grand Cairo putrid and peſtilential fevers prevailed annually in March, April, and May, which the ſoutherly winds make the hotteſt months in that country; but they ceaſed at the overflowing of the Nile, when the cold winds ſet in. (Proſper. Alpin. de Med. Egypt, lib. i. cap. 14. Mead on the Plague, p. 30.) And "at Smyrna the annual plague conſtantly ceaſes about the 24th of July, by the *dry and cold weather* they always have at that time." (Mead, p. 56.) Indeed, when this change of ſeaſon takes place, while every place abounds, it muſt be preſumed, with the contagion, yet it ceaſes to be detrimental. Proſper Alpinus remarks, that when this change of ſeaſon comes, in the month of June, even the clothes imbued with the moſt peſtiferous contagion then infect no one. "Sed quod valde mirabile creditur, omnia ſupellectilia peſtifero contagio infecta tunc nullum contagii effectum in eam gentem edunt."—And this inertneſs of the contagion in the moſt infected places, on the approach of winter, was moſt remarkable in the laſt plague of London. "Many who made moſt haſte in retiring," ſays Dr. Hodges, "made the moſt to return, and came into the city without fear: inſomuch, that in December they crowded back as thick as they fled: the houſes, which were before full of the dead, were now again inhabited by the living; the ſhops, which had been moſt part of the year ſhut up, were again opened, and the people again cheerfully went about their wonted affairs of trade and employ: and even what is almoſt beyond belief, thoſe citizens, who before were afraid even of their friends and relations, would, without fear, venture into the houſes and rooms where infected perſons had but a little before breathed their laſt: nay, ſuch comforts did inſpire the languiſhing people, and ſuch confidence, that many went into the beds, where perſons had died, before they were even cold, or cleanſed from the ſtench of the diſeaſed." (Loimologia, or Hiſt. Acc. of the Plague in 1665, p. 27.) In the ſame way we read, that when the plague was in Italy, the Neapolitans uſed no artifice to purify either their goods or houſes; yet the diſeaſe ceaſed among them as entirely as in the beſt regulated towns. (Heberden, loc. cit.)

Theſe facts amply prove the extenſive influence of certain ſeaſons, in favouring and interrupting the progreſs of the moſt peſtilential epidemics; and that not in conſequence of any occult, but of certain ſenſible and obvious conditions of the weather. The ſame circumſtances of the ſeaſons modify the propagation and diminution of the minor epidemics, ſuch as dyſentery, remittent and intermittent fevers, &c. and even the ſmall-pox. Of the former of theſe, we ſhall more properly ſpeak under the ſecond head of cauſes; namely,

2. *Marſhy and other Effluvia.*—Galen aſſigns two cauſes for peſtilential fevers; the firſt of which is great heat of the weather, and the ſecond, which he conſiders as moſt frequent, a corrupted ſtate of the air, ariſing either from a multitude of dead bodies left unburnt, as after a battle, or from the evaporation of corrupted lakes and marſhes. (De Febr. Diff. lib. i. cap. 4.) Other authors of antiquity have noticed the coincidence of epidemic fevers with marſhy ſituations. Thus Diodorus, the hiſtorian, has recorded the occurrence of a peſtilential diſeaſe among the Carthaginians at the ſiege of Syracuſe, which he attributes to the combination of the following circumſtances; the multitude of people confined within a narrow compaſs, the ſituation of the camp in a low and wet ground, and the ſcorching heats in the middle of the day, ſucceeded by cold and damp air from the marſhes in the night. (Bibl. Hiſt. lib. xiv. cap. 70.) In more modern times the origin of epidemic diſeaſes from marſh effluvia had been very generally obſerved. Fracaſtorius aſcribes a malignant epidemic fever, in Italy, in the ſixteenth century, to an extraordinary inundation of the Po, which, happening in the ſpring, left marſhes, and thoſe corrupting infected the air through the ſummer. Foreſtus remarks, that, from the putrefaction of the water only, the city of Delft, where he practiſed, was ſcarcely ten years free from the plague or ſome peſtilential diſtemper. (Obſervat. lib. vi.)

The effects of marſh or putrid effluvia in giving riſe to epidemic diſeaſes have, indeed, been evinced in moſt of the large cities, and ſtill more obviouſly in the camps of modern times. Sir John Pringle, ſpeaking of the hot weather, during one of the campaigns in the Netherlands, in 1748, obſerves, that though the heats were great, yet they were the cauſe of little ſickneſs, till the troops were cantoned in the marſhes, where a conſiderable degree of putrefaction and moiſture being joined, ardent, remitting, and intermitting fevers, and fluxes became general. It is remarkable that theſe pernicious exhalations do not riſe high, nor ſpread far from their ſource, at leaſt without ſuch dilution as diminiſhes their deleterious qualities. Dr. J. Hunter has affirmed, that in the barracks at Spaniſh Town, in Jamaica, (which conſiſted of two floors, the firſt upon the ground, the ſecond over the firſt,) the difference in health of the men on the two floors was ſo great as to engage the attention of the aſſembly of the iſland, and upon inveſtigation it appeared that three were taken ill on the ground floor for one on the other. Even at a few hundred feet above the level of the marſhes, the ſituations are extremely healthy. (Obſerv. on the Dif. of the Army in Jamaica, note B. p. 268, 3d edit.) The air of a marſh or of a foul camp, the ſame author obſerves, may deſtroy an army almoſt as ſoon as the true plague. But the remedies in fuch cafes are obvious, and confift in getting at a proper diftance from the noxious exhalations, or removing the caufes of them. "A very fmall fpace frequently includes the limits of healthy and unhealthy ground." It is not now neceffary to ftate that agues, or intermittents, originate folely from the effluvia of marfhes.

Another fpecies of effluvia, which is the fource of epidemic difeafes in camps and in towns, when ill conftructed and neglected, arifes from ground contaminated with human and other excrements, the remains of victuals, the water ufed in cookery, for wafhing, the foul ftraw rotting in tents, &c. Whenever a camp remains long on the fame ground, efpecially in hot and moift weather, fluxes, and intermitting and remitting fevers, feldom fail to become epidemic, unlefs great precautions are ufed to bury all excrementitious matter, and proper receptacles and drains under ground are prepared for the urine, water of cookery, &c. (See Dr. Hunter, loc. cit. p. 285.) In this cafe, however, as in that of marfh effluvia, the difeafes produced will difappear, by moving the camp a few hundred yards from the foul ground.

Thefe facts throw great light on the epidemics of large cities, which were formerly fo frequent and fatal. A large town may be confidered as an extenfive camp, but deftitute of the means of changing its fituation, and, confequently, liable to be infefted with the fame difeafes as are endemic and epidemic in camps, unlefs the precautions juft alluded to, for the purpofe of removing the fources of the peftilential effluvia, be fully adopted. And we find, accordingly, that during and previous to the 17th century, (and even later, in fome countries,) the large towns were almoft conftantly infefted, in the fummer and autumnal months, with the plague, malignant, intermittent, and remittent fevers, and dyfentery; the fame diforders to which camps are liable. This was the condition of London during the period fpecified. We have already remarked, that the plague was feldom abfent from the beginning of the 17th century to the year 1669, and that four dreadful vifitations of that calamity occurred within the fame fpace of time. Of the extent to which intermittent and remittent fevers prevailed, in this metropolis, we have alfo ample evidence. Dr. Short remarks, that early in the century, *viz.* between 1629 and 1636, "one of 40 of the whole that died of fevers, died of agues;" whereas, "now (1750) fcarce *one* of 1100 that die of fevers die of this difeafe." (New Obf. Nat. Moral, &c. on Bills of Mortality, 1750, p. 208.) Burnet, in his "Hiftory of the Reformation," fays, that in the laft year of queen Mary's reign "intermitting fevers were fo univerfal and contagious, that they raged like a plague." Both Sydenham and Morton have left us abundant evidence of the frequent epidemic prevalence of agues, as well as of remitting fevers, which laft Morton affirms to have been extremely deftructive for feveral years before the great plague, *viz.* from the year 1658 to 1664. He ftates that Oliver Cromwell died of this fever in 1658; and that his own father, himfelf an experienced phyfician, alfo died of it; when his whole family, the writer included, were infected. (Morton, Pyretologia, App. ad Exercit. ii.) Even fo late as from 1720 to 1729, according to Dr. Short, "they (intermittents) and remittents afflicted the whole nation grievoufly."

Sometimes together, and fometimes alternating with thofe autumnal fevers, the dyfentery was a frequent epidemic in London, in the times to which we allude, and was often attended with great fatality. For five and twenty years fucceffively, from 1667 to 1692, the bills of mortality fhew the fum of deaths under the titles of "bloody flux," and "griping in the guts," which muft both be confidered as dyfentery, to have amounted every year to above 2000. During the laft century, the difeafe has gradually declined, (Dr. Heberden on Increafe and Decreafe of Diff. Difeafes, p. 34.) and the other fatal epidemics, juft mentioned, have quite difappeared. See Annual Medical Regifter for 1808, vol. i. where the changes of difeafe in London are difcuffed at length.

We cannot doubt, that the prefent comparative healthinefs, and efpecially the great freedom from all epidemics (the contagions of fmall-pox, fcarlet fever, and meafles excepted) which this metropolis now enjoys, is to be afcribed altogether to the meafures, by which the fources of the effluvia, which excite them, have been removed, and to the general habits of cleanlinefs and ventilation which are at prefent obferved by the people. Thefe falutary meafures are principally the conftruction of privies, drains, and common fewers; a hard and regular pavement, with a proper level for carrying off the humidity, and well cleanfed by fcavengers; an abundant fupply of water to every part of the town, &c.

In all thefe points, the condition of London, like that of moft other large cities in Europe, during the 17th century, was extremely defective. In the preceding centuries its condition muft have been ftill more incommodious and filthy, fo that few years elapfed without the occurrence of a confiderable peftilence. We have not room, in this place, to enter more at large into a defcription of its circumftances; but muft content ourfelves with referring to the work of Dr. Heberden, jun. juft quoted, where an abundant collection of evidence, as to the connection of thofe epidemics with filth and negligence in the economy of this and of other large towns, will be found. (See alfo the Ann. Med. Regifter for 1808. Maitland's and Nourthouck's Hiftory of London.) See Plague.

It is extremely gratifying, both in a phyfical and moral point of view, to obferve that the fame means which contribute to our perfonal comforts, and to elevate us above the favage, *viz.* the progrefs of civilization and refinement, have led to banifh the moft loathfome and fatal diftempers, to prolong life, and to diminifh the prevalence and fatality of other difeafes of lefs fatality. "While the metropolis has extended itfelf in all directions, and multiplied its inhabitants to an enormous amount, *i.e.* while the apparent caufes of its unhealthinefs have been augmented, it has actually become more favourable to health. In the year 1697, for example, the total mortality of London was 20,970; whereas, the total mortality of 1797 amounted only to 17,014: and when we take into confideration the great increafe of the population of the out-parifhes at the latter period, the *comparative* healthinefs of London will appear in very ftrong colours." Ann. Med. Regifter, p. 321.

Sometimes the air of a particular diftrict feems to have been impregnated with effluvia from putrefying animal and vegetable matter, which has occafioned an epidemic in that neighbourhood. Foreftus has mentioned the putrefaction of a large fifh, of the whale kind, which was left by the tide, and died, on the coaft of Holland, and, during its putrefaction, infected the country with a horrid ftench, in confequence of which a fatal epidemic fever broke out in the diftrict of Egmont. (Obf. lib. vi. 9. tom. i.) The fame author informs us of a peftilential fever, which raged at Venice in his time, and was produced by the corruption of a fmall kind of fifh in that part of the Adriatic. (Ibid.) Inftances are alfo on record of epidemic fevers occafioned by the effluvia of putrid cabbages, as well as of plants

plants in marſhes. (Rogers on Epidem. p. 41.) Theſe ſources of epidemics, however, are rare, and can ſeldom occur under a well regulated police.

3. *A crowded Population.*—From the earlieſt periods of time, of which we have any record, peſtilential diſeaſes were known to be the effect of crowded population, and to rage peculiarly in cities, forts, and other confined places. In the ſacred writings peſtilence is every where mentioned as the peculiar ſcourge of *cities*. "The ſword is *without*," ſays the prophet Ezekiel, chap. vii., "and the peſtilence and famine *within*; he that is in the field ſhall die with the ſword; and he that is in the *city*, famine and peſtilence ſhall devour him." And again, chap. xxxiii., it is ſaid, "they that be in the *forts* and the caves ſhall die of the peſtilence." The city of Rome was ſubject to the moſt fatal epidemics from a very early period of its hiſtory: Athens ſuffered alſo extremely; and in modern Europe the great cities have been the common ſeats of plagues, from Conſtantinople to Moſcow, and from Cadiz and Marſeilles, to Copenhagen and Dantzic. (See an enumeration of the cities infected with the plague, and the dates of its occurrence, by Dr. Heberden, *loc. cit.* p. 81, *et ſeq.*) The ſame obſervation applies to the cities of Aſia and Africa; to Aleppo, Cairo, &c. &c., as well as to thoſe of America.

We have already ſtated, that the prevalence of epidemic and peſtilential diſeaſes in this metropolis was obviouſly connected with the exiſtence of filth of every ſpecies, and that their gradual diſappearance has been coeval with the improvements of the city, and the removal of theſe nuiſances. The ſame fact is obſervable in all the cities of Europe: and thoſe which, from natural or political cauſes, have been backward in adopting the improvements of modern times, have more lately exhibited the ſame effects of their negligence. The plague appeared at Copenhagen in 1764; and at Moſcow ſo late as the year 1771. It is farther obſervable, that peſtilential diſeaſes generally appear firſt in the moſt crowded and uncleanly parts of towns, and rage moſt ſeverely in the moſt crowded and dirty habitations, *i. e.* among the poor. The plague of 1665, in London, is ſaid to have been by many perſons called "the poor's plague." Thoſe of 1626 and 1636 broke out at Whitechapel, a part of the town which abounded with poor, and with ſlaughter-houſes: and that of 1665 is ſaid to have broke out firſt at St. Giles's; and there, Dr. Heberden remarks, it would probably break out again, if ever we ſhould ſuffer ſuch another calamity.

For it muſt be obſerved, that a crowded and uncleanly population contributes, in a double manner, to the origin and propagation of epidemic and peſtilential diſeaſes. It not only occaſions the accumulation of every ſpecies of filth externally, from which effluvia ariſe to contaminate the atmoſphere, in hot and moiſt ſeaſons, thus producing all the diſeaſes of camps; but it produces another ſpecies of effluvia, internally, in the habitations of men; *viz.* from the bodies of the ſick, and even of the healthy, which at once generate malignant fevers, and aggravate thoſe which ariſe from the other ſources. (See CONTAGION.) So that under the circumſtance of the combination of theſe cauſes, namely, when the heat and moiſture of autumn generate the effluvia from external filth, and contagion is ſuperadded from the accumulation of the corporeal effluvia, from the want of internal cleanlineſs and ventilation, diſeaſes of an epidemic nature are readily excited, and are propagated extenſively and fatally. Hence, before the value of theſe internal cautions was underſtood, malignant fevers ſo frequently occurred in hoſpitals and gaols, that they obtained the appellation of hoſpital-fever and gaol-fever. Indeed we are told that, ſo late as the latter end of the 17th century, in the gaol of Newgate, a contagious fever uſed to break out annually, in hot weather; and that the ſame was true of moſt gaols in Europe; (The City Rembrancer, quoted by Dr. Heberden) and ſeveral facts on record, prove, how readily any acute diſeaſe is thus propagated by contagion, under theſe circumſtances of crowded and filthy habitations; although originally, and in cleanly and airy apartments, it was incapable of ſpreading from one individual to another. Thus ſir John Pringle obſerved, that, "in autumn 1757, ſeveral ſoldiers were brought into the hoſpital at Portſmouth, with a diſorder compounded of the autumnal and gaol-fever; for when theſe men, upon being ſeized with the common fever of the ſeaſon, were confined to the holds of the crowded tranſports, their diſtemper aſſumed that form. (Diſ. of the Army.) So Dr. Lind has ſtated, that, upon admitting into an hoſpital one perſon with a flux, ſeveral other patients in the ſame ward have had this ſymptom added to their other complaints. (Lind on Fever and Infection.) And Dr. Blane has obſerved generally, that, ſuppoſing a ſhip's company be prediſpoſed to acute diſtempers, and one man or more ill of a dyſentery be brought on board, this will become the prevailing diſeaſe. (On the Diſeaſes of Seamen.)

Theſe facts, which evince the facility with which any acute diſeaſe, or its leading ſymptom, is communicated from individual to individual, in a cloſe and crowded apartment, when extreme cleanlineſs and ventilation are not attended to, will ſerve to explain ſeveral apparent anomalies in the hiſtory of ſeveral diſeaſes, which have been ſtated as the reſult of ſome myſterious epidemic principle in the atmoſphere. We allude to the occaſional ſpreading of particular maladies in hoſpitals, in a ſort of epidemic way; ſuch as the appearance of eryſipelas, connected with all ſlight injuries of the ſcalp, or other ſuperficial parts, as related by ſir William Blizard, of the London hoſpital, and as occurred in the ſurgical ward of the Royal Infirmary at Edinburgh, many years ago; the diſpoſition to inflammation and abſceſs about the perineum and neighbouring parts, mentioned by the ſame writer, &c. (See a Paper "On ſome epidemical Effects," Med. Facts and Obſ. vol. ii. 1792.) Such occurrences, we believe, are rare in proportion to the degree of cleanlineſs in thoſe receptacles of the ſick. We have been aſſured that the occurrences of this nature at Edinburgh have ceaſed, ſince a more rigid ventilation and purification have been adopted in the Royal Infirmary.

4. *Deficient and Depraved Aliment.*—The obvious cauſes of epidemic diſeaſes, already mentioned, may operate both as exciting and as prediſpoſing cauſes; but that to which we now direct our attention, perhaps, chiefly acts in inducing a debilitated and half-morbid condition of the body, which renders it liable to be affected by thoſe exciting cauſes. Certain it is that famine and peſtilence have been obſerved to go together, ſince the earlieſt ages of the world; and are conſtantly mentioned in combination, in the ſacred writings; to which war is frequently added. Dearth is almoſt neceſſarily a part of the deſolation of war; which, therefore, contributes to the production of peſtilence indirectly by producing dearth. Ὁ λοιμὸς μετὰ λιμὸν, "the plague after famine," was an old Greek adage. Where articles of food are extremely ſcarce, they are often alſo corrupted, and may thus contribute to reduce the human conſtitution to a ſtate prediſpoſed to diſeaſe. Foreſtus imputes the plague at Delft, in the year 1557, to the eating of mouldy grain, which had been long kept up by the merchants in a time of ſcarcity. (*Loc. cit.*) And ſir J. Pringle ſays, he had heard it obſerved, that in this iſland the dyſentery is frequent among the common people, in thoſe parts where they live

live moftly on grain, when the preceding crop has been damaged in a rainy feafon, or kept in damp granaries. (*Loc. cit.* cap. vii. p. iii.) In ancient times the corruption, as well as fcarcity of food, was affigned as the caufe of peftilence; as by Cæfar himfelf when befieging Marfeilles, (De Bello Civili, lib. ii. 20.) "Panico enim vetere, atque hordeo corrupto, omnes (*fcil.* Maffilienfes) alebantur; quod ad hujufmodi cafus antiquitus paratum, in publicum contulerant." When we advert to the fatal epidemic difeafe, termed Feu facrè, Mal des ardens, &c. by the French, and known to originate from *ergoted* rye, ufed as food, we fhall not hefitate to afcribe confiderable effects to the fort of food juft mentioned. (See Philof. Tranfact. vol. lv. p. 110, and Mem. de la Soc. Royale de Medecine, for 1776.) Dr. Willan has obferved, that the Morbus Hungaricus, defcribed by Sennertus, "and fome other difeafes reputed peftilential, might be added to the lift of epidemics, occafioned by the *ergot;* or by a fimilar degeneration in other grain. The fweating-ficknefs, which occurred more than once in England, at the beginning of the fixteenth century, was perhaps owing to fome difeafe or depravation in wheat, &c." (On Cutaneous Difeafes, part iv. p. 499.) It may be added, that the only epidemic occurrence of contagious fever in London for feveral years back, occurred after the exceffively wet autumn of 1799, when corn was exceedingly damaged, and a confiderable fcarcity enfued.

5. *Exhauftion by Fatigue, &c.*—Befides the debility of conftitution, and confequent predifpofition to difeafe, induced by imperfect nourifhment, during a famine, the exhauftion produced by exceffive corporeal exertions, lofs of fleep, and the depreffing paffions, probably contributes in no fmall degree to predifpofe the body to difeafes. Thus epidemic fevers have been obferved to arife after great battles. Dr. Gottwald traced the origin of the plague at Dantzick to Pinozow, foon after the battle of the Swedes and Saxons, in 1702. (Ingram, Hift. of Plagues, p. 86.) To the fame caufe, perhaps, we may impute the contagious fever, which raged among the troops of the late fir John Moore, on their return from the haraffing campaign in Spain. (1809.) Van Swieten obferves, that "ftrong paffions of the mind, particularly terror, augment the efficacy of infection, as all writers on the plague unanimoufly allow," and that the fame paffion contributes to render the difeafe more fatal. If this be correct, the extenfive operation of fear in befieged towns, and countries which are the feat of war, muft produce confiderable influence; and it cannot be doubted, that the general panic, which rapidly fpreads among the inhabitants of a town, where the plague is difcovered to exift, contributes materially to its propagation.

On reviewing the facts above ftated, it is obvious that the fources of epidemic and peftilential difeafes have been often traced to manifeft circumftances, in combination with one or more of which they have generally been obferved to occur: and more efpecially that the heats of fummer and autumn appear to be abfolutely neceffary to the propagation of a general peftilence. The obfervation of Celfus, in regard to the falubrity of the different feafons, has been confirmed by thofe who have practifed in warm climates, (Cleghorn on difeafes of Minorca) by the phyficians of camps, (Pringle, *loc. cit.* part ii. chap. i.) and by the condition of this country in the time of Sydenham. "Saluberrimum ver eft; proxime deinde ab hoc, hiems; periculofior æftas; *autumnus longe periculofiffimus.*" (Celfi De Med. lib. ii. cap. i.) But the experience of the laft century, during which this order of the feafons, in point of falubrity, has been almoft reverfed, (for we now find July and Auguft the moft healthy months of the year, and February and March the moft productive of difeafe,) has thrown confiderable light even on the occult principle, the το θεῖον, of the epidemic atmofphere. It has fhewn us, what Sydenham could not have anticipated, and what to him indeed muft have been incredible, that, while the feafons continue to occur, with their former viciffitudes, and while the bowels of the earth (for aught that we know) continue to fend forth their vapours as ufual, yet thofe fatal peftilential *conftitutions* of the air no longer appear; the plague has not been feen, fince the rebuilding of the city (1667); intermittents no longer infeft the metropolis, and the autumnal remittents are alike almoft unknown; efpecially fince the covering of Fleet ditch, and the other improvements, made in 1766; and the dyfentery, or bloody flux, now fcarcely adds twenty to the annual bills of mortality! This occult principle, then, this epidemical *fomewhat*, it muft be inferred, neither owed its origin to the atmofphere, nor to the bowels of the earth, nor to the eruptions of Ætna, nor to the approach of comets. For the former of thefe are, doubtlefs, unchanged; and the latter have continued to occur at intervals as ufual.

To what, then, are we to attribute the origin of thofe *epidemic conftitutions*, as they have been called, of particular years, in which certain difeafes extenfively prevail? We have not, perhaps, a fufficiency of facts to enable us to deduce a decided conclufion; but the following inference feems to approximate to the truth, and to fpring out of the facts already detailed.

The experience of camps, efpecially in moift feafons, teaches us how readily epidemical difeafes are produced, from the contamination of the lower portion of the atmofphere with the effluvia of foul ground, and alfo how confined and local that contamination is, fince a fmall elevation, or a removal to the diftance of a few hundred yards, from the fource of the effluvia, is fufficient to enable us to efcape their noxious effects. The experience of gaols and hofpitals, and other crowded and uncleanly habitations, has alfo demonftrated the facility with which human effluvia, accumulated about the fick, become contagious to thofe in their immediate vicinity; and alfo how readily, in this predifpofed and contagious ftate, any acute difeafe, *accidentally* introduced, is carried from individual to individual, fo as to become the prevalent or epidemic difeafe. Now, London, and all other crowded cities in the 17th century, combined within themfelves both thefe peculiarities of condition, belonging as well to camps as to gaols and hofpitals. The atmofphere was contaminated with the local effluvia, which rendered it peftilential externally; and, within the dwellings, efpecially in the poorer parts of the town, infectious atmofphere was produced, and thus whatever difeafe was generated, was propagated readily, and gave a character to the particular *conftitution* of the epidemic feafon. How varioufly the epidemics muft be modified, according to the various degrees and combination of the exciting and pre-difpofing caufes, muft be obvious on reflection. When the bodies of the people happen to be pre-difpofed to difeafe by want of food, or actually difordered by corrupted food, when the accumulation of filth, or the increafe of marfhy ground from rains or inundations, fend forth miafmata in a moft abundant and concentrated form, in confequence of a peculiar autumnal feafon, the moft extenfive epidemic difeafes may be expected to arife. And we believe, that under fuch a combination of obvious circumftances, peftilence never fails to appear.

On the other hand, although a large city cannot, like a camp, be removed from the fource of the peftilential effluvia, which it generates, yet induftry may remove the fource of thefe effluvia from it. And it appears to be a perfect

perfect confirmation of the preceding conclufions, that, as this removal has been accomplifhed in London, (for example,) as the arts of peace and civilization have advanced, and wealth has introduced the difpofition and the power to multiply perfonal comforts and conveniences; and as habits of cleanlinefs and ventilation have been generaly diffufed; in the fame proportion, and with equal fteps, the improvement of the general health, the abfolute difappearance of the plague and the other epidemics, and the increafe of longevity, are to be remarked. Hence it is only within the laft few years, that the deaths have fallen fhort of the number of births within the bills of mortality of London.

We cannot, from our prefent knowledge of facts, however, account for all thofe modifications of difeafes, nominally the fame, which are obferved to prevail at different feafons, and which require different modifications of the treatment. It can only be ftated as highly probable, that whether the epidemic difeafes originate from contagion, or human effluvia, or from the effluvia of foul ground, their degrees of violence may depend on the degrees of concentration of thofe effluvia; and the contagion of a mild or fevere difeafe may tend to propagate more particularly a difeafe of fimilar character. We have already feen that peculiar fymptoms, fuperadded to an acute difeafe, as affections of the lungs or of the bowels with general fever, are readily propagated along with that fever, and have modified both its character and the requifite treatment.

It has been juftly obferved, that "in military phyfic," (and the obfervation applies to epidemic difeafes in general,) "the great improvements to be made are not fo much in the cure as in the prevention of difeafes, which depends altogether upon the knowledge of their caufes." (Dr. John Hunter, *loc. cit.* p. 281.) Now one of the moft important circumftances to afcertain, during the prevalence of an epidemic is, whether it arifes from contagion, that is, from the influence of effluvia from the bodies of the difeafed, or from the contamination of the air by the effluvia of foul ground, &c. For "if a difeafe arife from contagion, as the author juft quoted remarks, "there are fure remedies againft it, which are fo well afcertained, that while the plague, the moft contagious and the moft fatal of all difeafes, commits its greateft ravages in large cities, individuals remain in the midft of them in perfect fecurity, trufting to a careful feclufion under proper regulations. (See Contagion.) Again, if difeafe arife from the air contaminated by the foul ground of a camp, or the exhalations of a marfh, it can only be avoided by a change of fituation, or by taking care not to come within the fphere of activity of fuch noxious caufes." Or in a large town, it may be added, by a ftrict enforcement of public and private cleanlinefs. But it is often extremely difficult to decide upon this point; a generally operating caufe affects fuch a number of individuals about the fame time, in the fame fituation, that they may feem to be infected by each other. So that, in fact, it has been difputed whether the plague itfelf be a contagious difeafe; and in regard to the dreadful epidemics of America, medical obfervers are by no means agreed as to their contagious origin. The contagion of the plague will be difcuffed hereafter. In the mean time we fhall ftate fome obfervations which may help to guide our decifion in fuch cafes.

By a contagious difeafe, is to be underftood a malady in the courfe of which a poifon is generated in the body of the fick, which produces in others a fimilar difeafe. The poifon in fome difeafes, as the fmall-pox and chicken-pox, is fufficiently apparent; and the other difeafes, which alfo arife from fpecific contagion, and occur but once during life, as meafles, fcarlet fever, hooping-cough, &c. are well known. In others, again, as in typhus and the plague, it almoft eludes our fenfes, and is only active when concentrated or accumulated, or clofe to the body of the fick. Now thefe contagious difeafes equally affect all ages and defcriptions, who fuffer expofure to their caufe: wherever they prevail, the old inhabitants of a country fuffer as much as thofe that have lately arrrived. But this is never the cafe in the yellow fever, remittent fever, or even intermittent fever, which arife from external miafmata; for fuch as are feafoned to the country or climate fuffer infinitely lefs than new-comers. Again, difeafes proceeding from fuch a caufe, generally diffufed, and operating upon all, do moft conftantly recur in the fame perfons as long as they remain expofed to the original caufe; thus in camps and marfhy fituations, the fick are conftantly relapfing in remittents and intermittents, till they change their fituation. Dr. Hunter particularly obferves, that the mortality among foldiers in the Weft-Indies is, in a great meafure, owing to thefe repeated attacks. But what the fame writer confiders as the *experimentum crucis*, to prove the non-exiftence of contagion, is, when the fick leave their ufual refidence, and go to other places which are healthy, without fpreading the difeafe. This conftantly happens in the remittent fevers of the Weft-Indies; for the good effects of changing the air of the towns for that of the mountains is fo well known, that it is very generally practifed; but certainly without the flighteft fufpicion of any mifchief arifing from any contagion carried by the fick. If we try by this rule the fever epidemic in Philadelphia in 1793, we fhall not pronounce it to be contagious. One obfervation more may be added: when difeafe arifes from a caufe generally diffufed, feparation, which in contagious difeafes is commonly effectual, is here of no avail. Thus, fhips of war have gone into a harbour in the Weft-Indies, and have had no intercourfe with the people on fhore, or with the crews of other fhips, and yet in a few days the men have been feized with the prevailing fever in great numbers. (Hunter, ibid.)

With refpect to the laft argument but one, indeed, the inference is not perfectly conclufive; for malignant typhoid fevers, (and the plague, which is probably but an extreme degree of the fame fever,) although they produce a contagion that is active and virulent in a confined and clofe atmofphere, neverthelefs become much lefs contagious, in a clear and open air; fo that we fhould expect that, on a removal of the fick to the country, the difeafe would affume a lefs virulent form. In the plague at Mofcow in 771, we are told by Dr. Mertens, that the patients, who were conveyed to the neighbouring villages, communicated the difeafe to the inhabitants of thofe places; which they would the more readily do, as probably their cleanlinefs was not fuperior to that of Mofcow itfelf.

The fpecific contagions, as they have been called, as fmall-pox, meafles, and fcarlet-fever, which occur but once in the courfe of life, and chiefly attack children, become epidemic generally at pretty regular periods, in large towns. This may be principally explained, perhaps, by the circumftance of the neceffary interval requifite for the production of fubjects, who have not undergone thefe difeafes.

On the whole, however, although the progrefs of refinement in the comforts of human life, during the laft century, have thrown much light on the nature and origin of epidemic conftitutions, in different years; it muft be allowed, neverthelefs, that much farther obfervation of facts will be requifite, in order to illuftrate the fubject completely.

EPIDENDRA, from ἐπὶ, *upon*, and δένδρον, *tree*, in *Natural Hiſtory*, a word uſed by ſir Hans Sloane, and ſome other authors, to expreſs thoſe plants which grow upon others, ſuch as the miſletoe, which grows upon the apple-trees, &c. Theſe are more commonly diſtinguiſhed by the name of paraſitical plants. See Dodder.

EPIDENDRUM, in *Botany*, ſo named by Hermann, Linnæus, and others, from ἐπὶ, *upon*, and δένδρον, *a tree*, becauſe moſt of the ſpecies, if not all, grow paraſitically on the trunks or branches of trees. Linn. Gen. 464. Schreb. 606. Willd. Sp. Pl. v. 4. 114. Mart. Mill. Dict. v. 2. Juſſ. 66. Swartz. Act. Holm. 1800. p. 240. Tracts on Botany, 182. Schrad. Journal, 1799. 209. t. 1. Orchid. in Schr. Neues Journ. v. 1. 79. Claſs and order, *Gynandria Monandria*. Nat. Ord. *Orchideæ*, Linn. Juſſ.

Gen. Ch. reformed. *Cal.* three-leaved. *Cor.* Petals two, nearly equal to the calyx-leaves, ſpreading; nectary a lip, turbinate and tubular at the baſe, connected with the ſtyle, deſtitute of a ſpur, its termination dilated, aſcending, ſpreading, either undivided or lobed. *Stam.* Anther an hemiſpherical, deciduous, terminal lid, of two or four cells; maſſes of pollen ſtalked, in pairs. *Piſt.* Germen inferior, oblong or obovate, erect, furrowed; ſtyle ſemi-cylindrical, often gibbous, concave in front; ſtigma either concave or convex, in the fore-part of the ſtyle near the top. *Peric.* Capſule oblong or obovate, with three or ſix ribs, with one cell and three valves, opening by clefts between the ribs. *Seeds* numerous, minute, each clothed with a chaffy tunic, inſerted into the downy internal ridges of the valves.

Eſſ. Ch. reformed. Calyx-leaves ſpreading. Lip tubular at the baſe, attached to the fore-part of the ſtyle, deſtitute of a ſpur. Anther a terminal lid, deciduous.

The original genus of *Epidendrum* in Linnæus, whoſe eſſential character is "Nectary turbinate, oblique, reflexed," comprehends many ſpecies which do not anſwer to that character, and which have, indeed, in ſeveral inſtances, been referred to this genus without a ſufficient knowledge of their flowers. Hence profeſſor Swartz has chiefly derived his genera of *Cymbidium*, *Dendrobium*, (ſee thoſe articles,) *Oncidium*, *Aërides*, and *Vanilla*, ſo that his *Epidendrum*, whoſe characters we have given above, is become a much ſmaller, as well as a more intelligible genus, though perhaps not more natural, it having the cloſeſt poſſible affinity to *Cymbidium* and *Dendrobium*. The ſpecies in Swartz are 23, in Willdenow 26. Profeſſor Martyn has, with great induſtry, collected 124 under the original genus. Dr. Swartz mentions 19 new ones as diſcovered in South America by the authors of the Flora Peruviana and Chiloenſis.

Among the genuine ſpecies of *Epidendrum*, as the genus ſtands at preſent, are

E. *cochleatum*, Linn. Sp. Pl. 1351. Curt. Mag. t. 572. Jacq. Ic. Rar. t. 605. Andr. Repoſ. t. 13. A native of Jamaica, and the firſt of its tribe that ever flowered in England. It is cultivated in a ſtove, in rotten bark, contrived ſo as to imitate, as much as poſſible, its natural ſituation in the clefts of aged trees, with occaſional ſupplies of water. The *bulbs* are green and ſmooth, of a compreſſed oval figure, each throwing out from its baſe numerous thick entangled fibres, which naturally adhering to the rugged bark, ſtrongly fix the plant and imbibe nouriſhment for its ſupport. A pair of oblong, rigid, recurved *leaves*, entire, as in all this natural order, ſpring from the ſummit of each bulb, and between them grows a *ſtalk*, about a foot high, bearing a ſpike of ſeveral *flowers*. Theſe are reverſed, the long pale-greeniſh calyx and petals hanging down, while the broad, concave, ſomewhat cordate nectary, of a chocolate hue ſpeckled with green, ſtands erect. The flower has little or no ſmell.

E. *fragrans*. Sw. Prod. 123. (E. cochleatum; Curt. Mag. t. 152.) A native alſo of Jamaica, flowered in the ſtove of Chelſea garden, under Mr. Fairbairn's care, in Feb. 1789. This has much reſemblance to the foregoing, but the *petals* are broader, the *nectary* pale ſtreaked with red, and tipped with a long point, and the flowers have a ſweet ſmell. The *ſtalk* moreover is ſhorter in this ſpecies than the *leaves*.

E. *amabile*. Linn. Sp. Pl. 1351. (Angræcum album majus; Rumph. Amb. lib. xi. 99. t. 43.) Native of the Eaſt Indies. This has beautiful white *bloſſoms*, twice as large as in Rumphius's plate, on a long ſlender branched *ſtalk*. The lip is five-lobed, and terminates beſides in a pair of very long, taper, almoſt capillary points. It would be a great acquiſition to our ſtoves.

E. *nutans*. Sw. Prod. 121. A native of Jamaica, flowered in Kew gardens in March 1791. This has a leafy *ſtem*, terminated by a ſtalk bearing a few pale *flowers*, whoſe lip is four-lobed. They are about the ſize of E. *fragrans*.

E. *ciliare*. Linn. Sp. Pl. 1349. Curt. Mag. t. 463. is a beautiful and magnificent plant, native of the Weſt Indies, which flowered at Mr. Whitley's nurſery, Old Brompton, for ſeveral years before 1799. (*Curtis.*) The *flowers* are numerous and fragrant; their calyx-leaves and petals each near two inches long, of a yellowiſh buff-colour; lip white, with two elegantly fringed lobes. This ſpecies is now not very rare in the Engliſh ſtoves.

E. *fuſcatum*. Sm. Spicil. t. 23. is rather ſingular than ornamental. The late Hon. Mrs. Barrington received it from Jamaica, and it bloſſomed in her garden in 1791. The *ſtem* is leafy, and terminates in a very long ſimple ſcaly ſtalk, bearing a denſe corymbus of ſmall *flowers*, which, like the whole plant, are of a brown purpliſh hue.

Several ſpecies, more or leſs a-kin to this laſt, occur in the works of Jacquin, as well as ſome more ſplendid ones with tall branching ſtalks, none of them yet introduced into our gardens.

EPIDERMIS, in *Anatomy*, is the thin inſenſible membrane which covers the true ſkin, and which conſtitutes, therefore, in all parts, the external ſurface of the body. See Skin.

Epidermis, in *Vegetable Anatomy*, from ἐπὶ, *upon*, and δέρμα, the *ſkin*, or *hide*, is the ſcarf ſkin, or pellicle, which covers every part of a living plant, as a ſimilar cuticle covers the human ſkin. In the tender growing parts of vegetables this membrane is of the moſt delicate texture, pellucid and colourleſs, extremely thin, yet not deſtitute of tenacity, being wonderfully extenſible on ſtalks, or other parts, of quick growth. Under a high magnifier it is found to be porous in a regular manner, and differently in different plants, ſo as to allow of the paſſage of fluids in a definite degree, in either direction, according to the nature of each plant. Hence ſome leaves perſpire ſlowly, but imbibe moiſture with great rapidity, as thoſe of the ſucculent tribes; while others tranſmit their fluids, or imbibe external moiſture, with nearly equal facility, as aquatics. Such differences are detected by experience, but ſcarcely diſcoverable by microſcopical inveſtigation.

The *Epidermis* is of the moſt eſſential importance to the life of the plant, as of the animal, protecting the living parts which it covers from the injuries of the air, while it allows of due perſpiration and abſorption, as well as of the action of light through its nearly colourleſs ſubſtance. It differs greatly in thickneſs according to the part of the plant to which it belongs. Exquiſitely delicate on the fine organs of a flower, like the cuticle of the animal eye, it has conſiderably more ſubſtance on the leaf, and ſtill more on the branch

branch of a tree. On old trunks it is generally obliterated or deftroyed, being there no longer neceffary, the dead layers of bark, (fee BARK and CORTEX,) anfwering all the purpofes of protection, while the peculiar functions of an organized porous *epidermis* are not wanted. Yet in the birch, and a few other trees, the membrane in queftion confifts of multiplied permanent layers, like the bark, and clothes the trunk as long as that part exifts. The cuticle is eafily feparable from young ftalks in a rapid ftate of vegetation, and from any part of a plant by means of maceration, boiling or putrefaction, being nearly, if not abfolutely, deftitute of vitality, and very little fubject to decompofition.

Befides the effential office of a guard to the living vegetable body againft all hurtful ftimulants, the *epidermis* anfwers many fecondary purpofes of protection. When naked, as ufual, it proves but a feeble defence againft heat or cold, but it is often covered with hair or wool, in which cafe it becomes a very powerful one, particularly againft the too violent action of a burning fun. Flowers indeed, though peculiarly prefented to all the force of this luminary, have fcarcely ever any fuch woolly or downy defence; for the functions which they have to perform are often urgent with refpect to light and heat. Many petals, notwithftanding, are filky or downy on their outfide, apparently to protect them from cold, or poffibly from too fcorching a heat before they are full-grown, examples of which may be feen in *Convolvulus*, *Anemone*, and feveral other genera; but the infides of fuch petals are exquifitely fmooth.

Examples of a very firm fmooth *epidermis*, of confiderable ftrength and thicknefs, may be found in the common currant, *Ribes rubrum*, the elder, *Sambucus nigra*, and the laburnum, *Cytifus Laburnum*. On the branches of the latter it acquires almoft a horny hardnefs; but it is ftill more cartilaginous in the hard white tubercles fprinkled over the leaves of *Aloe perlata*, and in the teeth of the foliage of fome *Saxifragæ*, as well as the briftly warts of feveral fpecies of *Echium* and others of the *afperifoliæ*. On the leaf of the white willow, and the *Protea argentea*, the cuticle has a fine filky clothing of a filvery hue; while in many more plants it is equally white, but deftitute of glofs. In the leaf of many kinds of mullein, *Verbafcum*, and the fruit of the peach, we find it denfely covered with hairs, more or lefs branched. The herbage of the betony, *Betonica officinalis*, is clothed with rigid briftles, fixed upon the cuticle, which in a dry ftate excite fneezing. Similar hairs on the cuticle of the ftinging nettle are curioufly perforated, to tranfmit a venomous fluid lodged in bags at their bafe, like the poifon in a ferpent's tooth. Graffes, corn and horfetail, *Equifetum*, have much flinty earth in their *epidermis*; while in the cork-tree, the common maple, and the Dutch elm, the fame part is of a foft elaftic fungous fubftance. The fruit of the plum, and leaves of the cabbage, have their *epidermis* covered with a fine blueifh powdery refinous fecretion, which will fcarcely allow rain to come in contact with them, yet fuch plants readily abforb moifture.

Nothing can be more abfurd than the idea which fome philofophers have formerly entertained, that the *epidermis* was deftined to give fhape to a plant, and that certain lumps or excrefcences on the ftems of trees were originally owing to a cafual wound or crack in this membrane. This opinion is eafily refuted by purpofely making fuch a wound or opening, when it will be found that no tumour can be produced by any fuch means; fpontaneous tumours being in reality the caufe, not the effect, of the burfting of the *epidermis*. S.

EPIDICASIA, Επιδικασια, among the *Athenians*. Daughters, inheriting their parents' eftate, were obliged to marry their neareft relations; which gave occafion to perfons of the fame family to go to law with one another, each pretending to be more nearly allied to the heirefs than the reft. The fuit was called επιδικασιας δικη; and the virgin, about whom the relations contefted, επιδικος. Pott. Archæol. Græc. lib. 1. cap. 24. tom. i. p. 147.

EPIDIDIUM, in *Ancient Geography*, is the name which Ptolemy gave to that peninfula on the weftern coaft of Scotland, which forms part of the county of Argyle, called Cantyre and Knapdale; and including the ifles of Iflay and Jura, which the Roman geographer confidered as being part of it: but whether it then was integral, or not, cannot be afcertained from his account. The peninfula might at an early period have been an ifland; fuch changes has the fea made upon our furge-beat coafts: for "Dr. Smith derives this name from a fimilar Celtic word, fignifying the ifle of the Picts, who at that time were the principal inhabitants of that part of Scotland." Sir John Sinclair's Stat. Acc. vol. x. p. 519. But fuch a conclufion is not juftifiable by the rules of Celtic derivation. *Cyn*, in that language, fignifies a wedge, and *tor*, land or territory; it is, therefore, obvioufly derived from thofe two etymons conjoined, perfectly defcriptive of fuch a tongue of land, *i. e.* a wedge-fhaped territory. Mr. Baxter imagines the Pepidii, fynonymous with Epidii, to have derived their name from the Britifh word Papidiauc, which fignifies any thing fhaped like a flute or pipe, as was the peninfula of Cantyre, the country of the Pepidii. From the fouthern point, called the mull of Cantyre, promontorium Epidium, the coaft of Ireland may be plainly feen; it being only 16 miles to the fouth foreland in Coleraine.

EPIDIDYMIS, in *Anatomy*, a part of the tefticle, fituated behind the body of that organ, and confifting of its excretory duct in a wonderfully convoluted form. It ends in a ftraight tube, called the vas deferens. See TESTIS.

EPIDO'SIS, from επιδιδωμι, *to increafe*, in *Surgery*, a preternatural enlargement of parts.

EPIDOT. See STRAHLSTEIN.

EPIDOTES, from επιδιδωμι, *I caufe to grow*, in *Mythology*, deities which were fuppofed to prefide over the growth of infants.

EPIDROME, from επι, *upon*, and δρεμω, *to run*, in *Surgery*, an afflux of fluids, or, as they were formerly phrafed, humours, efpecially when it arofe from the application of a ligature round any part.

EPIDROMUS, of επι and δρομος, *courfe*, in the *Ancient Shipping*, a fail near the ftern, which was the largeft but one in the fhip.

EPIECIA, in *Ancient Geography*, a town of Greece, towards the fea, and not far from Corinth; N. of Tenea.

EPIEZ, in *Geography*, a town of France, in the department of the Loiret, and diftrict of Beaugeney; 12 miles E. of Orleans.

EPIGÆA, in *Botany*, from επι, *upon*, and γεα, *the earth*, expreffive of the proftrate growth of this humble fhrub. Linn. Gen. 219. Schreb. 295. Willd. Sp. Pl. v. 2. 615. Mart. Mill. Dict. v. 2. Juff. 161. Clafs and order, *Decandria Monogynia*. Nat. Ord. *Bicornes*, Linn. *Ericæ*, Juff.

Gen. Ch. *Cal.* Perianths double, clofe together, permanent; the outer of three ovato-lanceolate, pointed leaves, of which the external one is larger than the reft; inner in five deep, upright, lanceolate, pointed fegments, fomewhat longer than the outer. *Cor.* of one petal, falver-fhaped; tube rather longer than the calyx, hairy within; limb fpreading, in five deep ovate-oblong lobes. *Stam.* Filaments ten, thread-fhaped, the length of the tube, and inferted into its bafe; anthers oblong, acute. *Pift.* Germen globofe,

globofe, with five furrows, downy; ftyle cylindrical, as long as the ftamens; ftigma obtufe, in five lobes. *Peric.* Capfule nearly globular, depreffed, with five angles, five cells, and five valves. *Seeds* numerous, roundifh. *Receptacle* large, feparating into five parts.

Eff. Ch. Outer calyx of three leaves; inner in five deep fegments. Corolla falver-fhaped. Capfule of five cells, with a central five-parted receptacle bearing the feeds.

The fpecies are two.

1. E. *repens.* Linn. Sp. Pl. 565. Swartz Prod. 74. Andr. Repof. t. 102. Lamarck Illuftr. t. 367. f. 1. "Leaves ovate, inclining to heart-fhaped, entire. Tube of the corolla cylindrical." Native of pine forefts in Virginia and Canada, but, like many plants of a cold or alpine climate, difficult to preferve in our gardens. It flowers in April or May. The *root* throws out many woody, procumbent, creeping, branched, hairy, leafy *ftems*, which form wide-fpreading patches. *Leaves* alternate, on hairy foot-ftalks, ovate, obtufe, entire, heart-fhaped at the bafe, veiny, fhining, but roughifh to the touch. *Stipulas* none. *Flowers* in terminal, denfe, bracteated clufters, fragrant, of a pale blufh-colour, each about the fize of a fmall cowflip. It is increafed by parting the roots, thrives in a light fandy loam, but requires the fhelter of a long-continued deep fnow, or fome equivalent protection, to furvive our winters. We faw it in great perfection at Meffrs. Lee and Kennedy's nurfery, Hammerfmith, in 1797.

2. E. *cordifolia.* Swartz Prod. 73. Lamarck Illuftr. t. 367. f. 2. "Leaves heart-fhaped, roundifh, ferrated, convex, hifpid, rigid. Tube of the corolla ovate." Native of boggy places on the higheft mountains of Guadaloupe and Cayenne. Smaller than the former, with pointed and more hifpid *leaves*, whofe foot-ftalks are very fhort. *Flowers* in like manner terminal, but with a more inflated tube. The young fhoots are very hairy.

Epigæa, in *Gardening*, comprehends a plant of the low, trailing, fhrubby, flowering kind. This is the creeping epigæa, or trailing arbutus (E. repens).

Method of Culture.—This is readily effected in this plant by the trailing ftalks, which foon put out roots at the joints, and may then be cut off from the old or parent plants, and be fet out in a fhady fituation, where the foil is moift, in the autumnal feafon, that the plants may be well eftablifhed before the fpring. In cafes where the winter proves fevere, it may be neceffary to lay a few dried leaves, or other light covering over them, to protect them from froft; but after they become well rooted, they feldom require more than being kept clean from weeds.

Thefe are ornamental plants in the fronts of the borders of fhrubberies.

EPIGASTRIC Artery, in *Surgery.* The proper mode of operating in certain cafes of ruptures, fo as not to run any rifk of wounding this veffel, will be explained in the article Hernia.

Epigrastric *Region*, in *Anatomy*, one of thofe portions, into which the cavity of the abdomen is divided by anatomifts in their defcriptions. "The epigaftric region," fays Winflow, "begins immediately under the appendix enfiformis at a fmall fuperficial depreffion, called the pit of the ftomach, and in adult fubjects ends above the navel at a tranfverfe line, fuppofed to be drawn between the laft falfe ribs on each fide.

"This region is fubdivided into three parts, one middle, named epigaftrium, and two lateral, termed hypochondria. The epigaftrium takes in all that fpace which lies between the falfe ribs of both fides, and the hypochondria are the fpaces covered by the falfe ribs." Sect. 7. § 79, and 80.

EPIGASTRIUM. See Epigastric.

EPIGINOMENA, of επιγινομαι, *I fupervene*, in *Medicine*, are new fymptoms which occur in the progrefs of a difeafe. See Epiphenomena.

EPIGLOTTIS, in *Anatomy*, is a fmall and thin piece of cartilage, placed at the back of the tongue, and having the office of clofing the glottis, or opening of communication between the larynx and pharynx, when the food is paffing into the latter cavity from the mouth. The anatomical defcription of this part will be found in the article Larynx; its offices are defcribed in that of Deglutition.

EPIGONIUM, επιγονιον, a mufical inftrument among the ancients, with forty ftrings, fo called from its inventor Epigonius, a native of Ambracia, a city of Epirus. Mem. Acad. Infcript. vol. v. p. 167.

EPIGONIUS, in *Biography*, was a mathematician of Sicyon, and a native of Ambracia, who is celebrated by the ancients for the invention of an inftrument of forty ftrings, which was called after his name, Epigonium. When he lived is uncertain, but as it was in times of fimplicity, we may fuppofe that thefe ftrings did not form a fcale of forty different founds, but that they were either tuned in unifons and octaves to each other, or accommodated to different modes and genera. The 12 femi-tones of our three-ftopt harpfichords included thirty-fix different ftrings.

The Greeks were divided into numerous fects of mufical fpeculators, before and after the time of Ariftoxenus: as the Epigonians, Damonians, Eratoclians, Agenorians, and many others enumerated by Porphyry, in his Commentary on the Harmonics of Ptolemy. Of thefe, however, all we know is, that they *differed*; it is, perhaps, little to be lamented, that we no longer know about *what*.

Mufic has many obligations to Epigonius. He was the firft who played on ftringed inftruments without a *plectrum*. And, according to Athenæus, he firft united the melody of flutes to that of the citharas; and by this means foftened the harfhnefs and inflexibility of the citharas when played alone. He invented the chromatic genus, and was the original author of chorufes.

EPIGRAM, in *Poetry*, a fhort poem, or compofition in verfe, treating only of one thing, and ending with fome point, or lively ingenious thought.

The word is formed of επιγραμμα, *infcription*, of επιγραφειν, *to infcribe*, or *write upon*.

Epigrams then, originally, fignify *infcriptions*, and they derive their origin from thofe infcriptions placed by the ancients on their tombs, ftatues, temples, triumphal arches, &c. See Inscription.

Thefe, at firft, were only fimple monograms: afterwards increafing their length, they made them in verfe, to be the more eafily retained: Herodotus, and others, have tranfmitted to us feveral of them.

Such little poems retained the name of epigrams, even after the defign of their firft inftitution was varied, and people began to ufe them for the relation of little facts and accidents, the characterifing of perfons, &c.

The Greeks confine their epigrams to a very narrow compafs; for though, in the Anthology, we here and there meet with a very long one; yet, ordinarily, they do not exceed fix, or, at moft, eight verfes. The Latins were not always fo fcrupulous, and the moderns much lefs, as to thefe bounds.

M. le Brun, in the preface to his "Epigrams," defines an epigram a little poem, fufceptible of all kinds of fubjects, and ending with a lively, juft, and unexpected thought; which are three qualifications effential to the epigram; particularly

ticularly the firſt and laſt of them, *viz.* brevity, and the point or cloſe of the epigram.

To attain brevity, only one thing is to be aimed at in the poem, and that to be purſued in the conciſeſt terms poſſible. Authors are much divided as to the length the epigram is to be confined to; the ordinary limits are from two to twenty verſes; though we have inſtances, both among the ancients and moderns, where they extend to fifty. But ſtill it is allowed, that the ſhorter the better, and more perfect, as it partakes more of the nature and character of this kind of poem. The point or turn is a quality much inſiſted on by the critics, who require the epigram conſtantly to cloſe with ſomething poignant and unexpected, to which all the reſt of the compoſition is only preparatory. Others there are, who exclude the point, and require the thought to be equally diffuſed throughout the whole poem, without laying the whole ſtreſs on the cloſe: the former is uſually Martial's practice, and the latter that of Catullus. Which is the moſt beautiful and perfect manner is diſputed by a third claſs of critics.

The Greek epigrams have ſcarce any thing of the point or briſkneſs of the Latin ones: thoſe collected in the Anthology have moſt of them a remarkable air of eaſe and ſimplicity, attended with ſomething juſt and witty; ſuch as we find in a ſenſible peaſant, or a child that has wit. They have nothing that bites, but ſomething that tickles. Though they want the ſalt of Martial, yet, to a good taſte, they are not inſipid; except a few of them, which are quite flat and ſpiritleſs. However, the general faintneſs, and delicacy of the pleaſantry in them, has given occaſion for a Greek epigram, or "epigram à la Greque," to denote, among the French, an epigram void of ſalt or ſharpneſs.

It is principally the point that characterizes the epigram, and diſtinguiſhes it from the madrigal. See POINT.

In the modern verſification, as obſerved by F. Mourgues, the epigram and madrigal are diſtinguiſhed by the number of verſes and the cloſe. 1. By the number of verſes, which in the modern epigram does not go beyond eight, nor in the modern madrigal comes ſhort of ſix; and, 2. In that the cloſe, or period, of the epigram, has always ſomething more lively and ſtudied than that of the madrigal.

The epigram is the loweſt, and leaſt conſiderable of all the productions of poetry; and it is in general rather an effect of good luck, than of art, to ſucceed therein. The fineſſe, and ſubtilty, of the epigram, M. Boileau obſerves, ſhould turn on the words rather than the thought; which ſeems very little to the credit of this kind of compoſition, as it reduces it to the nature of the pun, or equivoque. F. Bouhours confirms the hint, in adding that the equivoque is what uſually ſhines the moſt in the epigram.

One great beauty of the epigram is, to leave ſomething for the reader to gueſs, or ſupply. Nothing pleaſes the mind ſo much, as to find ſomething in itſelf in the objects preſented it; nor does any thing diſguſt it more than to preclude it from ſhewing and exerciſing a faculty it values itſelf for. Segrais.

The epigram admits of great variety of ſubjects: ſome are made to praiſe, and others to ſatirize, which laſt are much the eaſieſt; ill-nature ſerving inſtead of point and wit. Boileau's epigrams are all ſatires on one or another. Thoſe of Des Reaux are all made in honour of his friends; and thoſe of Mad. Scudery are ſo many eloges. The epigram being only a ſingle thought, it would be ridiculous to expreſs it in a greater number of verſes; it muſt have its unity like the drama. The comedy has an action for its ſubject, and the epigram a thought.

We might ſelect a number of excellent epigrams in our own language, if our limits allowed of enlarging this article. We ſhall content ourſelves with ſubjoining the following. The firſt is that of Mr. Pope, ſaid to be written on a glaſs with the earl of Cheſterfield's diamond pencil.

"Accept a miracle, inſtead of wit,
See two dull lines by Stanhope's pencil writ."

The next is an epigram, expreſſed conciſely and cloſing beautifully, which was written on the leaves of a fan by Dr. Atterbury, late biſhop of Rocheſter:

"Flavia the leaſt and ſlighteſt toy
Can with reſiſtleſs art employ.
This fan in meaner hands would prove
An engine of ſmall force in love;
Yet ſhe with graceful air and mien,
Not to be told or ſafely ſeen,
Directs its wanton motion ſo,
That it wounds more than Cupid's bow.
Gives coolneſs to the matchleſs dame,
To every other breaſt a flame."

Mr. Prior laſhed the impertinence of a bad writer, who had taken the liberty of cenſuring him, in the following epigram:

"While faſter than his coſtive brain indites,
Philo's quick hand in flowing letters writes.
His caſe appears to me like honeſt Teague's,
When he was run away with by his legs:
Phœbus, give Philo o'er himſelf command;
Quicken his ſenſes, or reſtrain his hand.
Let him be kept from paper, pen, and ink,
So he may ceaſe to write, and learn to think."

The following epigram was written by Mr. Weſley, on occaſion of erecting a monument to Mr. Butler, author of Hudibras, in Weſtminſter Abbey:

"While Butler, needy wretch, was yet alive,
No generous patron, would a dinner give.
See him, when ſtarv'd to death, and turn'd to duſt,
Preſented with a monumental buſt!
The poet's fate is here in emblem ſhown,
He aſk'd for *bread*, and he receiv'd a *ſtone*."

See BUTLER.

EPIGRAPHE, Επιγραφη, *Superſcription*, an inſcription on a building, to ſignify its uſe, occaſion, the time when, and the perſon by whom it was built.

EPIGRAPHES, Επιγραφεις, among the Athenians, officers that rated all thoſe of whom taxes and contributions were required, according to every man's ability, kept the public accounts, and proſecuted ſuch as were behindhand with their contributions. Potter. Archæol. Græc. lib. i. cap. 14. tom. i. p. 81.

EPILA, in *Geography*, a town of Spain, in the province of Arragon, on the Xiloca; 17 miles W. of Saragoſſa.

EPILEPSY, in *Medicine*, ἐπιληψία, and ἐπιληψις, ſignifying *ſudden ſeizure*, is a diſeaſe which conſiſts of convulſions of the greater part of the muſcles of voluntary motion, attended with a loſs of ſenſe and feeling, and ending in a ſtate of inſenſibility, and ſeeming ſleep.

This diſeaſe has received a variety of denominations, eſpecially among the ancient writers. By the early Greeks it was called the *ſacred diſeaſe*, from a notion of its origin in ſupernatural fupernatural influence ; fome of the exorcifts and impoftors of thofe times even pretended to decide, from variations in the fymptoms, whether the fits were occafioned by Cybele, Neptune, Mars, or fome of the heroes. Hippocrates feems to have been the firft who combated thefe abfurd notions of his countrymen ; and feverely reprehends the impoftures of the exorcifts, in pretending to fet afide what more than human power had inflicted, by incantations, magic ceremonies, and fometimes by the moft contemptible juggling. (See Hippoc. de *Morbo Sacro.*) Aretæus, however, remarks that it might have the denomination of *facred* on other accounts ; either from its magnitude, every thing great being deemed facred ; or becaufe it could not be removed by human means, but only by divine power ; or from the opinion that a dæmon had entered into the patient, or for all thefe reafons together. (De Caufis Affect. lib. i. See alfo Cæl. Aurelian. De Morb. Chron. lib. i. cap. iv.) In like manner the Romans call every thing remarkable and great "facred :" "*facra* anchora," "auri *facra* fames," &c. (Van Swieten. § 1071.) Upon the fame ground epilepfy has been called morbus *Herculeus*, the Herculean difeafe. By the Romans, it was fometimes termed morbus *comitialis*, "the affembly difeafe ;" either becaufe epileptic perfons were more frequently obferved to be feized in a crowd of people, or becaufe the public meetings, called *comitia*, were adjourned if any one happened to be attacked with an epileptic fit. It has likewife been termed morbus *caducus*, or "falling ficknefs," becaufe the patients, when they are feized with the paroxyfm, fall down.

The leading features and principal circumftances of the epileptic convulfions are nearly the fame in all the different perfons whom the difeafe affects. The difeafe confifts of fits, which attack fuddenly often thofe who are feemingly in perfect health, and, after lafting for fome time, pafs off, and leave the perfons again in their ufual ftate.

The individual attacked lofes fuddenly all fenfe and power of directing his mufcular actions ; fo that, if ftanding or fitting, he falls immediately, or perhaps with convulfions is thrown to the ground. In that fituation he is agitated with violent convulfive actions, varioufly moving his limbs and the trunk of his body, with a force that is altogether preternatural. Commonly the limbs on one fide of the body are more violently agitated than thofe upon the other. In all cafes the mufcles of the face and eyes are much affected, exhibiting various and violent diftortions of the countenance. The tongue is often affected, and thruft out of the mouth, while the mufcles of the lower jaw are alfo affected, and, fhutting the mouth with violence, often wound the tongue grievoufly. While thefe convulfions continue, the face becomes red, then livid and fwelled, from the interruption to the circulation through the head, and there is commonly at the fame time a frothy moifture iffuing from the mouth ; and in the moft fevere cafes the urine and alvine excrements are involuntarily difcharged. In fome inftances a hiffing or ftertorous noife is emitted. The convulfions have for a few moments fome remiffions, but are fuddenly again renewed with great violence. Generally, after no long time, this terrible ftruggle ceafes altogether, and the patient remains for fome time without motion, in a ftate of abfolute infenfibility, and under the appearance of a profound fleep. After fome continuance of this feeming fleep, he fometimes fuddenly, but for the moft part by degrees only, recovers his fenfes and power of motion, but without any memory of what had paffed from the firft feizure of the fit, and complaining of head-ache, and exceffive pain in all the limbs as if from fevere fatigue. During the convulfions the pulfe and refpiration are hurried and irregular ; but, when the convulfions ceafe, they return to their ufual regularity and healthy ftate.

In moft cafes the attack of epilepfy comes on fuddenly, without any warning fymptom : but fometimes it is preceded by certain fenfations for a few moments previous to its actual commencement. Of thefe the moft remarkable is that, which has been termed the *Aura epileptica ;* which is a fenfation of fomething moving in fome part of the limbs or trunk of the body, and from thence creeping upwards to the head ; and when it arrives there, the perfon is immediately deprived of fenfe, and falls into an epileptic fit. This feeling is defcribed fometimes as refembling that of a cold vapour, fometimes as like a fluid gliding, and fometimes like the fenfation of a fmall infect creeping along the body ; and very often the patients can give no other diftinct idea of their fenfation, than as in general of fomething moving along. It might be fuppofed that this fenfation arofe from fome affection of the extremity or other part of a nerve, acted upon by fome irritating caufe ; and that the fenfation, therefore, followed the courfe of fuch a nerve. But it is not found to follow the courfe of any nerve diftinctly, and it generally feems to pafs along the integuments. There are occafionally alfo other fymptoms immediately preceding the fit, and generally referred to the head, where no *aura* is perceived. In fome perfons a giddinefs comes on ; in others a fpark of light, which increafed to a bright beam, ufually ufhers in the paroxyfm ; depending probably on the fudden turgefcence of the veffels in the head, which produces preffure on the optic nerve, and occafions this depraved fenfation. Dr. Gregory ufed to mention in his lectures, at the college of Edinburgh, the cafe of an officer, who had a more fingular perverfion of fight, previous to the fit of epilepfy ; he always fancied that he faw an apparition of an old woman, with a blue cloak, holding a ftaff in her hand, with which fhe knocked him down. He alfo mentioned an inftance of vifual depravation which occurred to Dr. Fothergill ; a young lady, whom the Dr. was attending as an epileptic patient, remarked that he was covered with fpangles, (the more unufual as an ornament to a quaker's coat,) and immediately fhe fell down in a fit.

Under the article CONVULSIONS we have entered into a detail of the circumftances which conduce to their origin and production ; and as the whole of thofe obfervations apply to the epileptic convulfions moft particularly, it will not be here neceffary to repeat them. We have there ftated that convulfions occur under two oppofite conditions of the body, *viz.* of *repletion* and *inanition ;* or, in the language of Dr. Cullen, of *excitement* and *collapfe* (Firft Lines, § 1286.) : and that various *irritations* in different parts of the body, but efpecially in the head, give rife to them in different inftances.

Sauvages has defcribed a great variety of fpecies of epilepfy, which he has diftinguifhed chiefly according to the caufes which produced them. Dr. Cullen has mentioned only three fpecies, which (as to the utility of divifion with a view to the curative indications) might be reduced to two. His firft fpecies is epilepfia *cerebralis* (from *cerebrum*, the brain), which attacks fuddenly, without any evident caufe, or preceding fenfation, except perhaps a giddinefs or deprivation of fight ; and includes the *plethoric* epilepfia and eclampfia of Sauvages, as well as his *cachectic* epilepfy. The fecond fpecies, is E. *fympathica*, in which the *aura epileptica*, before defcribed, precedes the attack ; a circumftance which is fcarcely of fufficient importance to defignate a fpecies. The third, E. *occafionalis*, includes thofe inftances of epilepfy which originate from manifeft and accidental irritation, and which fubfide when the irritation

tation is removed. Thefe various caufes of irritation are, wounds, or blows of the head, from falls, and other external injuries; pain in various degrees, as from parturition, dentition, worms in the alimentary canal; indigefted food, or other fubftances in the ftomach, as narcotic poifons, fpirituous liquors, &c; paffions of the mind, efpecially fear; and a variety of other fources of difturbance to the fyftem, as the eruption of fmall-pox, and other febrile irritations, the venereal orgafm, intenfe ftudy, the fuppreffion of cuftomary difcharges, &c.; and, laftly, the imitative propenfity, which is particularly confpicuous in women and children, as illuftrated at large under the head of CONVULSIONS.

We have there ftated the impoffibility of explaining the proximate caufe of convulfive difeafes, in confequence of our ignorance of the nature of the nervous power, or of the connection between the action of the mufcles and the brain, or the faculty of volition, in a ftate of health. And it were fufficient to mention the attempts to reafon upon the fubject, which the ableft phyficians have made, in order to prove their futility. The learned Boerhaave fays, (*Aph.* 1086.) "Et patet quidem, caufam proximam omnis epilepfiæ exquifitæ femper effe nimiam cerebri in nervos motorios, nullam in fentientes, actionem." "It is obvious that the proximate caufe of every perfect epilepfy is always too great an action of the brain upon the nerves of motion, and too little upon thofe of fenfe:" which is only ftating the fact in other words; for it amounts merely to this: "in every true epilepfy the motions of the body are violent, and the fenfe is loft: the proximate caufe is ftill as obfcure as before." Dr. Cullen fcarcely pretends to form a theory upon the fubject. "I might fay," he obferves, "that it is an affection of the energy of the brain, which, ordinarily under the direction of the will, is here, without any concurrence of it, impelled by preternatural caufes. But I could go no further: for as to what is the mechanical condition of the brain, in the ordinary exertions of the will, I have no diftinct knowledge; and therefore muft be alfo ignorant of the preternatural ftate of the fame energy of the brain under the irregular motions here produced." (Firft Lines, § 1284.) The indications of cure therefore cannot be formed from a knowledge of the proximate caufe of the difeafe; but we obtain fome ufeful intimations for the treatment, by diligently attending to the various remote caufes; both thofe which induce a predifpofition, and thofe which occafionally excite the difeafe. Our principal object, then, will be to avoid the occafional caufes, and to remove or correct the predifponent.

The predifpofition to epilepfy, in the majority of inftances, feems to confift partly in what may be termed a morbid irritability, or mobility, of conftitution, in which the action of flight irritations (which are applied to moft perfons with impunity) excites great commotion in the nervous fyftem; and partly in a turgefcence of the veffels of the head, which accompanies a general plethora. This appears from the circumftances, that plethoric perfons are very frequently the fubjects of epilepfy; that it is often brought on by caufes inducing any unufual turgefcence of the blood-veffels; and that it has been frequently cured by diminifhing the plethoric ftate of the body, more frequently, we believe, than by any other fyftem of practice. This principle was inculcated by Dr. Cullen, and is ftrenuoufly adopted by the prefent Dr. Gregory, his fucceffor. It was likewife maintained by the late Dr. Fothergill, who has left us the following excellent remarks on this point of practice.

After ftating that many epilepfies occurred to him, which eluded all his endeavours to relieve them by means of the medicines ordinarily recommended as fpecifics, and which therefore fuggefted the neceffity of adpoting fome other mode of procedure, he fays, "I had obferved that fits were moft liable to return in the plenitude of health; that epileptics were often extremely incautious in refpect to diet; that children, highly indulged, were liable to the difeafe; that in every other period of juvenefcence, and in middle aged adults, if they were at all fubject to the difeafe, it was when they had either committed fome exceffes, or, by one means or another, were plethoric; and that, in habits fubject to epilepfy, the difeafe feldom recurred, without either an habitual indulgence in eating, or a neglect of neceffary exercife. This induced me to recommend, in many cafes, a total abftinence from all animal food, and from all fermented liquors. Care was taken to regulate the fecretions, and fuch a courfe of medicine prefcribed, as might feem expedient to induce the patients, or their friends, fcrupuloufly to comply with fuch a courfe of diet. It was in vain to reftrict the quantity of animal food. There are few who have, at all times, refolution enough to fubmit to the firft intimations of fatiety. It was, therefore, neceffary to enjoin fuch a kind of diet, as was accompanied with but flender provocations to excefs, and which, at the fame time, would afford the leaft quantity of nutriment; by which that fullnefs, which, in many epileptic cafes, appears to be a ftimulus fufficient to produce the fpafms, would be avoided, and the parts, which were the immediate feat of irritation, might gradually recover a degree of ftrength and firmnefs, that would be proof againft every flight impreffion.

"It often happens in difeafes, that a proper plan of diet is of much more importance in the cure than any thing we are acquainted with in the *Materia Medica*: it is, however, of not lefs neceffity to engage the patients and their friends in a fteady perfeverance of the method we direct. The generality of people have very little notion that diet can do more than merely fupport their ftrength; that it can be made fubfervient to the cure of their difeafes, they cannot eafily be brought to comprehend, &c.

"In young boys, I apprehend, the epilepfy moft generally proceeds from their own craving appetites, and the neglect of thofe who are about them. It may not be improbable, but in fuch cafes worms may alfo have a fhare in producing the fits. Be this as it may, anthelmintics, however powerful, feldom cure the difeafe; they may abate occafionally the frequency, or the violence of the attacks, but they too often, at the fame time, bring on a greater degree of irritability, and at length, if repeated frequently, and in confiderahle dofes, feldom fail of confirming the difeafe. Moderate laxatives, with a light chalybeate interpofed, and fteadily continued, with a courfe of diet, confifting of milk, vegetables, fruit, and things prepared from them, and in moderate quantities, feldom fail of removing the difeafe in fuch habits. Riding and bathing in cold water, and the ufual means of eftablifhing good health, muft, at the fame time, be attended to, and the plan purfued with patience; for it is not to be expected in difeafes that affect the nervous fyftem, the moft remote and fineft part of the economy, when once they have debilitated, or otherwife difordered, thefe very feeling parts, and their influence is become habitual, that after-medicines, however active, penetrating, and efficacious, can, in a very fhort time, reftore the ability to perform their functions as they ought to do." (See Medical Obf. and Inquiries, vol. vi. p. 72.)

This plan of light and moderate living, with occafional laxatives, fhould be adopted in every cafe of epilepfy, where it does not arife from lofs of blood, or other caufes of inanition, or is not connected with a cachectic or emaciated habit: and even in the laft cafe, the plan is often ufeful, efpecially

cially where a morbid change, fuch as exoftofis, fuppuration, or tumour of any kind, is going on in the head.

It might be fuppofed that artificial evacuations, efpecially blood-letting, would be the moft effectual means of diminifhing the plethoric ftate of the fyftem: and fuch it certainly proves, when the plethora has become confiderable; and if it threatens immediate difeafe, this evacuation ought to be made to the quantity that the urgency of the fymptoms feems to require. It is, however, a matter of old obfervation, that blood-letting is not the proper mode of preventing the recurrence of the plethoric ftate; but, on the contrary, that it is often the means of favouring it, efpecially when the operation is performed at regular periods. There is, however, a cafe of epilepfy, as Dr. Cullen remarks, in which there is a periodical or occafional recurrence of the fullnefs and turgefcence of the fanguiferous fyftem, giving occafion to a recurrence of the difeafe. In fuch cafes, when the means of preventing plethora have been neglected, or may have proved ineffectual, it is abfolutely neceffary for the practitioner to watch the returns of thefe turgefcences, and to obviate their effects by the only certain means of doing it, that is, by a large blood-letting. When the general plethora is not great, but the fymptoms indicate confiderable local turgefcence in the head, the application of cupping-glaffes, after fcarification of the neck, or the ufe of a feton, blifter, or iffue, near the fame part, will afford the means of fome relief, by the evacuations which they produce. An open iffue, indeed, in diftant parts, as in the arm, has been found ufeful in fome inftances of epilepfy, by tending to obviate the plethoric ftate, or, as Dr. Cullen fuggefts, by determining occafional turgefcences to thofe parts, and, therefore, diverting them, in fome meafure, from their action upon the brain.

Epilepfy, however, as we have already ftated, is alfo the refult of a ftate of debility, with which the exceffive nervous mobility that is eafily excited to convulfions is, in many other inftances, obferved to be connected; efpecially in hyfteria, in the condition of infancy, &c. Where this debility has been the confequence of inanition, as from lofs of blood, from previous difeafe, and fo forth, a nourifhing generous diet will be requifite to reftore the ftrength; and inftances are occafionally feen, in which the propriety and fuccefs of this practice are manifeft. Where there is obvioufly a feeble ftate of body, with pale complexion, and without any appearances of local plethora, the propriety of being much in the open air, of ufing the cold bath frequently, and of regular exercife, adapted to the ftrength and habits of the patient, muft be equally evident. He may ftill farther contribute to remove debility, and its confequences, efpecially that great mobility which is a principal part of the predifpofition to epilepfy, by the ufe of tonic and antifpafmodic medicines.

By a fort of routine, too generally purfued by indifcriminating practitioners, remedies of the laft mentioned claffes are moft commonly given in epileptic cafes, more particularly of late the metallic tonics, while the diet and regimen are not fufficiently attended to. However, as the circumftances of the conftitution occafionally favour their operation, it cannot be doubted that the difeafe has, in many inftances, been removed by thefe means; and numerous cafes are on record, in which particular fpecies of tonic remedies have effected the cure of epilepfy. The preparations of iron have been moft commonly employed for this purpofe, as the rubigo ferri, or the fulphat of iron, or its combination with ammonia (ferrum ammoniacale); and cures have been faid to be accomplifhed by all thefe preparations. Dr. Cullen, however, obferves, that he never found them effectual; which he attributes partly to their not having been always employed in the proper circumftances of the difeafe, and partly to the inadequate quantities in which they have been given. (Firft Lines, § 1335.) A preparation of copper, the cuprum ammoniacum of the Edinburgh Difpenfatory, has been one of the moft celebrated of the metallic tonics, and Dr. Cullen admits it to have been often fuccefsful. It fhould be given in the dofe of one grain at firft, twice in the day, and gradually increafed to as much as the ftomach will bear. Zinc, efpecially in the form of flowers of zinc, (as the oxide was formerly denominated,) has been much extolled for its virtues in the cure of epilepfy, and other fpafmodic difeafes, when it was ufed in fmall dofes. Much larger quantities of it, however, have been adminiftered lately, and its character of efficacy has been confiderably diminifhed. The fulphat of zinc, or white vitriol, appears to be a more efficacious tonic. Arfenic has more recently been introduced as a remedy for epilepfy. The fafety and great powers of this metal, as a medicine, efpecially in the cure of *periodical* diforders, fuch as intermittent fevers, megrim, or intermittent head-ache, &c. have been fully eftablifhed, and afford an analogy in its favour. A writer on this fubject, in the Edin. Med. and Surg. Journal (for July 1809) ftates, that he has found arfenic fuccefsful in the cure of epilepfy, when it "occurred in young fubjects, principally anterior to the age of puberty, and of what is termed a delicate make, and feeble ftamina, efpecially when the difeafe affumes, or very nearly approaches, a periodic form. The drunken epileptic likewife, when not of a full plethoric habit, has found a cure from the firm and judicious ufe of this potent remedy, due attention having been paid to the alvine evacuations." There is ftill another tonic of the metallic clafs, which has lately been recommended as an efficacious remedy for epilepfy, the nitrat of filver (or lunar cauftic), and is faid to have cured the difeafe, when it had already been of many years ftanding. (See two cafes of this nature, Med. and Phyf. Journal, vol. i. p. 184. vol. ii. p. 70.) A quarter of a grain of this active fubftance, given three times a day, is a fufficient dofe for an adult in the beginning; it may be afterwards carefully increafed.

The vegetable tonics are admitted to poffefs lefs efficacy in alleviating this dreadful diforder. Among thefe the bitters have chiefly been employed, and the cinchona is the moft active. Like the arfenic, it is efpecially adapted to thofe epilepfies which recur at certain periods, and which are not at the fame time accompanied with any plethoric ftate, or turgefcence of the blood: in fuch periodical cafes, if the bark is employed fome time before the expected recurrence, it may be ufeful; but it muft be given in large quantity, and as near to the time of the expected recurrence as poffible. The leaves of the orange tree have fometimes proved ufeful in this difeafe, probably by the bitter quality which they poffefs.

But this caution muft again be given, with refpect to the employment of any of the above-mentioned tonics in this difeafe, that in all cafes where it depends upon conftant or occafional plethoric ftate of the fyftem, thefe medicines are likely to be at leaft ineffectual; and if fufficient evacuations be not made at the fame time, they are likely to be very hurtful. The various fuccefs with which fuch remedies have been adminiftered is, doubtlefs, to be afcribed partly to inattention to thefe circumftances; although it is equally clear, that many epilepfies, connected with organic lefion in the head, or a connate diforder of the habit, are beyond the power of any medicine.

With a view of diminifhing the tendency to the convulfions of epilepfy, various antifpafmodic medicines have been employed,

employed, ſuch as valerian, caſtor, muſk, the fœtid gums, empyreumatic oils, and other ſubſtances of ſtrong and offenſive odour. But, although theſe remedies were generally adminiſtered at one period, and were much extolled for their antiſpaſmodic powers, they ſeem to have loſt their high character, in a great meaſure, and are much leſs employed than heretofore.

Several remedies have alſo been introduced, as *ſpecifics*, in the diſeaſe in queſtion; *i. e.* as remedies which poſſeſſed a peculiar influence over it, independently of any ſenſible quality or operation. Such are the viſcus quercinus, or miſletoe, the cardamine pratenſis, agaricus muſcarius, &c. Experience has not ſanctioned the recommendation of theſe medicines, which appear to be nearly inert. If the miſletoe were ever beneficial, it was probably in thoſe times when it was an object of religious ſuperſtition, and operated through the medium of an impreſſion on the mind. On the ſame principle, taking remedies that excited horror may have ſometimes ſucceeded in curing the diſeaſe; ſuch as the powder of human ſkulls, (pulvis cranii,) &c. A pamphlet has been publiſhed lately, however, in which the ſpecific efficacy of the miſletoe is again contended for by Dr. H. Fraſer. But the caſes, there related, are mentioned ſo briefly and uncircumſtantially, that no juſt inference as to the means of cure can be deduced; and the weight of negative evidence is, on the other hand, ſo great, that we are diſpoſed to attach little credit to the miſletoe. We have employed it, ſince the publication of the pamphlet alluded to; but without any effect.

Dr. Fothergill, whoſe experience and ſound obſervation led him to infer, that plethora was the moſt frequent cauſe of *curable* epilepſies, and the ſyſtem of diet and evacuation, before mentioned, the moſt effectual means of cure, was diſpoſed to attribute the reputed efficacy of all the laſt-named remedies for epilepſy to a very different operation, than was intended by the preſcriber: namely, to their impeding digeſtion, and conſequently preventing incurring plethora. "Valerian," he ſays, "caſtor, the fœtid gums, empyreumatic oils, and, if there be any thing ſtill more diſguſtful, commonly make a part of the medicines propoſed for this diſeaſe. There are ſome others, whoſe qualites, indeed, are not quite ſo repugnant to our taſte and ſmell, ſuch as the miſletoe, and the *flores cardamines*; but to balance this difference, it is requiſite to take theſe ſuch a length of time, and in ſuch quantities, as make them not leſs diſguſtful at length. May not, therefore, both theſe kinds of medicines, and moſt of thoſe made uſe of as ſpecifics from ancient authority, now and then confirmed with inſtances of benefit, derive the greateſt part of their conſequence from their quantity, or their diſguſting qualities, which, by leſſening the appetite, allow nature to recover herſelf, and ſhake off a diſeaſe, which indulgence principally produced." (Med. Obſ. and Inquir. vol. vi. p. 77.)

The ſight of others in a fit of epilepſy is the moſt common of the mental irritations which produce epilepſy: this, therefore, ſhould be guarded againſt, eſpecially among children, and more particularly in a family where epilepſy has already appeared. The famous caſes of epilepſy, thus communicated among the orphans at the hoſpital at Haerlem, are well known; (ſee Convulsions,) as well as Boerhaave's ſucceſsful cure, by threatening a ſevere puniſhment (burning with a hot iron) to the firſt who ſhould be ſeized with a fit. This counter-impreſſion upon the mind, which Dr. Cullen whimſically terms the *tonic* of fear, was ſufficient to obviate the effects of the other. (See Kaau Boerhaave impetum faciens, § 406.)

Some anti-epileptic powers have been attributed to opium, hyoſcyamus, or henbane, digitalis, and ſome other ſedative medicines; but it is obvious that theſe ſubſtances can only be ſerviceable in thoſe caſes where the diſeaſe depends upon irritation, or increaſed irritability, when their effects will be temporary; and that, when there is any plethoric or inflammatory condition preſent, they muſt, with the exception of digitalis, prove hurtful, eſpecially opium.

With reſpect to the fit itſelf nothing can be done, in general, except reſtraining the patient from injuring himſelf. He ſhould be removed from the ground, or from the vicinity of any hard body, againſt which he might be bruiſed by the convulſive motions of the limbs; and in thoſe caſes in which the tongue is apt to be protruded, and lacerated by the teeth, a ſort of gag ſhould be introduced. In very plethoric habits, where the determination of blood to the head is very great, it may be adviſeable to open a vein during the fit, in order to obviate the immediate danger of life, from a rupture of the veſſels of the brain.

When the fit is preceded by an *aura*, as before mentioned, which has been ſuppoſed to ariſe from irritation propagated along the courſe of ſome particular nerve, various means of preventing the fit have been ſuggeſted; ſuch as deſtroying the part, in which the *aura epileptica* ariſes, by means of the knife or cauſtic, applying a bliſter, or making an iſſue in it, or cutting the branch of the nerve along which the *aura* ſeems to paſs, or laſtly, applying a ligature upon the limb, above the part from which the *aura* ariſes. A tourniquet has been recommended for the laſt purpoſe, to be worn looſe upon the limb, and tightened the inſtant that the *aura* is perceived; by which means the epilepſy has been ſaid to have been prevented in ſeveral inſtances.

On diſſection after death from epilepſy, a variety of morbid and preternatural appearances have been in the head, to which the ſymptoms might be juſtly attributed, in conſequence of the mechanical irritation of the brain. Thus irregularity in the arrangement of the bones, or ſome other malformation of the cranium, inequalities or protuberances on its interior ſurface, ſplinters, or depreſſion of the bones from fracture; tumours, thickening, and oſſification in the membranes enveloping the brain; fluids of various acrimony effuſed, or collected within the brain, or on its ſurface, and tumours formed in the ſubſtance of the brain; have in various inſtances been diſcovered after epilepſy had proved fatal.

EPILESMON, from ἐπιλήθω, *I cauſe to forget*, a term uſed by the old writers in *Medicine*, to expreſs a loſs of memory.

EPILOBIUM, in *Botany*, a name adopted by Conrad Geſner, and explained by him as indicative of the character of this genus, ἐπὶ λοβοῦ ἴον, *a violet*, or beautiful flower, growing upon a pod; in which he is followed by Dillenius and Linnæus. See Bauhin's Pinax 245, ſect. 7; Dill. Plantæ Agri Giſſenſis, 132; and Linn. Phil. Bot. 176. Willow-herb.—Linn. Gen. 188. Schreb. 251. Willd. Sp. Pl. v. 2. 313. Sm. Fl. Brit. 409. Mart. Mill. Dict. v. 2. Juſſ. 319. Gærtn. t. 31. (Chamænerion; Tourn. t. 157.) Claſs and order, *Octandria Monogynia*. Nat. Ord. *Calycanthemæ*, Linn. *Onagræ*, Juſſ.

Gen. Ch. *Cal.* Perianth ſuperior, of one leaf, deeply four-cleft; ſegments oblong, pointed, coloured, deciduous. *Cor.* Petals four, roundiſh, broadeſt upward, cloven, ſpreading, inſerted into the calyx between its ſegments. *Stam.* Filaments eight, awl-ſhaped, alternately ſhorter; anthers oval, compreſſed, obtuſe. *Piſt.* Germen inferior, cylindrical, very long; ſtyle thread-ſhaped; ſtigma thick, obtuſe, either undivided or four-cleft, the lobes revolute, downy. *Peric.* Capſule very long, cylindrical, with four furrows, four

four cells, and four valves, with a longitudinal linear partition originating from the centre of each. *Recept.* columnar, fquare, its angles attached to the partitions, which at length feparate from it. *Seeds* numerous, oblong, crowned with down, and affixed in two rows to each angle of the receptacle.

Eff. Ch. Calyx in four deep fegments. Petals four. Capfule oblong, inferior. Seeds feathered.

An elegant genus of plants, with flowers of a paler or deeper rofe-colour, natives of watery or boggy fituations, chiefly in the cooler or mountainous parts of Europe. The *roots* in all are perennial, and often creeping. *Leaves* undivided. *Flowers* fpiked or racemofe, terminal. *Stamens* in fome direct, in others declining.

The fpecies in Willdenow are twelve, to which are to be added E. *rofeum,* Schreb. Lipf. 147. Sm. Fl. Brit. 411. Engl. Bot. t. 693, and E. *alfinifolium,* Villars Dauph. v. 3. 511. Engl. Bot. t. 2000, both by him made varieties of E. *montanum.* The Britifh fpecies therefore, at prefent afcertained, are nine.

E. *anguftifolium,* Linn. Sp. Pl. 493. Curt. Lond. fafc. 2. t. 24. Engl. Bot. t. 1947, called the French or Perfian Willow, or Rofebay Willow-herb, is one of the moft handfome, though moft common, of the whole. It rarely with us occurs wild, but thrives and bloffoms abundantly in any garden, whether the fituation be moift or dry, even in almoft any part of London. Linnæus fays, Fl. Lapp. n. 146, "it frequently, like a garden, furrounds the hut of the wild Laplander, who vies with Diogenes in the fimplicity of his houfehold furniture, but whofe habitation feems the palace of a divinity, when this ftately plant is in bloom." This is an inftance, among many, of a truly alpine plant fucceeding well in the fmoke of a city, while others require the pureft air poffible.

EPILOGUE, Epilogus, in *Oratory,* &c. The peroration, or laft part of a difcourfe, or treatife; containing ordinarily a recapitulation of the principal matters delivered.

The word is Greek, επιλογος, formed of the verb επιλεγω, *I fay after;* the epilogue being the end, or conclufion of a difcourfe.

Epilogue, in *Dramatic Poetry,* is a fpeech addreffed to the audience, when the play is over, by one of the principal perfons or actors in the piece; containing ufually fome reflections on certain incidents in the play, particularly thofe of the part of the perfon who fpeaks it.

In the modern tragedy, the epilogue has ufually fomewhat of pleafantry in it; intended, perhaps, to compofe the paffions raifed in the courfe of the reprefentation, and fend the audience away in good humour; though how far that defign is good and laudable will bear fome difpute: an ingenious author in the Spectator compares it to a merry jig on the organ, after a good fermon, to obliterate any impreffions that might have been made thereby, and fend the people away juft as they came.

In effect, though the epilogue, in this fenfe, may feem an abufe, yet has it the countenance of antiquity; the Romans had fomething of the fame nature, though under another name. Their exodium was a kind of farce, brought on the ftage when the tragedy was over: "ut quicquid lacrymarum ac triftitiæ cepiffent ex tragicis affectibus, hujus fpectaculi rifus detergeret," fays the fcholiaft of Juvenal. The epilogue is but of modern date, much later than the prologue. Many, indeed, have taken the exodium of the ancient Greek drama for an epilogue, becaufe Ariftotle defines it to be a part rehearfed after the chorus had fung for the laft time; but in reality, it was of a quite different nature. The exodium was the laft of the four parts of the tragedy: containing the unravelling and cataftrophe of the plot, and anfwering to our laft, or fifth act.

EPIMEDIUM, in *Botany,* as at prefent underftood, is certainly different from the επιμηδιον of Diofcorides, which feems to be *Ofmunda Lunaria,* though his defcription does not exactly agree even with that plant. The derivation of the name has always appeared obfcure. Ambrofini deduces it "from επιμυω, *to clofe,* or *fhut up,* becaufe the leaves conceal the flowers; or from επι μηδια, becaufe of its growing frequently in Media." Neither of thefe is fat sfactory, and the word feems rather to have a reference to the plant μηδιον, a *Campanula,* or fomething very near that genus, which immediately precedes it in Diofcorides. However this may be, the name *Epimedium* is now univerfally applied to the Barren-wort. Linn. Gen. 59. Schreb. 79. Willd. Sp. Pl. v. 1. 660. Sm. Fl. Brit. 187. Prod. Fl. Græc. 103. Mart. Mill. Dict. v. 2. Juff. 287. Tourn. t. 117. Clafs and order, *Tetrandria Monogynia.* Nat. Ord. *Corydales,* Linn. *Berberides,* Juff.

Gen. Ch. *Cal.* Perianth inferior, of four ovate, obtufe, concave, fmall, fpreading, deciduous leaves, placed directly under the petals. *Cor.* Petals four, ovate, obtufe, concave, equal, fpreading. Nectaries four, pouch-fhaped, blunt at the bafe, the fize of the petals and lying upon them, fixed to the receptacle by the edge of their orifice. *Stam.* Filaments four, awl-fhaped, preffed clofe to the ftyle; anthers oblong, erect, of two cells and two valves, the latter feparating from their bafe upwards, leaving the partition free. *Pift.* Germen fuperior, oblong; ftyle fhorter than the germen, as long as the ftamens; ftigma fimple. *Peric.* Pod oblong, pointed, of one cell and two valves. *Seeds* numerous, oblong.

Eff. Ch. Petals four. Nectaries four, pouches lying on the petals. Calyx oppofite to the petals, caducous. Pod fuperior, of one cell, with many feeds.

E. *alpinum.* Linn. Sp. Pl. 271. Engl. Bot. t. 438. Fl. Græc. ined. t. 150. Ger. em. 480. The only fpecies, a native of fhady mountainous places in feveral parts of Europe, not very difficult of cultivation in our gardens, flowering in May. The *root* is perennial, creeping, flender, blackifh. *Stems* upright, fimple, about a foot high, round, fmooth, bearing one large, twice or thrice compound leaf, divided irregularly in a three-fold order, and compofed of large, pendent, tremulous, thin, delicate, heart-fhaped, pointed, finely ciliated, fmooth leaflets, glaucous beneath; and one upright *panicle,* alternately branched, whofe ftalks are red, and rough with glandular hairs. *Flowers* fingular and elegant, drooping, with dark red petals, and yellow pellucid nectaries. Dr. Smith, in his Englifh Botany, fuggefts that "perhaps what is called the ftem ought to be reckoned only the footftalk of the leaf, which, as in *Turnera,* bears the flowerftalk."

EPIMENIDES, in *Biography,* a Cretan philofopher and poet, who was contemporary with Solon, and of whom many fables are related. Among others it is faid, that, being fent by his father in fearch of a ftraying fheep, he flept in a cave, where he repofed himfelf for 50 years, and when he awoke, found to his furprife, that he was become an old man, that every thing about him was become new and ftrange. It is alfo recorded of him, that he could difmifs the foul from his body, and recal it at pleafure; and that he had familiar intercourfe with the gods, and poffeffed the gift of prophecy. Moft of thefe fictions may probably have originated with the Cretans, who were, to a proverb, famous for their powers of invention. (Titus, i. 12.) The more credible account of Epimenides is, that he was a man of fuperior talents, who pretended to intercourfe with the

the gods, and in order to justify his pretensions, lived in retirement upon the spontaneous productions of the earth, and practised various arts of imposture. At the time of his pretended inspiration he might, possibly, have the art of appearing totally insensible and entranced, which would be considered by ignorant and deluded spectators as a power of dismissing and recalling his spirit. Such was his reputation for sanctity, and for the performance of religious rites, that, during a plague in Attica, which happened in the 46th olympiad, about 596 years B.C., the Athenians sent for him to perform a sacred lustration: in consequence of which, as it is said, the gods were appeased and the plague ceased. Of this ceremony we have given a particular account under the article ALTAR. On occasion of this visit to Athens, Epimenides became acquainted with Solon, the Athenian legislator, who is said to have disapproved the conduct of the Athenians in this instance of superstition; and yet availed himself of the advice of the philosopher in compiling his celebrated code. The Athenians, however, were delivered from the pestilence, and were disposed liberally to requite Epimenides for his services. The philosopher declined accepting their offered recompence, and contented himself with a branch of the sacred olive, which grew in their citadel, and with this he returned to his native country, after having concluded a league between the Gnossians of Crete and the Athenians. Soon after his return to Crete he died, as Laertius says, at the age of 157 years, or, as the Cretans pretend, at the age of 299 years. The superstitious Cretans paid him divine honours after his decease; and he has been reckoned by some the 7th wise man of Greece, to the exclusion of Periander from this number. Laertius enumerates a variety of pieces written by Epimenides, both in prose and verse. Among the former was a treatise "On Sacrifices," and "An Account of the Cretan Republic;" and among the latter "The Genealogy and Theogony of the Curetes and Corybantes," in 5000 verses; "Of the Building of the ship Argo, and Jason's Expedition to Colchis," in 6500 verses; "Of Minos and Rhadamanthus," in 4000 verses; and a treatise "Of Oracles and Responses," mentioned by St. Jerome, from which St. Paul is said to have taken the quotation in his epistle to Titus, ch. i. 12. Laert. l. i. c. 10. Brucker's Hist. Phil. by Enfield, vol. i.

EPIMETRON, επι and μετρον, *measure*, in *Antiquity*, an allowance given the tax-gatherers in the Roman provinces, over and above the just quantity of wine or grain they were obliged to furnish. The epimetron, or over-measure, in different provinces, was different, being always greater in those that were remote, than in the nearer provinces. The different kinds of things wherein it was given made likewise a difference in the quantity allowed. The reason of allowing an epimetron, or over-measure, was to make good the leakage of the wine and waste of grain, that would necessarily happen by transporting it to Rome.

The provinces whose taxes were converted into money, and paid in specie, were free from epimetron.

EPIMORIOS, Επιμοριος, *superparticular*, of μειρω, *I divide*, an epithet given by Galen to certain differences in the pulses with respect to their inequality as to the time of their beating. All times, rythms, or modulations of the pulse, according to number, consist, he observes, of equal or unequal proportions. Of equal, when the time of the distension is equal to that of contraction; and of unequal, when the one of these exceeds the other; and this inequality may be from certain or uncertain excesses. The certain excesses may be either in multiple proportion, or as number to number, which is the epimorion.

EPIMULIS, of επι, *upon*, and μυλη, *whirle bone on the top of the knee*, a name given, by some anatomists, to the patella, or knee-pan.

EPIMYLIA, in the *Ancient Music*. We are told, in Athenæus, that the epimylia, and the song called "Hymæus," were the same (see HYMÆUS): Athenæus adds, that it is probable that the word epimylia comes from εμυλις, which in Dorian signifies sometimes the return, and sometimes the augmentation and surplus of nourishment given to those who labour at the mill. But perhaps after all, this word comes from μυλα, *a mill*.

EPIMYTHION, Επιμυθιον, in *Rhetoric*. See FABLE.

EPINA, or HARPINA, in *Ancient Geography*, a town of Triphylia, upon the river Parthenia, N. of Phryga.

EPINAC, in *Geography*, a small town of France, in the department of Saône and Loire, chief place of a canton in the district of Autun, with a population of 1128 individuals. The canton contains 11 communes and 5802 inhabitants, on a territorial extent of 155 kiliometres.

EPINAL, or ESPINAL, a town of France, in the department of the Vosges, chief place of the district of the same name, with a population of 7321 individuals. It is situated on the river Mosello, 12 miles N.W. of Remiremont, and 480 miles of Paris, and 42 miles S.E. of Nancy. N. lat. 48° 22′. The canton has a territorial extent of 297½ kiliometres, 19 communes, and 14,709 inhabitants.

As chief place of a district, Epinal has a sub-prefect, a ranger, a brigadier-general, who commands in the department, a captain of the national gendarmerie, two courts of justice, and a register office. It has several paper-mills. The soil produces wheat, rye, oats, hemp, and flax. Its principal trade is with hemp and flax, hemp and flax seed, oil, and the produce of a few manufactures of linen and cotton stuffs, and writing paper. The whole district comprises five cantons, 116 communes, and 62,592 inhabitants, on a territorial extent of 1285 kiliometres.

EPINAY, a small town of France, in the department of l'Ille and Vilaine; three miles W. of Vitré, which, before the revolution of 1789, conferred the title of marquis on the lord of the manor.

EPINENEUCOS, from νευω, *I nod*, in the old writers of *Medicine*, a word used to denote a sort of unequal pulse, beating differently in the different parts of the same artery; as when it rises strongly against the two middle fingers of the physician who feels it, and weaker at the extremes; this sort of pulse is described by Galen as common to hectic patients, and is called also perineneucos.

EPINEPHELOS, of επι and νεφελη, *clouds*, in the *Writings of the Ancient Physicians*, a term used to express the cloudy matter seen floating in the urine in fevers, &c. See ENEOREMA.

EPINETTE, *Fr.* in *Music*. See SPINET.

EPINEU *le Chevreuil*, in *Geography*, a town of France, in the department of the Sarte and district of Sillè; 12 miles W. of Le Mans.

EPINEUL, a town of France, in the department of the Yonne, and district of Tonnerre; 1½ mile N. of Tonnerre.

EPINEUX *des Lombes*, in *Anatomy*, a name given by Winslow, and some other of the French authors, to certain small muscles of the loins, not mentioned by the old anatomists; but called by Albinus interspinales lumborum.

EPINICINION, Επινικινιον, in the *Ancient Music*, a song of victory, by which the Greeks celebrated the triumph of conquerors.

EPINICION, Επινικιον, from επι, *on*, νικη, *victory*, in the *Greek and Latin Poetry*, denotes, 1. A feaft, ceremony, or rejoicing, on occafion of a victory obtained. 2. A poem or compofition, on the fame fubject. Scaliger treats exprefsly of the epinicion in the Poetics, lib. i. cap. 44.

EPINOI, in *Geography*, a fmall town of France, in the department of the North; 9 miles S. of Lille, and 9 miles N. of Douai.

EPINYCTIS, (from επι, and νυξ, *night*,) in *Surgery*, a kind of puftule, of the nature of the furunculus, originating in the night-time; or, according to Ætius and Paulus, attended at this period with the moft pain.

EPIODIUM, in the *Ancient Mufic*, a funeral fong or dirge with the Greeks; called Mænia by the Romans.

EPIPACTIS, in *Botany*; according to Hederic, from επιπηγνυμι, or επιπηγνυω, to congeal, or to grow together at the fummit. In this fenfe the name may very well apply to the *Helleborine* of fome authors, for which Haller and Swartz retain it, and which has always been taken for the επιπακλις of Diofcorides, whofe account of the matter is too fhort and vague to afford much light. The petals of this plant do indeed approach each other, towards the upper part, more than in many of the *Orchideæ*, and fuch an explanation is more correct than that of Ambrofini, who derives the word from παγος, ice, or πηκλος, frozen, "becaufe the herb grows in very cold places, as it were upon or above the ice;" which circumftance by no means applies to it. Haller in Act. Helvet. v. 4. 100. Hift. Stirp. Helvet. v. 2. 147. Swartz. Act. Holm. 1800. p. 231. t. 3. f. N. Tracts on Botany, 159. Sehrad. Neues Journ. v. 1. 62. Willd. Sp. Pl. v. 4. 83. (Helleborine; Tourn. t. 249. Serapias; Linn. Gen. 462. Schreb. 503. Juff. 65. Gærtn. t. 14.) Clafs and order, *Gynandria Monandria*. Nat. Ord. *Orchideæ*.

Gen. Ch. reformed. *Cal.* three-leaved; leaflets direct, a little fpreading, concave, acute. *Cor.* Petals two, rather fmaller than the calyx, flightly fpreading. Nectary a lip proceeding from the lower part of the ftyle, tapering, or concave, or keeled, at the bafe, ufually longer than the calyx, deflexed, entire or cloven, concave or flattifh, often furrowed above. *Stam.* Anther an hemifpherical, moveable, permanent, terminal lid, of two cells, attached by its pofterior edge to the top of the ftyle; maffes of pollen oblong, powdery, granulated, fometimes lobed. *Pift.* Germen inferior, obovate, erect, furrowed, fometimes twifted; ftyle erect, roundifh, notched at the top; ftigma in front, oblique, under the anther. *Peric.* Capfule inferior, oval, with fix ribs and one cell, opening by clefts between the ribs. *Seeds* numerous, minute, tunicate.

Eff. Ch. reformed. Calyx-leaves direct, flightly fpreading. Lip without a fpur. Anther a terminal permanent lid. Pollen powdery, granulated.

Swartz and Willdenow enumerate fourteen fpecies of this genus, eight or nine of which are Britifh. They are divided into two fections, eight of them having an undivided lip, and fix a cloven one. The former are,

1. E. *latifolia*. (Serapias latifolia; Linn. Syft. Veg. ed. 14. 814. Sm. Fl. Brit. 942. Engl. Bot. t. 269.) A native of cool, fhady, rather mountainous woods, throughout Europe. The *roots* are perennial and creeping. *Stems* fimple, about two feet high, leafy, roughifh. *Leaves* ovate, or broad-lanceolate, ribbed and plaited, clafping the ftem alternately. *Flowers* in a long terminal fpike, with bracteas at leaft as long as the germen, the lower ones longer than the whole flower. *Calyx* and *petals* of a brownifh green. *Nectary* fhorter than either, heart-fhaped in front, purplifh, acute.

2. E. *paluftris*. (Serapias paluftris; Scop. Carn. v. 2. 204. Lightf. 527. Sm. Fl. Brit. 943. Engl. Bot. t. 270.) An elegant native of watery, boggy meadows, in England and other parts of Europe, flowering in July and Auguft. The *flowers* are fewer, but larger and more fpecious than the laft, being variegated with white, purple and yellow, and the lip is crenate. Linnæus has called this S. *longifolia*, but very incorrectly, and from miftake.

3. E. *microphylla*. Sw. (Serapias parvifolia; Ehrh. Herb. 120.) A native of Germany and Switzerland; poffibly alfo of England, as we have fome fufpicion of its being the Helleborine altera, atrorubente flore, of Ray's Synopfis, 383. It moft refembles the firft fpecies, but has much fmaller leaves.

4. E. *grandiflora*. (E. pallens; Sw. Serapias grandiflora; Sm. Fl. Brit. 944. Engl. Bot. t. 271.) Frequent in the beech woods of Berkfhire and other midland counties of England, flowering in June. The *flowers* are few, clofed, large and elegant, white with yellow lines upon the lip. *Leaves* elliptical.

5. E. *enfifolia*. Willd. (Serapias enfifolia; Sm. Fl. Brit. 945. Engl. Bot. t. 494. S. xiphophyllum; Linn. Suppl. 404.) Confounded by Haller, Hudfon and others with the laft, from which it differs in its minute *bracteas*, narrower and longer *leaves*, fhorter *lip*, and more flender *germen*. It grows in Switzerland, and very rarely in the mountainous parts of Yorkfhire and Worcefterfhire.

6. E. *rubra*. (Serapias rubra; Linn. Syft. Veg. ed. 14. 816. Sm. Fl. Brit. 946. Engl. Bot. t. 437.) Native of fhady mountainous woods in feveral parts of Europe, rare in England. It is diftinguifhed by its elegant rofe-coloured *flowers*, whofe lip is marked with yellow wavy ridges, and auricled at its bafe.

7, 8. E. *erecta* and *falcata*, natives of Japan, are the only remaining fpecies of this fection; and thefe, as Willdenow obferves, appearing to have a fpur to the flower, are perhaps fpecies of *Limodorum*.

The fpecies in Swartz and Willdenow with a cloven lip are,

9. E. *Nidus avis*. (Ophrys Nidus avis; Linn. Sp. Pl. 1339. Sm. Fl. Brit. 931. Engl. Bot. t. 48.) A parafitical plant, growing in fhady beech woods, chiefly on a chalky foil, and fingular for its uniform pale brown hue. The *root* confifts of numerous cluftered juicy fibres. *Leaves* none, except fmall fcales on the ftem. *Flowers* numerous, forming a denfe fpike, inodorous, with a cloven divaricated lip.

10. E. *ovata*. (Ophrys ovata; Linn. Sp. Pl. 1340. Sm. Fl. Brit. 932. Engl. Bot. t. 1548. Curt. Lond. fafc. 3. t. 60.) Frequent in woods, flowering in June like moft of its genus. The *ftem*, a foot high, bears only two oppofite, broad, oval leaves, and a fpike of numerous fmall green *flowers*, whofe long pendulous lip produces a fmall drop of honey in front, thus proving its right to the title of nectary. See Sm. Introd. to Botany, 461.

11. E. *cordata*. (Ophrys cordata; Linn. Sp. Pl. 1340. Sm. Fl. Brit. 933. Engl. Bot. t. 358.) Grows on boggy mountainous heaths in Scotland and the north of England, as well as in Switzerland, &c. It is fcarcely a quarter fo large as the laft, and has heart-fhaped *leaves*, and a four-lobed lip.

12. E. *convallarioides*. Sw. in Web. and Mohr. Beitr. v. 1. t. 1. (Ophrys cordata; Michaux Fl. Boreali-Amer. v. 2. 158.) Native of the Weft Coaft of North America, and of Newfoundland. A flender delicate fpecies, with a pair of roundifh heart-fhaped *leaves*, capillary racemofe *flower-ftalks*, narrow *calyx* and *petals*, and a dilated lip.

13. E.

13. E. *camtſchatca.* Sw. and Willd. (Ophrys camtſchatca; Linn. Sp. Pl. 1343. Neottia; Amœn. Acad. v. 2. 361. t. 4. f. 24.) Native of Siberia. Deſtitute of *leaves*, except a few ſheathing ſcales. The *flowers* are much like the laſt, but have a more linear nectary.

14. E. *unifolia.* (E. porrifolia; Sw. and Willd. Ophrys unifolia; Forſt. Prod. 59.) Found by Forſter in New Zealand. The *leaf* is ſolitary and ſheathing, riſing above the ſtalk, which it embraces, and which bears a ſhort denſe ſpike of ſmall *flowers*. We ſee no advantage in changing the original ſpecific name.

EPIPEDOMETRY, of επι, πους, *foot*, and μετρω, *I meaſure*, in *Mathematics*, ſignifies the meaſuring of figures that ſtand on the ſame baſe.

EPIPETRON, in *Botany*, a name given, by Theophraſtus and Ariſtotle, to a plant, ſuppoſed by many to be the ſame with the empetrum of Dioſcorides. But there is great reaſon to doubt whether the epipetron of the two older authors be the ſame plant; and whether, if they mean two different plants by this name, either of them agree with the empetrum of Dioſcorides. Theophraſtus ſays, that his epipetron never flowers: and Ariſtotle ſays, that his epipetron grows on rocky places, and continues to grow after it is taken up, as the orpin and ſome other plants will do.

EPIPHÆNOMENA, of επι and φαινομενον, *ſymptom*, in the *Writings of the Ancient Phyſicians*, a term uſed to expreſs ſuch of the ſymptoms, in certain diſeaſes, as did not uſually appear till the time that the diſeaſe was actually formed, called alſo epiginomena.

EPIPHALLUS, in the *Ancient Muſic*. It appears by a paſſage in Euſtathius, often quoted by Meurſius, that this was alſo the name of a dance, performed to flutes.

EPIPHAN, in *Geography*, a town and diſtrict of Ruſſia, in the government of Tula, ſituated on the Don.

EPIPHANES. See EPIPHANIUS. This term in Greek, Επιφανης, denoted eminent or illuſtrious, and thus it was applied to Antiochus, which ſee.

EPIPHANES, of επι and φαινομαι, an epithet given to Jupiter, becauſe he manifeſted his preſence by lightning and thunder, &c.

EPIPHANIA, a word uſed, by ſome of the ancient phyſicians, to expreſs the external habit of the body.

EPIPHANIA, in *Ancient Geography*, a town of Aſia Minor, in Cilicia, near the Mediterranean, between the branches of mount Amanus, on the river Carſus; probably denominated Epiphania in honour of Antiochus Epiphanes, king of Syria, who poſſeſſed Cilicia. We learn from Tacitus, that the part in Cilicia, in which this town was ſituated, became ſubject to the dominion of Rome under Lucullus, about the year of the city 683. It was afterwards epiſcopal under the metropolis of Anazarba.

EPIPHANIA *on the Euphrates*, a town of Aſia, ſituated on that river.

EPIPHANIA, a town of Syria, on the Orontes; which was ſubjected to the Romans about the year 690, during Pompey's expedition into the territory of Apamæa and into Coeleſyria. This town was ſituated between Lariſſa and Arethuſa; and it was reckoned by the Orientals one of the moſt ancient towns in the world, founded, as they imagined, by Hamath, one of the ſons of Canaan; and that its name was changed by the Macedonians in honour of Antiochus Epiphanes. (See HAMATH.) It was epiſcopal under the metropolis of Apamæa.

EPIPHANIA, a town of Aſia Minor, in Bithynia. Steph. Byz.—Alſo, a town of Aſia, on the banks of the Tigris, called by Steph. Byz. *Arſecicerta.*

EPIPHANIUS, or EPIPHANES, in *Biography*, the ſon of Carpocras, or Carpocrates, an hereſiarch in the ſecond century, was inſtructed by his father in the whole circle of the ſciences, and particularly in the Platonic philoſophy; but his death, when he was 18 years of age, diſappointed the hopes which the Carpocratians entertained concerning him. After his death he was honoured by them as a god, particularly in the iſland of Cephalonia, where a temple was erected to him, with altars, a grove, and a muſæum, and where the day of his nativity was celebrated with hymns, libations, ſacrifices, and feaſtings. Theſe are the reports of Clement of Alexandria and of Epiphanius, unconfirmed by the teſtimony of other writers. Epiphanes is now claſſed with the Valentinians. Lardner Hiſt. Heret. c. iii. § 1.

EPIPHANIUS, biſhop of Salamis in the iſland of Cyprus in the fourth century, and dignified by the Catholics with the title of Saint, was born in the vicinity of Eleutheropolis, in Paleſtine, about the year 320. In his youth he went into Egypt, where he inclined to the ſect of the Gnoſtics, but ſeparating from them, he joined himſelf to the Egyptian Aſcetics, imbibing their principles and conforming to their manners. In his 20th year he returned to his own country, and became a diſciple of Hilarion, the father of Paleſtine monkery. After ſome time he founded a monaſtery at Bezanduce, the village in which he was born, over which he preſided for the greateſt part of his life. In 367 or 368, he was appointed biſhop of Salamis, afterwards called Conſtantia, where his piety and ſanctity were held in high eſtimation, and where he was aſſiduouſly employed in writing defences of the orthodox doctrines againſt the attacks of heretics. His zeal, however, involved him in many troubles, which embittered a conſiderable portion of his life. One of the principal circumſtances which contributed to embarraſs and embroil him, and to entail diſgrace on his memory, was his inveterate oppoſition to the opinions of Origen. This produced a conteſt with John biſhop of Jeruſalem, who favoured theſe opinions, which, after many mutual invectives and recriminations, terminated in a breach between the two biſhops, that convulſed the eaſtern churches by the hatred and perſecuting ſpirit manifeſted in the conduct of their reſpective partiſans. Theophilus, biſhop of Alexandria, was an active adherent to the cauſe of Epiphanius, and held a council in 399, which condemned the writings of Origen, and prohibited all perſons from reading them, or having them in their poſſeſſion. This example was followed by a council of the biſhops of Cyprus, ſummoned by Epiphanius himſelf in the year 401. Failing of ſucceſs by the decrees of theſe councils and by the perſecution againſt Origen, which they were the means of inſtigating, the determined and zealous prelate took a voyage to Conſtantinople, in order to induce the biſhops in that city to adopt and ſanction the decrees of Alexandria and Cyprus. On his arrival, he declined holding any intercourſe with Chryſoſtom, biſhop of that city, unleſs he joined in the condemnation of Origen, and in withdrawing his protection from the exiled Egyptian monks. Exaſperated by the diſappointment of his views, he reſolved to preſent himſelf to the people in the church of the Apoſtles, and openly to condemn the books of Origen, and all his advocates. But before he could execute his purpoſe, he was warned of the irregularity of his proceedings, and of the ſedition which they might occaſion; and he, therefore, thought it moſt prudent to abandon his deſign. His next attempt was that of intereſting the court in his favour; and ſo violent and implacable was his zeal againſt thoſe who favoured Origen, that

that when the empress Eudoxia besought his prayers in behalf of the younger Theodosius, who was dangerously ill, he assured her that he should not die, if she would consent to discard the heretics, who were sheltered under the imperial patronage. The princess very properly reproved this arrogant and impious message; and his impetuosity was also checked by the Egyptian monks, who convicted him of being unacquainted with the principles of the persons, against whom he had been industriously exciting universal indignation. Thus foiled and abashed, he set out on his return to Cyprus, and died either on his voyage, or soon after his return, in the year 402 or 403, at a very advanced age. The piety of Epiphanius was unquestionable; but it was blended with a gloomy superstition, which led him to promote the austere discipline of the cloister, and to employ his episcopal influence in multiplying monastic institutions. In offices of charity for the relief of the indigent, he expended not only his own private fortune, but the greatest part of the revenues of his church, and large sums entrusted to his disposal. His learning was considerable, for, according to St. Jerome, who mentions him in terms of high commendation, and calls him πενταγλωττος, a man of five languages, he understood Greek, Syriac, Hebrew, Egyptian, and partly Latin. It is allowed, however, that he was deficient in judgment, and unskilful in wielding the weapons of controversy. Careless in his transcripts from ancient authors, and credulous in admitting unauthenticated reports, he has been betrayed into various contradictions and absurdities, so that his works, with respect to authority and reference, are depreciated in value. His style is mean, harsh, and unpolished, without perspicuity, and without connection. In his remaining works he has given several catalogues of the books of the Old and New Testament. His canon of the Old Testament was much the same with that of the Jews. (See Canon.) The books of the New Testament received by him are the same with those generally received by us. For both these classes of sacred books he professes the highest regard; nor does he ever make use of Christian apocryphal books, written in the name of apostles and falsely ascribed to them. With respect to the books of the New Testament, he says, that Matthew preached, and wrote his gospel in Hebrew, and that he was the only writer of the New Testament who used this language. He had heard, however, that the gospel of St. John, and the Acts of the Apostles, had been translated from Greek into Hebrew, and were in the library of the Jews at Tiberias. Matthew wrote first, and soon after Mark, who was Peter's companion at Rome. The third gospel, in his enumeration, was that of Luke. John wrote his gospel at the age of 90 years, and Epiphanius says, that it was occasioned by the errors of the Ebionites, the Cerinthians, the Merinthians, and Nazarenes. He ascribes the book of the Acts to Luke. He frequently quotes the epistle to the Hebrews as Paul's; he also cites the epistle of James, the two epistles of Peter, John's first and second epistles, and the Catholic epistle of Jude. He also received the book of Revelation. Of the baptism of Christ, he says, that it took place when he was 29 years and 10 months, thus understanding St. Luke's words, iii. 23. He says, there are two passovers in our Lord's ministry, according to St. John's gospel, and that he suffered at the third passover, in the 33d year of his life on earth; and therefore he did not think the "feast of the Jews," mentioned John, v. 1. to be a passover. He says, that the apostles did not preach themselves, but Jesus Christ, Lord. Therefore there was no sect, or church, called after the apostles; for we never heard of Petrians, or Paulians, or Bartholomeans, or Thaddeans, but of Christians only; as they were called at Antioch. The works of Epiphanius were first printed in Greek at Basil by Oporinus in 1544; and the subsequent impressions have been numerous, of which the most valuable is that published at Paris in 1622, in two volumes folio, by the learned Petavius, who gave a new Latin version, with critical notes and observations. This edition was afterwards printed at Cologne in 1682, in two volumes folio. Cave's H. L. vol. i. sub sæc. Arian. Lardner's Works, vol. iv.

Epiphanius, surnamed "The Scholastic," a native of Italy, and an eminent Greek and Latin scholar, was born about the year 510. At the request of Cassiodorus he translated into the Latin language the ecclesiastical histories of Socrates, Sozomen, and Theodoret, a version more entitled to commendation for its fidelity than its elegance. Cassiodorus was also indebted to Epiphanius for the improved version of the "Codex encyclicus," or collection of synodal letters of the year 458, addressed to the emperor Leo, in defence of the council of Chalcedon. Cave H. L. vol. i. sub sæc. Eutych.

Epiphanius, patriarch of Constantinople in the 6th century, strenuously vindicated the orthodox doctrines against the Eutychians, and after elevation to his dignity in the year 520, procured the condemnation of the latter in a synod of bishops held at Constantinople. Whilst he was patriarch, the decrees of the council of Chalcedon were confirmed, and a reconciliation was completed between the churches of Constantinople and Rome, after a schism which lasted 35 years. Five letters of this patriarch to pope Hormisdas on the subject of the union are extant in the 4th volume of the collection of the Latin councils. Cave H. L. vol. i. sub sæc. Eutych.

EPIPHANY, in *Ecclesiastical Antiquity*, the feast of kings; a double festival, of the first rank, solemnized on the sixth of January, commonly called "Twelfth day," in honour of the appearance of Jesus Christ to the three kings, or magi, who came to adore, and bring him presents.

The feast of Epiphany, now held in honour of the adoration of the magi, had its first institution among the Greeks, from a different object, *viz.* our Saviour's birth; and was called theophany, and epiphany, that is, appearance, and manifestation, of God.

Pope Julius, who reigned from the year 337 to 352, was the first who taught the church to distinguish the feasts of the nativity and epiphany. Papebroch. Paral. ad Conat. p. 23. Act. SS. Maii, tom. vii.

The word in the original Greek, επιφανεια, signifies *appearance*, or *apparition*; and was applied, as some critics will have it, to this feast, on account of the star which appeared to the Magi. St. Jerom and St. Chrysostom, take the Epiphany for the day of our Saviour's baptism, when he was declared to men by the voice, "Hic est Filius meus dilectus, in quo mihi complacui: This is my beloved Son, in whom I am well pleased." And accordingly it is still observed by the Cophtæ and Ethiopians in that view. (See Ludolph. Hist. Æthiop. lib. xxi. cap. 2.) Others contend, that the feast of Christmas, or the nativity of our Saviour, was held in diverse churches on this day; which had the denomination Epiphany, or appearance, because of our Saviour's first appearance on earth, as at that time. And it must be allowed, that the word is used among the ancient Greek fathers, not for the appearance of the star to the magi, but for that of our Saviour to the world. In which sense, St. Paul used the word επιφανεια, *epiphania*, in his second epistle to Timothy, chap. i. ver. 10. Ammianus Marcellinus makes mention of this feast, lib. xxi. cap. 2. and

and obferves, that it was held in January. Upon which paffage Valefius, in his notes, endeavours to fhew, that the hiftorian meant by Epiphany the feaft of the nativity.

The heathen writers ufed the word epiphania in the like fenfe, *viz.* to exprefs the appearance of their gods on earth. And the Chriftians, after their example, applied it, in the general, to exprefs any appearance, or manifeftation of the Deity.

EPIPHEOS, in *Botany*, the name given by the ancients to the dodder, or cufcuta, which grew upon the fhrub they called phæos. This was the ftæbe of the modern Greeks, defcribed by Honorius Bellus. It was a cuftom, among the old writers, to name the cufcuta, or dodder, from the plant it was found growing upon, as they fuppofed that it in fome degree partook of the virtues of that plant. Thus that which grew upon thyme was called epithymum, and that upon the nettle, epiurteca, and that upon flax, epilinum; fo of many others.

The fhrub phæos was alfo called ftæbe by Diofcorides and Theophraftus; and hence this dodder was fometimes called epiftæbe.

EPIPHLEBOS, of επι and φλεψ, *a vein*, in the *Writings of the Old Phyficians*, a term ufed to denote fuch perfons as were lean, and of a hot temperament, and whofe veins, for that reafon, appeared ufually very turgid and prominent in the hands, &c.

EPIPHLOGISMA, (from επι, and φλογιζω, *to inflame*,) in *Surgery*, a violent inflammation, accompanied with pain, fwelling, and rednefs. Alfo, a great internal heat: likewife, the affection ufually called eryfipelas.

EPIPHONEMA, Επιφωνημα, *Acclamation*, in *Rhetoric*, a fententious fort of exclamation, which is frequently added after a narrative, or rehearfal of any thing remarkable; containing ufually a lively, clofe reflexion on the fubject there fpoken of and intended to give it greater force, and render it more affecting to the hearers.

Such is that of St. Paul, when, after difcourfing of the rejection of the Jews, and the vocation of the Gentiles, cries out,

"O the depth of the wifdom and knowledge of God!"

Such alfo is that of Lucretius, after relating the ftory of Agamemnon's facrificing his daughter Iphigenia:

"Tantum religio potuit fuadere malorum."

This figure is frequently expreffed in a way of admiration. Such is that of Cicero, when after having obferved, that all men are defirous of living to an advanced age, but uneafy under it when attained, he makes this juft reflection upon their conduct: "So great is their inconftancy, folly, and perverfenefs!" (Cic. de Senect. c. 2.)

The epiphonema is ufually expreffive of the milder and more gentle paffions, and is not fo vehement and impetuous as exclamation.

EPIPHORA, (from επιφερω, *to carry with force*,) in *Surgery*. The original import of the word "epiphora" feems to have been a violent determination of fluids to any part of the body. At prefent, however, all furgeons confine the meaning of the term to an affection, in which the tears, not being able to pafs in a proper manner down into the nofe, accumulate in front of the eye, and trickle over the cheek. The diforder is alfo not unfrequently denominated the "watery eye."

Whoever is in the habit of confulting furgical books, will foon perceive, that writers do not make a clear diftinction between the epiphora, and fome ftates of the fiftula lachrymalis. Thus Mr. Ware has particularly confidered the fpecies of epiphora, which, he fays, "is produced by an obftruction to the free paffage of the tears from the eye into the nofe. This obftruction (he adds) may take place either in the ducts leading from the puncta lachrymalia into the lachrymal fac, or in the fac itfelf. When the ducts are obftructed, a cafe which rarely occurs, the tears fall over the cheek, and the fac is conftantly empty. Preffure on the fac, therefore, can produce no regurgitation, either of tears, or mucus, into the eye. The method of cure is here evident. A fmall probe of a fuitable fize muft be introduced through the puncta of the obftructed ducts into the fac, and this operation be daily repeated until the obftruction be removed. But, (continues Mr. Ware,) the part in which the obftruction more commonly lies, is in the fac itfelf; and in this cafe, the tears, mixed fometimes with mucus, flow back into the eye through the puncta, when preffure is made on the fac." Now, this latter kind of difeafe, Pott, Scarpa, and other diftinguifhed furgical authors, confider only as one ftage of the fiftula lachrymalis.

We do not mean, however, by what has been ftated, to make any attempt to defend the manner in which the expreffion "fiftula lachrymalis" is employed; our fole aim is to fhew, that, unlefs a line of diftinction is drawn between what fhould be called "epiphora," and what "fiftula lachrymalis," the comprehenfion of the fubject is rather embarraffed, than promoted, by having two different terms, which fo glaringly encroach upon each other in the extent of their fignification. The epiphora, in the meaning of a mere weeping of the eye, may arife from a variety of caufes, which muft be removed, ere the complaint can be cured. An encanthis, or any other kind of tumour in the inner angle of the eye, a polypus in the nofe, an ectropium, a trichiafis, &c. may obftruct the due flowing of the tears into the nofe, and thus make them fall over the fubjacent cheek, fo as to occafion an epiphora. This latter diforder may alfo be the confequence of a part of the caruncula lachrymalis having been loft, either by difeafe, or an unfkilful employment of the knife in fome previous operation. An epiphora is always attendant on obftructions in the ductus nafalis. Mr. Ware obferves, with regard to another fpecies of epiphora, originating from a too copious fecretion of tears, that, if it does not depend on an affection of the mind, its more remote caufe is ufually an inflammation of the eye. In this inftance, a cure is to be effected by fubduing the ophthalmy, and afterwards ftrengthening the eye by mild aftringent applications, fuch as cold water, either alone, or containing a fmall quantity of the zincum vitriolatum.

When the membrane, which lines the lachrymal fac, is in a morbid ftate, the mucus which it fecretes is often fo thickened, that it becomes incapable of paffing through the fac, and lodging in this fituation, prevents the natural and regular defcent of the tears from the eye into the cavity of the nofe.

This fpecies of epiphora has occafionally been benefited by the unguentum hydrargyri nitrati, applied to the edges of the eye-lids, and rubbed into the fkin over the lachrymal fac. Relief is alfo alleged to have been derived from the ufe of ftimulating applications to the infide of the nofe, which applications are fuppofed to have acted by increafing the fecretion from the pituitary membrane.

However, we muft confefs, that no men of experience, at the prefent day, place fufficient reliance on the preceding methods, to recommend them to be tried by their patients. At the fame time it fhould be underftood, that thefe plans are fometimes exceedingly proper to be adopted in conjunction with other more efficacious meafures.

In

In the year 1712, M. Anel recommended the introduction of a probe, and then the injection of a fluid, through the puncta lachrymalia, with a view of clearing away whatever matter might prevent the tears from readily finding their way through the lachrymal fac and nafal duct into the nofe. M. Anel relates, that he accomplifhed many ftriking cures in this manner; and Heifter confirms the efficacy of the plan, by appealing to his own practice, in which he had often produced a complete recovery in the fhort fpace of three days.

In the year 1780, fir William Blizard confidered, that when water was injected through the punctum lachrymale, it not only had but very little fpecific weight, but was driven through the lachrymal fac in an unfavourable direction. Thefe reflections led him to make the propofal of introducing quickfilver through a fmall pipe, which communicated with a long tube full of this metal. Sir William Blizard was of opinion, that the quickfilver, in confequence of its great weight, would have more power when the fac was filled with it, of removing the obftruction, than the mere injection of water. This gentleman alfo, in a paper read to the Royal Society, ftates, that he had produced a cure by the introduction of quickfilver in an example which had lafted feven months; and that the mercury paffed readily through the ductus nafalis, at the third and fourth times of repeating the operation.

When the celebrated Mr. Ware was in Paris, in the year 1791, he learnt from Meffieurs Grandjean and Monfieur Arrachart, eminent oculifts in that city, that the plan of injecting water through the puncta lachrymalia, in incipient cafes of fiftula lachrymalis, was not given up in France. Mr. Ware even faw fome troublefome cafes cured on the continent in this way. Hence he was determined, on his return to London, to give Anel's operation a fuller trial than he had previoufly done. For this purpofe he got Mr. Pepys, in the Poultry, to conftruct a fmall filver fyringe, with pipes of different fizes adapted to it.

The following cafe, which afforded Mr. Ware the firft opportunity of afcertaining more carefully the efficacy of Anel's treatment, is related in his own words, and will ferve to inform the reader of feveral ufeful practical circumftances.

"A lady in Great Ruffel-ftreet came under my care, who for many months had been fubject to an epiphora of the left eye, which prevented her both from reading and working with her needle, without undergoing great inconvenience. Whenever fhe employed herfelf in any way that required clofe attention, her eye became overfpread with tears, and the fight was fo much confufed, that it obliged her to leave off almoft as foon as fhe began. A great variety of remedies had been applied, under the direction of different medical men, but none of them produced any effential amendment. On examining the eye, I obferved that the tunica conjunctiva, near the inner angle of the eye-lids, was flightly inflamed; and on preffing the lachrymal fac with my finger, I perceived that a tear regurgitated through the lower punctum. This appearing to be a proper cafe for the ufe of the fyringe, I immediately determined to employ it. But I found, that though a tear came through the lower punctum on my preffing the fac, yet this punctum was fo fmall that it would not admit the point of the fmalleft fyringe I then had. I introduced into it, however, a fmall probe, and by means of this I fo far dilated the orifice, that it admitted the point of the fyringe on the next day without any difficulty. Upon my firft ufing the injection, the water efcaped through the upper punctum almoft as faft as it was introduced through the lower; but, notwithftanding this, I perfevered in urging the liquor on, until the whole contents of the fyringe were exhaufted. I repeated the injection three times the fame day in immediate fucceffion. The lady, however, was not fenfible that any part of the water paffed through the duct into the nofe during either of thefe operations; and indeed it foon became evident that none had paffed; for, having cleared her nofe before I began, on her blowing it again immediately afterwards, fhe could produce no moifture on her handkerchief. I repeated the operation three times, both on the fecond and on the third day; and each day, during the time that the water was paffing, I not only endeavoured to prevent it from coming through the upper punctum, by covering it with the point of my finger, but I occafionally preffed the lachrymal fac in order to give the water an inclination downward. On the fourth day I very plainly perceived, on the patient's clearing her nofe after the operation, that a part of the water had paffed through the duct; and, the next morning, I had the fatisfaction to hear, that the eye, on the preceding day, had watered much lefs frequently than it had done for a confiderable time previous to it. I repeated the procefs above-mentioned about ten times, in as many days, and I obferved that the quantity of water which paffed through the duct was augmented every time I ufed it. The tears, after this, refuming their natural courfe, the lady recovered the power to read and work without any inconvenience." (See Ware on the Epiphora.)

Mr. Ware, in his practice, ufes common water for the injection, fometimes in a cold ftate, but more frequently warmed. The pipes which this gentleman employs, are alfo much fhorter than the one reprefented by Mr. Benjamin Bell in his Syftem of Surgery, (vol. iii. pl. 37). They are alfo a little arched towards their point. Mr. Ware thinks, that when they are made in this manner, they can be more conveniently introduced into the punctum lachrymale, than when long and ftraight. He recommends always having ready feveral pipes of different fizes, and ufing the largeft one which can be introduced without pain. He finds it alfo advantageous to ftand either behind the patient or on the fide oppofite to that of the difeafed eye; and high enough to have a full command of the patient's head. Thus the operator will gain a complete view of the lower punctum, which will alfo be in a convenient pofition to receive the pipe of the fyringe. Mr. Ware, moreover, advifes us to remove the finger from the lower eye-lid as foon as the pipe is introduced, and to place it over the upper punctum, fo as to prevent the fluid from efcaping through this aperture. The fame finger is likewife to be occafionally ufed in making preffure on the lachrymal fac, in order to aid in forcing the injection down into the nofe.

Mr. Ware has publifhed fome additional remarks on the epiphora, and makes fome very valuable obfervations on the treatment of another fpecies of the diforder; we allude to that kind which proceeds from a thickening of the membrane which lines the lachrymal fac and duct, and a fpafmodic conftriction in any part of this paffage, conjoined, perhaps, with a morbid fecretion of thickened mucus. Mr. Ware imputes a few occafional failures, in the above fimple mode of treatment, to the caufes of the difeafe being fometimes of this nature. The following extract will explain the different methods to which this celebrated oculift has recourfe in different cafes.

"I in general begin the treatment by injecting fome warm water through the inferior punctum lachrymale, and I repeat the operation four or five days in fucceffion. If, in this fpace of time, none of the water pafs through the duct

duct into the nofe, and if the watering of the eye continue as troublefome as it was before the injection was employed, I ufually open the angular vein, or direct a leech to be applied near the lachrymal fac; adding here a caution, that the leech be not fuffered to fix on either of the eye-lids, left it produce an extravafation of blood in the adjacent cells. About the fame time that blood is taken away in the neighbourhood of the eye, I ufually vary the injection, and try the effects either of a weak vitriolic, or anodyne, lotion. In fome inftances alfo, when I have found it impoffible, after feveral attempts, to inject any part of the liquid through the duct, I have introduced a golden probe, about the fize of a briftle, through the fuperior punctum lachrymale, and, attending to the direction of the duct, have infinuated its extremity through the obftruction, and conveyed it fully into the nofe; immediately after which I have found, that a liquid, injected through the inferior punctum, has paffed without any difficulty; and, by repeating thefe operations, for a few fucceffive days, I have at length eftablifhed the freedom of the paffage, and completed the cure. In other inftances, I have recommended a ftrongly ftimulative fternutatory to be fnuffed up the nofe, about an hour before the time of the patient's going to reft, which, by exciting a large difcharge from the fchneiderian membrane, has fometimes alfo greatly contributed to open the obftruction in the nafal duct.

"Cafes occur very rarely which may not be relieved by fome of the means above related." (Ware's Additional Remarks on the Epiphora.)

When the difcharge has been fetid, Mr. Ware has fometimes found, that a vitriolic lotion, injected into the fac, has quickly corrected the quality of the matter.

Scarpa, in his "Offervazioni fulle principali Malattie degli Occhi," maintains, that the chief part of the yellow vifcid matter, which accumulates in the lachrymal fac, is fecreted by the lining of the eye-lids, and by the little glands of Meibomius; and that the altered quality of this fecretion has a principal fhare in the caufe of the difeafe. He ftates, that the truth of this fact may at once be afcertained by everting the eye-lids; and efpecially the lower one of the affected fide; and by comparing them with thofe of the oppofite eye. The former will always exhibit an unnatural rednefs of the internal membrane, which has a villous appearance, all along the extent of the tarfus, while their edges are fwollen; and numerous varicofe veffels are diftinguifhable on its furface. The follicles of Meibomius are alfo turgid and prominent.

Hence, Scarpa advifes making fuch applications to the infide of the eye-lids, as have a tendency to improve the quality of the fecretion from them, at the fame time, that attempts are made to remove the obftruction in the ductus nafalis. Mr. Ware, indeed, had previoufly noticed, that fuch treatment may occafionally be proper.

"When an epiphora is occcafioned by an acrimonious difcharge from the febaceous glands on the edges of the eye-lids, it muft be evident, that injections into the fac will be very infufficient to accomplifh a cure, becaufe the fac is not the feat of the diforder. The remedies that are employed muft be directed, on the contrary, to the ciliary glands themfelves, in order to correct the morbid fecretion that is made by them; and for this purpofe, I do not know any application that is fo likely to prove effectual as the unguentum hydrargyri nitrati of the new London Difpenfatory, which fhould be ufed here in the fame manner in which it is applied in common cafes of the pforophthalmy. It will be proper to cleanfe the eye-lids every morning, from the gum that collects on the edge during the night, with fome foft unctuous application; and I ufually advife to apply to them two or three times in the courfe of the day a lotion compofed of three grains of white vitriol, in two ounces of rofe, or elder-flower, water."

Mr. Ware very judicioufly cenfures the plan of applying collyria to the eye by means of linen, wet in them; and he recommends eye-glaffes for the purpofe, or infinuating the fluid, between the eye and eye-lids, with a camel-hair pencil, thoroughly wet in the application. (Additional Remarks on the Epiphora.)

Scarpa alfo extols wafhing the eye, three or four times a day, with a vitriolic collyrium; and, befides praifing the ointment recommended by Mr. Ware, he recommends Janin's ophthalmic ointment, to be fmeared over the margins and lining of the eye-lids every morning and evening.

℞. *Adipis Suillæ. Tutiæ præp. Bol. Armen. fing.* ʒij. *Calcis Hydrarg. alb.* ʒj. *Mifce.* To be ufed at firft lowered with a larger proportion of lard, than is above ordered. See Fistula *Lachrymalis*.

EPIPHYLLOSPERMOUS Plants, of επι, φυλλον, *leaf*, and σπερμα, *feed*, are the fame with the capillaries, herbs which bear their feed on the back part of their leaves. See Capillary.

EPIPHYLLUM, in *Botany*, επι, *upon*, and φυλλον, *a leaf*, from the mode in which the flowers grow upon a flat ftem refembling a leaf, fee Cactus *Phyllanthus*, fp. 40.

EPIPHYSIS, in *Anatomy*, is a name given to certain parts of bones at a particular period of their formation. See Bone.

EPIPLA'SMA, from επι, and πλασσω, *to fpread*, in *Surgery*, the name of an application to wounds: it confifted of wheat meal boiled in hydrelæum.

EPIPLOCE, Επιπλοκη, in *Rhetoric*, the fame with climax, which fee.

EPIPLOCE'LE, from επιπλοον, *the omentum*, and κηλη, *a tumour*, in *Surgery*, an omental hernia, or a rupture formed by a protrufion of a piece of omentum from the cavity of the abdomen.

Le Dran informs us, that in an epiplocele there is nothing to be felt, except a doughy foftnefs, which neither abfolutely yields to the touch, nor very fenfibly refifts it. The tumour has a flabby unequal feel; and, when there is no ftricture, is perfectly indolent. It is more compreffible than that arifing from protruded inteftine, and, when the quantity of omentum is large, the epiplocele may, in fome meafure, be diftinguifhed by its weight.

As the fubject of omental ruptures will be particularly confidered under the head Hernia, we fhall, for the prefent, content ourfelves with referring to the latter article.

EPIPLOIC, in *Anatomy*, a term applied to parts which belong to the epiploon, or omentum; thus we have epiploic arteries, &c.

EPIPLOO'MPHALON, from επιπλοον, *the omentum*, and ομφαλος, *the navel*, in *Surgery*, an omental hernia protruding at the navel.

EPIPLOON, in *Anatomy*, called alfo omentum or cawl, is a membranous expanfion contained in the cavity of the abdomen: and continued from the peritoneal covering of fome of the vifcera. There are two very diftinct productions, of the nature juft defcribed, diftinguifhed by the appellations of minus and majus, from their difference in fize; and by thofe of hepatico-gaftricum, and colico-gaftricum from their fituation. But when the epiploon, or omentum, is fpoken of generally, the greater or colico-gaftric portion is underftood. To the peritoneal furface of the large inteftine are attached numerous fmall proceffes, which refemble the epiploa in their apparent ftructure, and are called *appendices epiploicæ*.

Although the omenta are ufually reprefented by anatomifts as proceffes of the peritoneum, their organization differs effentially from the ftructure of that membrane. Their groundwork or bafis confifts of the moft delicate and tranfparent membrane of the body; which is lacerated on the application of very flight force. This membrane is compofed obvioufly of two layers, connected by cellular tiffue, and containing numerous venous and arterial ramifications. A greater or fmaller quantity of fat is depofited between thefe layers, and in the courfe of the veffels. When this depofition is very confiderable, as in very corpulent individuals, or in animals who have been fattened for the flaughter, the peculiarly tranfparent delicate appearance of the omental membrane is entirely deftroyed, and the part is converted into a layer of fat. Ordinarily, however, the adipous fubftance is confined to the neighbourhood of the blood-veffels, accompanying them in their fubdivifions, but leaving intervals in which the membrane exhibits its diftinguifhing diaphanous appearance. In emaciated fubjects, during the period of infancy, and particularly in the fœtal ftate, the quantity of fat is very trifling. Under fuch circumftances we can obferve moft diftinctly that the depofition of fat is confined to the courfe of the veffels. As the omenta are entirely unconnected to the parts on which they lie, as well as to thofe by which they are covered, both their furfaces are fmooth and gliftening, and moiftened like thofe of other ferous membranes, by a ferous exhalation, which facilitates their motions over the neighbouring organs. Analogy warrants us in afcribing this fecretion to the arteries of the omenta; and we confequently confider thefe organs as an extenfion of the general ferous furface of the abdominal cavity.

Experiments on living animals, and furgical operations, clearly prove that the membrane of the omenta poffeffes little, if any, fenfibility in its healthy ftate.

The *leffer epiploon*, *mefogafter*, *omentum minus*, or *hepatico-gaftricum*, is the portion extended from the fmall arch of the ftomach to the concave or under furface of the liver. It arifes, behind, from the pofterior half of the tranfverfe fiffure of the liver; on the right it is continuous with the peritoneum covering the neck of the gall-bladder and the beginning of the duodenum; towards the left it is reflected immediately from the diaphragm. Advancing from thefe points, in two clofely united layers, towards the ftomach, it is attached to the end of the œfophagus, to the whole leffer arch of the ftomach, to the pylorus, and commencement of the duodenum. At this line its layers divide, and expand over the ftomach, one of them forming the fuperior, and the other the inferior peritoneal covering of this vifcus. Between the layers of the leffer omentum are contained the hepatic veffels and biliary ducts, the coronary veffels of the ftomach, fome branches of the cœliac plexus of nerves, and of the par vagum, and a few abforbent glands. Fat is rarely depofited here in fo large a quantity as in the large epiploon, fo that we can ufually fee through it that portion of the liver called lobulus fpigelii, which is in contact with its inferior furface.

The biliary ducts, the hepatic veffels with numerous accompanying branches of nerves from the cœliac ganglia, and a confiderable portion of the hepatic and cyftic abforbents, connected and furrounded by adipous and cellular fubftance, are inclofed in the right edge of the leffer omentum. This part is called *capfula Gliffoni*, from an Englifh anatomift, who defcribed it minutely in a work entitled "De Hepate." The very margin of the omentum is occupied by the biliary ducts, and the neck of the gall-bladder. At this border the two furfaces of the little omentum are continuous. Behind the unconnected edge, round which the peritoneum turns, is found the foramen of Winflow, or *foramem epiploicum*, large enough to admit one or two fingers, which can thus be placed in immediate contact with the back part of the liver, and the inferior furface of the little omentum. This opening is fituated between the neck of the gall-bladder, and the beginning of the duodenum, with the hepatic veffels in front, and the vena cava behind. It is not unufual to find its edges adhering together. We fhall have occafion to mention it again after defcribing the large omentum.

The great omentum, *epiploon majus*, *vel gaftro-colicum*, is the loofe membrane, more or lefs loaded with fat, lying in front of the bowels, and generally meeting our eye in laying open the abdomen. It differs extremely in length and fituation; in fome cafes reaching as low as the pelvis, and often defcending in ruptures to the very bottom of the fcrotum; while in others it extends but a fhort way below the umbilicus. It is always fhorter in children than in adults. We often find it folded, or rolled on itfelf, and drawn to fome one part of the abdomen, or tucked up over the ftomach, fo as to leave the fmall inteftines expofed to our immediate view. Its natural fituation between the bowels, and the parietes of the abdomen, explains the frequency of its protrufion, together with the inteftines, in herniæ. Some anatomifts affert that it hangs lower on the left than on the right fide of the abdomen.

The great omentum is a continuation of the peritoneal covering of the ftomach. We have already defcribed this as being formed by the feparation of the two layers which conftitute the little omentum. At the great curvature of the ftomach thefe layers again coalefce into one fheet of membrane, are produced till they meet with the tranfverfe arch of the colon, to inclofe which they again feparate. Meeting at the oppofite line they once more unite, and are continued under the name of the tranfverfe mefocolon to the root of the mefentery. The origin of the great epiploon, when minutely examined, commences in the left from the end of the œfophagus, and from the notch of the fpleen (where it forms a membranous connection between this organ and the ftomach) and includes the whole of the great arch of the ftomach nearly as far as the pyloris. The portion of membrane thus formed defcends loofely before the tranfverfe arch of the colon, and reaches to different lengths beyond it, conftituting the anterior layer, or *lamina gaftrica* of the great epiploon. At the lower or floating border this membranous expanfion is doubled on itfelf, and turning upwards again to meet the tranfverfe arch of the colon, forms the pofterior layer, or *lamina colica* of Haller. On the right fide the great omentum is not only attached to the tranfverfe portion of this inteftine, but is continued along its hepatic flexure, and for fome way down the afcending colon. In fome inftances it reaches as low as the cœcum. It is this lateral extenfion of the great omentum which conftitutes the *omentum colicum* of Haller. Each of the layers is compofed of a duplicature of peritoneum, as we have before ftated, containing its proper veffels, and fat, and united clofely by cellular tiffue. It will be evident, from our defcription, that the great omentum is formed by the anterior layer alone in the fpace between the ftomach and tranfverfe arch of the colon; below the latter it is compofed of the two layers, the lamina gaftrica, and the lamina colica lying in contact with each other, but having no further connection in a healthy ftate of the oppofing furfaces.

From this difpofition of the great and little epiploa, there

there refults, in conjunction with the inferior furface of the ftomach, and the fuperior furface of the tranfverfe mefocolon a membranous bag, called ufually the bag of the omentum. It offers every where on the infide a continuous ferous furface, where the fides of the cavity are in clofe contact, but not adherent. The communication between this pouch, and the general cavity of the peritoneum, is formed by the foramen of Winflow. In order to demonftrate this fact, as well as to difplay the bag formed by the omenta, we introduce into this opening a pipe, furrounded by fome foft fubftance, to prevent the efcape of the air. By blowing gently we are enabled to feparate the layers of the great omentum, which were in contact, and give to the whole the form of a large membranous bag, interfected by veffels and bands of fat, between which the membrane rifes in pouches of various fizes. The lines formed by the ftomach, and tranfverfe arch of the colon, are but faintly feen, owing to the diftention of the epiploon, which appears, as it were, fufpended between them. To infure the fuccefs of this experiment fome conditions are neceffary, which we are not always happy enough to bring together. There muft be no adhefion of furfaces, no large accumulation of fat, the fubject young, and the whole conducted with the greateft delicacy, as the flighteft rent in the membrane is fufficient to prevent fuccefs. In the fœtus, and in young children, the laminæ of the great omentum are eafily feparable throughout their whole extent. In adults, and more fo in old perfons, they are generally more or lefs united, fo that the cavity of the omenta is confined to the fpace contained between the little omentum, the under furface of the ftomach, and the tranfverfe mefocolon.

The arteries of the great omentum are derived from the right and left gaftro-epiploic veffels. They are in general fmall, and defcend between the layers of the lamina gaftrica, giving off branches on either fide, which anaftomofe freely in every direction. At the lower border of the omentum the trunks turn up again to meet the tranfverfe arch of the colon, with the arteries of which inteftine they form communications. The veins accompany the arteries in their courfe, and join the large venous trunks which end in the vena portarum. The few nerves it poffeffes are derived from the hepatic, and fplenic plexufes.

The *appendices epiploicæ*, or *omentula*, are principally obferved on the firft parts of the great inteftine, being in lefs number on the figmoid flexure of the colon and the rectum. They are irregularly difpofed, hanging in fringes, generally unconnected with each other, fometimes united by intermediate membranous productions. They are ufually dependent from the pouches of the inteftine, and not from the longitudinal bands. They are obvioufly formed by the peritoneal covering of the inteftines, united by cellular membrane, and containing a depofit of fat in almoft every inftance.

The ufe of the omenta is entirely unknown: The leffer epiploon offers a covering, and connecting medium to fome nerves belonging to the ftomach, and to the hepatic veffels and ducts. To the great epiploon many offices have been afcribed, none of which are fatisfactorily afcertained. It varies fomewhat in fize according to the ftate of the ftomach; fince, when the latter is diftended, it appears to enter between the layers of peritoneum forming the anterior fold, which lofe in this cafe their form of omentum, and become the temporary covering of this organ. What may be the probable advantages of this conftruction it is not eafy to decide. It has been fuppofed again to fecrete a lubricating fluid from its furface, which preferves the free motion of all the chylopoietic vifcera between each other. That it increafes the ferous furface of the abdominal cavity is evident; but in what manner this becomes an advantageous difpofition is more than we have the means of determining. The omentum colicum, and appendices epiploicæ are fubject to the fame obfervations, being fimilar in ftructure, and confequently in ufes. It is certain that a confiderable portion of the great omentum may be cut away, without any fubfequent inconvenience to the patient, as has been frequently obferved in cafes of omental hernia.

An epiploon is found in all the mammalia, where it is feen under every variety of form and fize; fo that no inferences can be drawn from its difpofition in thefe particulars. In all it contains more or lefs of fat between its membranes, the accumulation of which would appear to bear fome proportion to the active, or fluggifh habits of the animal. In the hybernating fpecies during the winter, it is loaded with fat, which exifts but in minute quantities during the fummer. The epiploon is not found in the other claffes of animals, at leaft there is nothing analogous to it, but a membranous production between the liver and ftomach, anfwering to the little omentum.

EPIPLO'SCHEOCE'LE, from ἐπίπλοον, *the omentum*, ὄσχεον, *the fcrotum*, and κήλη, *a tumour*, in *Surgery*, an omental rupture, fituated in the fcrotum.

EPIPOGUM, in *Botany*, ἐπὶ, *upon* and πώγων, *a beard*, becaufe the beard, or rather lip, is turned upwards. Gmel. Sib. v. 1. 11. t. 2. f. 2. is *Satyrium Epipogium* of Linnæus; *Limodorum Epipogium* of Swartz and Willdenow. See LIMODORUM.

EPIPOLÆ, in *Ancient Geography*, was originally a piece of high ground without the city of Syracufe, and afterwards fo little inhabited that it is not mentioned by Cicero in his defcription of this city. As it was the moft elevated fituation, and commanded Tyche and Neapolis, it was judicioufly inclofed by Dionyfius I., who encompaffed it with a wall nearly 4 miles in extent. Its additional defence was the fortrefs of Labdalon, at its bottom, on the eaft; and that of Euryalus, at its top, on the north. See SYRACUSE.

EPIPOMPEUTICA, in the *Ancient Mufic*. Voffius, in his poetical inftitutes, informs us, that this was a title given to fongs compofed and fung on occafions of great magnificence.

EPIPORO'MA, from ἐπιπωρόω, *to harden*, in *Surgery*, a hard tumour on a joint: a tophus.

EPIPROSLAMBANOMINOS, *Gr.* in the *Ancient Mufic*, a name given to the ftring or found below proflambanominos, which word correfponds with gamut in the Guido fcale.

EPIRE, in *Geography*, an ancient kingdom of Greece, now united with Albania, and included in that country, of which it forms the fouthern part, extending from Valona to Arta.

EPIROTS, in *Ancient Geography*. See the next article.

EPIRUS, a country of Greece, bounded on the eaft by Ætolia, on the weft by the Adriatic, on the north by Theffaly and Macedon, and on the fouth by the Ionian fea. This was the ancient kingdom of the Æacidæ, and was firft called "Epirus Dodonæa," *i. e.* the continent of the Dodonæans, and afterwards Epirus, or "the continent," that being the import of the Greek word Ἤπειρος. It was anciently divided into three diftricts or provinces; *viz.* Chaonia, Thefprotia, and Moloffis; to which fome authors add Caffopia, Caffiope, or Cæftrine, and Pindus. This country is faid to have been firft peopled by Dodanim, the fon of Javan, and grandfon of Japhet, or at leaft by fome of his pofterity. We find among the nations which occupied Epirus, before they were united into one people under the common name of Epirots, the Selli, who are thought to have been the

firft

firſt inhabitants of Epirus, and to have miniſtered in the temple of Dodona, the Chaones, the Moloſſi, the Dolopes, the Dryopes, the Ænianes, the Pelaſgi, &c. The form of government which prevailed in Epirus was unqueſtionably monarchical, the whole country being divided into many ſmall independent kingdoms. Homer, and other ancient writers, mention ſeveral kings who reigned here at the time of the Trojan war. But while the other Epirotic nations continued to be governed by princes of their own blood, the Moloſſi became ſubject, at an early period, to the power of Pyrrhus, a foreign prince, whoſe deſcendants were denominated Æacidæ, from Æacus, the founder of his family. Some of theſe petty kingdoms, in proceſs of time, exchanged the monarchical into a republican form of government; for Thucydides informs us, that in his time the Theſprotæ and Chaones were governed, not by kings, but by annual magiſtrates. However, the kingdom of the Moloſſi ſoon eclipſed all others; the Moloſſian princes having ſubjected the whole country, and united the ſeveral ſmall kingdoms of which it conſiſted into one, known to the ancients under the name of Epirus.

Pyrrhus, the firſt of the Æacidæ, was the ſovereign of this country at the period when regular and authentic hiſtory commences; and he is ſaid to have diſtinguiſhed himſelf at the ſiege of Troy, when his father was killed. His reign ſoon terminated by a premature death; for he was murdered by Oreſtes in the temple of Delphi, on account of his having married Hermione, the daughter of Menelaus, who had been betrothed to Oreſtes. He was ſucceeded by his ſon Moloſſus, and ſeveral other princes, whoſe names it is needleſs to record. At length Admetus was the ſovereign of Epirus, when Xerxes invaded Greece. This prince, upon the defeat of the Perſians, wiſhed to enter into an alliance with the Athenians, about the year 478 or 479 B. C. The ſucceſſors of Admetus were Tharymbas, who is ſaid to have introduced the ſciences into this country, and to have formed an excellent code of laws; and Alcetes, at whoſe death the kingdom was divided between his two ſons, Neoptolemus and Arybas, the latter of whom, when his brother died, became ſole ſovereign of the country, and conducted the government with great prudence, equity, and moderation. He alſo encouraged literature by extending his patronage to thoſe who excelled in it. His niece Olympias, of whoſe education he had taken great care, was married to Philip, king of Macedon, who had by her Alexander the Great. At his death, he was ſucceeded by Alexander, one of his nephews; who is ſaid to have been little inferior, in courage and conduct, to his nephew Alexander the Great; but he had the misfortune to engage, on his firſt ſetting out, with nations inured to the toils of war, and no leſs brave than his own Epirots; whence he uſed to ſay, that the country, which he propoſed to conquer, was inhabited by men, whereas the provinces his nephew Alexander went to ſubdue, were peopled by women only. (Aul. Gell. l. xvii. c. 21.) The immediate ſucceſſors of Alexander were Æacides and Alcetes II.; and the latter was ſucceeded by Pyrrhus, deſcended by the father from Achilles, and from Hercules by the mother. (See Pyrrhus.) After two or three ſhort reigns, Deidamia, great grand-daughter to Pyrrhus, ſucceeded her father Pyrrhus III. and having no iſſue, ſhe gave the Epirots their liberty, who formed themſelves into a republic, which was governed by magiſtrates annually elected in a general aſſembly of the whole nation. The Macedonians on one ſide, and the Illyrians on the other, taking advantage of the inteſtine diviſions, which generally attend a popular government, feized on ſeveral provinces belonging to the Epirots, and annexed them to their reſpective crowns. The Romans, after having conquered Philip of Macedon, reſtored them to their ancient liberty; but they ungratefully took up arms againſt their benefactors, and joined Perſes; which induced the Romans to ſend orders to Paulus Æmilius, after the reduction of Macedon, to plunder their cities and level them with the ground. This order was punctually, though reluctantly, executed throughout the whole country in one day. One hundred and fifty thouſand of the inhabitants were made ſlaves, and ſold to the beſt bidder for the benefit of the republic. All the cities of Epirus, to the number of 70, were diſmantled, and the chief men of the country carried to Rome, where they were tried, and moſt of them condemned to perpetual impriſonment. After this cataſtrophe, Epirus never recovered its ancient ſplendour. Upon the diſſolution of the Achæan league, it was made part of the province of Macedon; but when Macedon became a dioceſe, Epirus was made a province of itſelf, called the province of Old Epirus, to diſtinguiſh it from New Epirus, another province lying to the eaſt of it. On the diviſion of the empire, it fell to the emperors of the eaſt, and continued under them till the capture of Conſtantinople by the Latins, when Michael Angelus, a prince nearly related to the Greek emperor, ſeized on Ætolia and Epirus. He was ſucceeded by his brother Theodorus, who ſo far enlarged his dominions, that, diſdaining the title of deſpot, he aſſumed that of emperor, and was crowned by Demetrius archbiſhop of Bulgaria. Charles, the laſt prince of this family, dying without lawful iſſue, bequeathed Epirus and Acarnania to his natural ſons, who were expelled by Amurath II. Great part of Epirus was afterwards held by the noble family of the Caſtriots, who, though they were maſters of all Albania, yet ſtyled themſelves princes of Epirus. Upon the death of the famous George Caſtriot, Epirus fell to the Venetians, who were ſoon diſpoſſeſſed of it by the Turks, in whoſe hands it ſtill continues; being now known by the name of Albania, which comprehends the Albania of the ancients, all Epirus, and that part of Dalmatia which is ſubject to the Turks. Plutarch tells us, that the Epirots enjoyed the beſt ſort of liberty under their kings; for, as he ſays, a general aſſembly of the people was annually convened at Paſſaron, a city in the province of Moloſſis, where the king bound himſelf by a ſolemn oath to govern agreeably to the laws, and the people to obey and ſupport him as long as he ſhould make the laws the rule of his government.

EPISARCIDIUM, from επι and σαρξ, *fleſh*, a name given by many of the old authors to an anaſarca.

EPISCAPHIA, from επι and σκαφη, *boat*, feaſts celebrated by the Rhodians.

EPISCENIA, from επι and σκηνη, *tent*, feaſts celebrated by the Lacedæmonians.

EPISCENIUM, Επισκηνιον, in *Antiquity*, a place upon the top of the theatre, where all the machines for moving the ſcenes were kept. Potter. Archæol. Græc. lib. i. cap. 8. p. 42.

EPISCEPSIS, Επισκηψις, an action brought to prove the diamartyria, or proteſtation, that the perſon deceaſed had left an heir, to be falſe and groundleſs. Potter. Archæol. Græc. lib. i. cap. 24. i. p. 128.

EPISCIRA, Επισκιρα, or Episcirosis, a feſtival celebrated at Scira in Attica, in honour of Ceres and Proſerpine. Potter. Archæol. Græc. lib. ii. cap. 20. tom. i. p. 395.

EPISCHESES, from επεχω, or επισχω, *I reſtrain*, in *Medicine*, a term uſed by Dr. Cullen to denote the fifth order of his fourth claſs of diſeaſes, which includes the retention

tention of accuſtomed evacuations, *viz.* conſtipation of the bowels, ſuppreſſion of urine, of the catamenia, &c.

EPISCHION, from ἐπι and ἰσχιον, *iſchium*, a name given by the old Greek writers to the pubes.

EPISCOPACY, the quality of epiſcopal government, or that form of church diſcipline, wherein dioceſan biſhops are eſtabliſhed, diſtinct from, and ſuperior to, prieſts or preſbyters. See BISHOP, EPISCOPAL, EPISCOPALIANS, and HIERARCHY.

Epiſcopacy, and preſbytery, have been alternately eſtabliſhed and aboliſhed in Scotland.

EPISCOPACIDE, from ἐπισκοπος, *biſhop*, and *cædo*, *I kill*, the crime of murdering a biſhop by one of his own clergy. By the ancient laws of England, the ſame obedience is due from a clergyman to his biſhop as from a ſervant to his maſter; and therefore the offences of murdering either are made equal, that is, they are both petty treaſon.

EPISCOPAL, ſomething that belongs to a biſhop.

The word is formed of the Greek ἐπισκοπος, *overſeer*, derived from ἐπισκοπεω, *inſpicio*, *I inſpect*, or *overlook*.

Epiſcopal government, is the government of a dioceſe, wherein one ſingle perſon, legally conſecrated, preſides over the clergy of a whole diſtrict, in quality of head, or ſuperintendant thereof; conferring orders, and exerciſing a ſort of juriſdiction.

The preſbyterians reject the epiſcopal eſtabliſhment, and condemn the epiſcopal orders as a human inſtitution, the mere reſult of ſecular policy, or of pride and ambition.

Among the epiſcopal functions, the principal part is that of holding frequent viſitations of the dioceſe.

EPISCOPALES VALVULÆ, called alſo, by ſome, valvulæ mitrales, two valves in the pulmonary vein, which prevent the reflux of the blood to the heart.

EPISCOPALIA, is ſometimes uſed in the ſame ſenſe with pontificalia.

EPISCOPALIA, is alſo uſed to denote ſynodals, or cuſtomary payments, due to the biſhops from the clergy of their dioceſe.

Theſe cuſtomary payments have been otherwiſe called onus epiſcopale; and were remitted, by ſpecial privilege, to free churches and chapels of the king's foundation which were exempt from epiſcopal juriſdiction.

EPISCOPALIANS, or EPISCOPISTS, a name given to thoſe who adhere to the church of England, and particularly to the eccleſiaſtical hierarchy, ſuch as it was in the Romiſh church before the Reformation; who affect the diſcipline of biſhops, prieſts, canons, the office, or liturgy, &c. and retain the greateſt part of the canon law, with the decretals of the popes, more cloſely than the Catholics themſelves of ſeveral countries; though, as to matters of doctrine, or faith, they agree in moſt points with the Calviniſts, or Reformed.

In Scotland, the principal diſſenters are the Epiſcopalians; lay Epiſcopalians enjoy all the ſame civil privileges with thoſe of the eſtabliſhed church. They are under no reſtrictions; tied to no teſts, but are employed in all places of truſt, upon taking the oaths to the government. But the epiſcopal miniſters are liable to ſeveral penal laws; many of them having been nonjurors.

EPISCOPI MULTA. See MULTA.

EPISCOPISSA, a word uſed by writers of the middle ages, to denote a biſhop's wife.

EPISCOPIUS, SIMON, in *Biography*, a Dutch divine of the Arminian perſuaſion, was born at Amſterdam in the year 1583. Having entered on his academical ſtudies in the univerſity of Leyden in 1600; and graduated M. A. in 1606, he purſued his theological ſtudies with great aſſiduity; but on account of the diſputes that ſubſiſted between the Gomariſts and Arminians, he found obſtacles in the way of his admiſſion to the miniſterial office, which the burgomaſters of Amſterdam wiſhed him to aſſume. Diſguſted by this illiberal treatment, he left Leyden in 1609, and removed to the univerſity of Franeker, where he had to contend with ſimilar difficulties, on account of his attachment to the Arminian doctrines. In the year 1710, however, he was admitted to the profeſſion of the miniſtry, and appointed to a church at Bleſwyck, in the neighbourhood of Rotterdam. In the following year he appeared as one of the deputies at the conference held at the Hague, before the ſtates of the province, between ſix anti-remonſtrant and ſix remonſtrant miniſters, where he diſtinguiſhed himſelf by his defence of the opinions of his party. In 1712 he was choſen profeſſor of divinity at Leyden, in the room of Gomarus, who ſurrendered that office. In this ſituation he conducted himſelf with ſingular prudence, as well as ability, ſo that he lived on terms of amity with Polyander, his colleague, who belonged to the party of Gomariſts. The controverſy concerning predeſtination was at this time the occaſion of great animoſity; and Epiſcopius, and his friends, were objects of enmity and perſecution to the deluded populace. Their condition was rendered more perilous by the partiſans of Maurice, prince of Orange, by whom they were calumniated, not only as heretics in their theological ſentiments, but as enemies to the proteſtant religion, and to the United Provinces. At length Maurice and the Gomariſts, of whom he was the head, ſucceeded in obtaining a decree of the States for convening a national ſynod; but the Arminians remonſtrated againſt the meeting of ſuch a ſynod, becauſe they well know that it would be compoſed of their inveterate enemies, who on this occaſion would appear both as their accuſers and their judges. However, it met at Dort in the year 1618, (See *Synod* of DORT,) and the buſineſs of the ſeſſions was conducted as Epiſcopius and his party apprehended. The ruling members were invincible, and required implicit ſubmiſſion to their deciſions. It was in vain that Epiſcopius and his brethren demurred and remonſtrated againſt their proceedings. They were expelled from the ſynod, and their cauſe was tried during their abſence. The reſult was a ſentence, which charged them with peſtilential errors, and with being corrupters of the true religion. This ſentence was followed by their excommunication, a deprivation of their offices, eccleſiaſtical and civil, a prohibition to exerciſe their miniſtry, and beſides fines and impriſonment, baniſhment from the territories of the republic. Accordingly Epiſcopius, as well as ſeveral of his adherents, retired to Antwerp, where he drew up various publications in defence of his oppreſſed party, ſome of which are, "A Confeſſion of Faith," expreſſed for the moſt part in words and phraſes of ſcripture: a treatiſe, entitled "Antidotum adverſus Synodi Dordracenæ Canones," and two letters, addreſſed to Wadingus, a Jeſuit, who wiſhed to ſeduce him into his church, one on the rule of faith, and the other upon the worſhip of images. In 1609, Epiſcopius withdrew into France, and endeavoured to confirm and comfort his brethren, as well as to diffuſe the opinions for which he ſuffered, both by his correſpondence and publications. In 1626, after the death of prince Maurice, and the acceſſion of prince Frederick Henry, he returned to his native country, and enjoyed the benefits of toleration and tranquillity. The place of his ſettlement was Rotterdam, where he exerciſed his miniſtry for about 8 years, and compoſed ſeveral pieces of a theological

logical and controverfial nature, which were publifhed during his life and after his death. The Arminians, having remained for fome years unmolefted, eftablifhed a college at Amfterdam, of which Epifcopius was the firft theological profeffor, and this appointment occafioned his removal to Amfterdam in the year 1634. In the honourable and diligent difcharge of the duties of this office, he continued till his death, which happened in 1643. Epifcopius was a man of folid and extenfive learning; a cool and accurate judgment, a lively genius, and commanding powers of cloquence. His controverfial pieces, though occafionally intermixed with unbecoming ardour and bitternefs, are generally diftinguifhed by a fpirit of candour and moderation. His character was highly exemplary. His fentiments coincided with thofe of Arminius, which he reduced into a fyftematic form, and recommended by the graces of compofition. His works, confifting of commentaries, theological inftitutions, controverfial treatifes, &c. form two volumes in folio; which were edited by Peter Curcellæus, who has prefixed an account of the author. A larger life of him was publifhed by Philip â Limborch, the fon of his brother's daughter, written in the Dutch language, of which a Latin verfion appeared at Amfterdam in 1701. 8vo. Bayle. Mofheim. Moreri. Gen. Biog.

EPISCOPUS PUERORUM, *bifhop of the boys*, a ludicrous kind of office, formerly exercifed in churches, in that called the feaft of fools, or the feaft of the kalends. See *Boy* BISHOP.

EPISEMASIA, from επισημαινω, *I fignify*, in *Medicine*, is the very time that a difeafe firft feizes a perfon, and is properly called fignificatio. Blancard.

EPISODE, Επεισοδιον, from επι, *upon*, and εισοδος, *entry*, is commonly conceived to be a feparate incident, ftory, or action, which an hiftorian, or poet, inferts, and connects with his principal action; to furnifh out the work with a greater diverfity of events; though, in ftrictnefs, all the particular incidents whereof the action or narration is compofed, are called epifodes.

EPISODE, in *Dramatic Poetry*, was the fecond part of the ancient tragedy.

The origin and ufe of epifodes is defcribed by M. Hedelin, and F. Boffu. Tragedy, in its original, being only a hymn fung in honour of Bacchus, by feveral perfons, who made a kind of chorus, or concert of mufic, with dancing, and the like; to diverfify the reprefentation a little, and divert the audience, they determined at length to divide the finging of the chorus into feveral parts, and to have fomething rehearfed in the intervals.

At firft, a fingle perfon, or actor, was introduced, then two, then more; and what the actors thus rehearfed, or entertained the audience with, being fomething foreign, or additional to, or befide, the fong of the chorus, and no neceffary part thereof, was called επεισοδιον, *epifode*.

And hence tragedy came to confift of four parts, the prologue, epifode, exode, and chorus. The prologue was all that preceded the firft entrance of the chorus, and concluded with the firft interlude, or choral ode, between the acts. The epifode, all that was interpofed between the fingings of the chorus, and extended in general from the firft to the laft of the interludes. The exode, all that was rehearfed after the chorus had done finging, or comprehended all that was faid after the laft interlude. And the chorus, was the grex, or company, that fung the hymn. See each of thefe articles.

And as this recitation of the actors was in feveral parts, and inferted in feveral places, it might either be confidered together as a fingle epifode, confifting of feveral parts; or each part might be called a diftinct epifode.

Thefe feveral epifodes in the fame tragedy might either be taken from fo many different fubjects, or from the fame fubject divided into a proper number of recitations, or incidents.

To confider only the firft occafion, and inftitution of thefe foreign or additional pieces, it appears no ways neceffary, that they fhould be taken from one and the fame fubject; three or four recitations of different actions, no wife related, or connected to each other, would eafe the actors, and amufe the people, in the intervals of the chorus, as well as if they were all fo many parts of the fame action. By degrees, what was at firft only an addition to the tragedy, became the principal part thereof. Then the feveral pieces, or epifodes, began to be confidered as one fingle body which was not to have parts, or members of different nature, and independent of each other.

The beft poets took the thing in this light, and drew all their epifodes from the fame action; which practice was fo fully eftablifhed in Ariftotle's time, that he lays it down as a rule. Thofe tragedies wherein this unity and connexion were not obferved, he called epifodic pieces. See TRAGEDY.

EPISODE, in *Epic Poetry*. The term epifode, by being tranfplanted from the ftage to the epopœia, did not change its nature. All the difference Ariftotle makes between the tragic and epic epifodes, is, that the latter are more ample than the former.

Ariftotle ufes the word in three different fenfes: the firft taken from the enumeration already made of the parts of the tragedy, *viz.* prologue, chorus, epifode, and exode; whence it follows, that in tragedy, every thing is epifode that is none of the other parts; fo that as, among us, there are tragedies without either prologue, chorus, or epilogue, the tragic epifode includes the whole tragedy; confequently the epic epifode muft be the whole poem, in like manner; all there is to retrench from it being the propofition and invocation, which ftand in lieu of the prologue. In this fenfe, the epopœia and tragedy have each only one epifode; and if the parts or accidents be ill connected together, the poem will be epifodic and defective.

But farther, as all that was fung in the tragedy was called the chorus, in the fingular number, yet this fingularity did by no means prevent every part or divifion of the fame from being called a chorus, without making feveral choruffes; fo it was with the epifode; each incident, and part of the fable and action, is not only a part of the epifode, but it is an epifode itfelf.

The term epifode, therefore, in this fenfe, fignifies every part of the action expreffed in the plan, or firft draught of the fable; as the abfence and wanderings of Ulyffes, the diforders in his family, and his prefence, which retrieved and fet all to rights again.

Ariftotle furnifhes us with a third kind of epifode; in fhewing that what is contained and expreffed in the firft plan of the fable is proper, and that all the reft is epifode.

By *proper* he means what is abfolutely neceffary; and by epifode, what in one fenfe is neceffary, and in another not; fo that the poet is at liberty to ufe, or let it alone.

Thus, Homer, having made the firft draught of the fable of his Odyffey, was not at liberty either to make Ulyffes abfent from his country, or not. His abfence was effential; and therefore Ariftotle ranks it among the things he calls *proper*. But he does not beftow that appellation on the adventures of Antiphates, Circe, the Sirens, Scylla, Charybdis,

Charybdis, &c. The poet was at liberty to have left thefe alone, and to have chofen others in their room; fo that they are epifodes diftinct from the firft action, to which they are not immediately neceffary.

The third fenfe of the word epifode comes to the fecond: all the difference between them is, that what we call epifode in the fecond fenfe, is the ground or plan of the epifode in the third; and that the third adds to the fecond certain circumftances which are only probable, and not neceffary, as the places, princes, and people, among whom Ulyffes was caft by Neptune.

It muft be added, that in an epifode in the third fenfe, the incident, or epifode in the firft fenfe, whereon it is grounded, is to be extended and amplified; otherwife, an effential part of the action and fable does not become an epifode.

Laftly, it is in this third fenfe that we are to underftand that precept of Ariftotle, not to make the epifodes till after the names of the perfons have been chofen. Homer would not have fpoken of the fleets and fhips as he has done, if, in lieu of the names of Achilles, Agamemnon, and Iliad, he had chofen thofe of Adraftus, Capaneus, and Thebaid.

Upon the whole, the term epifode, in the epic poem, as ufed by the father of the critics, Ariftotle, does not fignify any foreign or accidental adventure; but the whole narration of the poet, or a neceffary and effential part of the action and fubject, amplified with probable circumftances.

Thus Ariftotle enjoins that the epifode be not added to the action, or fetched from elfewhere; but that it be a part of the action; and never ufes the word *adding*, in fpeaking of epifodes, though it occurred fo naturally to his interpreters, that they have generally ufed it in their tranflations and comments. He does not fay, that after laying the plan and choofing the names, the poet is to add the epifodes; but ufes the derivative of the word epifode, ἐπισοδεῖν, as if in Englifh we fhould fay epifodify his action.

From what has been faid, we may venture to define epifodes to be neceffary parts of the action, extended and filled up with probable circumftances. Now an epifode is only a part of an action, and not a whole action; and this part of the action, which is the bafe or ground of the epifode, muft not, when epifodified, retain any thing of the fimplicity which it had when firft expreffed in general, in the plan of the fable.

The fubject of a poem may be lengthened two ways; either by the poet's making ufe of a great many of his epifodes; or by his amplifying and giving a greater extent to every one. By this latter method, chiefly, it is, that the epic poets lengthen their poems much beyond the dramatic. It muft be added, that there are certain parts of an action, which of themfelves do not naturally prefent or afford more than one epifode; fuch as the death of Hector, of Turnus, or the like: whereas there are other parts of the fable more copious and fertile, and which oblige the poet to make diverfe epifodes on each, though laid down in the firft plan with as much fimplicity as the reft: fuch are the battles of the Trojans and Grecians, the abfence of Ulyffes; the wanderings of Æneas, &c. For Ulyffes's abfence fo many years from his own country, required his prefence elfewhere; and the defign of the fable was to throw him into feveral dangers, and different countries. Now each peril, and each new country, furnifhed an epifode, which the poet might ufe if he pleafed.

The refult of the whole is, that epifodes are not actions, but parts of actions; that they are not added to the action and matter of the poem, but make the action and matter themfelves; that of courfe they are not to be fetched from elfewhere, but raifed from the ground or bafis of the action; that they are not united and connected with the action, but with one another; that all the parts of an action are not fo many epifodes, but only fuch as are amplified, and attended with particular circumftances; and laftly, that their union with each other is neceffary in the ground of the epifode, and probable in the circumftances.

Epifodes, fays Dr. Blair, (Lectures, vol. iii.), as the term is now underftood, are certain actions, or incidents, introduced into the narration, connected with the principal action, yet not of fuch importance as to deftroy, if they had been omitted, the main fubject of the poem. Of this nature are the interview of Hector with Andromache, in the Iliad; the ftory of Cacus, and that of Nifus and Euryalus in the Æneid; the Adventures of Tancred with Erminia and Clorinda, in the Jerufalem; and the profpect of his defcendants exhibited to Adam, in the laft books of Paradife Loft. Such epifodes as thefe, are not only permitted to the epic poet; but, provided that they be properly executed, are great ornaments to his work. The rules that ferve to regulate them are fuch as follow: they muft be naturally introduced, and have a fufficient connection with the fubject of the poem; they muft feem to be inferior parts belonging to it, and not mere appendages annexed to it. In the next place, epifodes ought to prefent to us objects of a different kind, from thofe which go before, and thofe which follow, in the courfe of the poem. For epifodes are introduced into an epic compofition, principally for the fake of variety. Laftly, as an epifode is a profeffed embellifhment, it ought to be particularly elegant and well-finifhed; and, accordingly, it is, for the moft part, in pieces of this kind, that poets put forth their ftrength. The epifodes of Taribezus and Ariana, in Glover's Leonidas; and of the death of Hercules, in the Epigoniad, are the two greateft beauties in thefe poems. With regard to epifodes in didactic poetry; fee DIDACTIC *Poetry*.

EPISODIC, in *Poetry*. A fable is faid to be epifodic, when it is fwelled with unneceffary incidents; and its epifodes are not neceffarily, nor properly, connected with each other.

Ariftotle lays it down, that thofe tragedies are moft defective, whofe epifodes have no connection, or dependence on each other, which he calls epifodic, *q. d.* fuperabundant in epifodes; becaufe fo many little epifodes can never compofe one whole one, but neceffarily remain in a vicious plurality.

If an epifode be ufed, the names and circumftances whereof are unneceffary, and whofe ground and fubject make no part of the action, that is, of the matter of the poem, fuch an epifode renders the fable epifodic. This irregularity is difcovered, when one may take away a whole epifode, without fubftituting any thing in its room; and yet leave no chafm, or defect, in the poem. The hiftory of Hypfipule, in Statius's Thebaid, affords an inftance of thefe faulty epifodes. If the whole ftory of that illuftrious nurfe were retrenched, the fequel of the principal action would be the better for it. Nor would any body imagine he had forgot any thing, or that there was any member of his action wanting. Boffu, and Arift. Poet. cap. 9.

EPISPASTIC, from ἐπι and σπάω, *I draw*, in *Medicine*, a term denoting the quality of thofe fubftances, which, when applied to the fkin, draw the humours to the part, or excite inflammation and vefication in it. The word, therefore, is nearly fynonymous with veficatory, or bliftering. See BLISTER.

EPISPHÆRIA, from επι and σφαιρα, *a sphere*, in *Anatomy*, are windings and turnings in the outer fubftance of the brain, that the fanguiferous veffels may pafs more fecurely.

EPISTÆBE, in *Botany*, a name given to the cufcuta or dodder, found growing on the plant ftæbe of the ancient Greeks. See Epiphæos.

EPISTAPHYLINUS, in *Anatomy*, a name under which the azygos uvulæ mufcle has been defcribed. It will be found, in different writers, under the names of ftaphylinus, columellæ mufculus teres, mufculus uvulæ, or mufcle de la luette. It is defcribed in the article Deglutition.

EPISTATES, Επιςατες, derived from επι, *over*, and ιςημι, *I ftand*, in *Antiquity*, a perfon who has the command and direction of an affair, or of a people.

The term is of confiderable ufe, in fpeaking of the government of Athens, where the epiftates was the fenator in command for that day, or whofe turn it was to prefide that day. The conftitution was this: the ten tribes of Athens formed by Clifthenes, elected every year by lot, each of them, fifty fenators, which made a fenate of five hundred. Every tribe had the precedence in its turn, and furrendered it again fucceffively to another. The fifty fenators in office were called prytanes; the particular place where they affembled, prytaneum, and the term, or duration of their office, *viz.* thirty-five days, prytanea. During thefe thirty-five days, ten of the fifty prytanes prefided weekly, under the name of proedri; and of thefe proedri there was one to prefide each day of the week, under the title of epiftates.

No perfon was allowed to hold his office more than once in his whole life, left he fhould acquire too much the tafte of dominion: the fenators of all the other tribes ftill voted, according to the order the lot had given them; but the prytanes laid the bufinefs before them, and the epiftates took their votes and opinions.

It muft be added, that of the ten proedri, of each week, there were but feven that would prefide each his day in the quality of epiftates; the ten proedri elected the feven prytanes.

EPISTAXIS, from επιςαζω, *inftillo*, in *Surgery*, hemorrhage from the nofe.

When bleeding from the nofe takes place in fuch a degree as to be dangerous, or likely to bring on exceffive debility, the further effufion of blood may be ftopped in the following manner. Roll a confiderable piece of lint round the end of a probe; wet it completely through with a ftrong folution of the zincum vitriolatum; introduce it into the noftril, and prefs it as ftrongly as poffible againft the part whence the blood iffues. As foon as the blood ceafes to flow, we may conclude that the preffure acts on the bleeding point. This plan generally fucceeds.

When the blood, however, flows from fome point which lies very deeply in the noftril, it might be found impracticable to make preffure exactly on the bleeding veffels. At all events, we may then pafs a piece of catgut through the noftril, and bring it out of the mouth, from the fauces, by means of a pair of common forceps. A tent of lint may next be faftened to the ligature, and drawn backward through the mouth into the nofe, fo as completely to ftop up the pofterior opening of the noftril. The front aperture may be eafily filled with a proper doffil of lint. In this manner, it is clear that no further hemorrhage can happen, as the blood cannot poffibly find its way outward.

EPISTEMONARCH, derived from επιςημη, *knowledge*, and αρχη, *command*, a dignitary, in the *Ancient Greek Church*, appointed to watch over the actions of the church, and to infpect or fuperintend every thing relating to the faith, in quality of a cenfor. His office anfwered pretty much to that of magifter facri palatii at Rome.

EPISTHOTONOS, from επισθω, *forwards*, and τεινω, *to extend*, in *Surgery*, a fpecies of tetanus, in which the body is bent forwards. See Tetanus.

EPISTITES, from επιςημι, *I keep off*, in *Natural Hiftory*, the name of a ftone, defcribed by the writers of the middle ages, as being of a beautiful red, and fhining very elegantly. It was renowned for its many magical virtues, according to the idle tradition of thefe times; they faid it drove away all noxious animals, and kept off ftorms from the place where any one was who had it about him.

EPISTLE, a letter miffive.

The word is formed of επιςελλω, *I fend.*

The term epiftle is now fcarcely ufed, but for letters wrote in verfe, and letters dedicatory.

In fpeaking of letters written by moderns, or rather in the modern languages, we never ufe the word epiftle. Thus, we fay, the letters, not epiftles of the cardinal D'Offat, of Voiture, of Balzac, of Howel, of Pope, &c.: but thofe wrote by the ancients, or rather in the ancient language, we call epiftles; as the epiftles, not letters in Cicero, Pliny, Seneca. The epiftles of St. Paul, St. Peter, St. John, &c. to the Romans, Corinthians, &c.

A Table of St. Paul's Epiftles, in the order of time, with the places where, and the times when they were written.

Epiftles.	Places.		A. D.
1 Theffalonians 2 Theffalonians	Corinth		52
Galatians	Corinth, or Ephefus	Near the end of or the beginning of	52 53
1 Corinthians	Ephefus	The beginning of	56
1 Timothy	Macedonia		56
Titus	Macedonia, or near it	Before the end of	56
2 Corinthians	Macedonia	About October	57
Romans	Corinth	About February	58
Ephefians	Rome	About April	61
2 Timothy	Rome	About May	61
Philippians	Rome	Before the end of	62
Coloffians	Rome	Before the end of	62
Philemon	Rome	Before the end of	62
Hebrews	Rome, or Italy	In the fpring of	63

A Table of the Seven Catholic Epiftles, fo called becaufe they were written to Chriftians in general, and the Revelation, with the places where, and the times when they were written.

Epiftles.	Places.		A. D.
The Epiftle of St. James	Judea	61 or beginning of	62
The 2 Epiftles of St. Peter	Rome		64
St. John's 1ft Epiftle	Ephefus	About	80
His 2d and 3d Epiftles	Ephefus	Between	80 and 90
The Epiftle of St. Jude	Unknown		60 or 65
The Revelation of St. John	Patmos, or Ephefus		95 or 96

See Lardner's Credibility of the Gofpel Hiftory, vol. xvi. and vol. xvii.

Learned writers are not abfolutely agreed as to the dates of thefe feveral epiftles, nor the places whence they were written. It would lead us too far to examine and produce the various authorities and arguments that have been ufed for fettling thefe particulars: we fhall only mention that Dr. Doddridge dates the 1ft Epiftle to the Corinthians about the year 57; and the 2d Epiftle in 58; thofe to the Ephefians, Philippians, Coloffians, and Philemon, in 63; the 1ft to Timothy, in 58 or 65; the 2d to Timothy, in 66 or 67; the Epiftle to Titus, between St. Paul's firft and fecond imprifonment at Rome; the Epiftle of St. James, in 60 or 61; the 1ft of Peter in 61; the 2d, in 67; that of St. Jude, fome time after the 2d of Peter, according to Dr. Mills, in the year 90. As to the general defign of thefe feveral epiftles, it is obferved by Dr. Doddridge, who is defervedly efteemed an excellent and ufeful expofitor, that the Epiftle to the Romans is intended to fix in the minds of the Chriftians, to whom it is addreffed, a juft fenfe of the excellency of the gofpel, and to engage them to act in a manner agreeable to their profeffion of it: the Epiftles to the Corinthians are defigned to refolve fome important queries propofed by them, and to correct the various criminal irregularities and diforders, of which they were guilty: the principal defign of the Epiftle to the Galatians was to affert and vindicate the apoftle's authority and doctrine, and to confirm the churches of Galatia in the faith of Chrift, efpecially wih refpect to the important point of juftification; to expofe the errors that were introduced among them, and to revive thofe principles of Chriftianity which he had already taught them. In the Epiftle to the Ephefians, that apoftle endeavours to eftablifh them in the faith; and to this end to give them more exalted views of the divine love and the excellence of Chrift; to fhew them that they were now, though Gentiles, made partakers of equal privileges with the Jews; to encourage them, by his own example and concern for their welfare; and to engage them to the practice of duties becoming their Chriftian character. The Epiftle to the Philippians is defigned to comfort them under the concern they felt on his account; to check a party-fpirit that had broke out among them, and to promote union and affection; to guard them againft the feduction of judaizing teachers; to fupport them under their trials, and to infpire them with an ambition of excelling in ornamental and diftinguifhed attainments. The Epiftle to the Coloffians is defigned to excite them to a temper and conduct worthy of their facred character, and to fecure them from the influence of thofe Pagan fophifts or Jewifh bigots, who endeavoured to feduce them from the purity of the Chriftian faith. The two Epiftles to the Theffalonians are intended to confirm them in their adherence to the Chriftian faith, and to engage them, from the fufferings they had already endured, and the extraordinary character they had hitherto maintained, to make great advances, and to excel ftill more in religion and virtue; and alfo to rectify fome erroneous apprehenfions they entertained about the coming of Chrift, and to direct them in the proper exercife of Chriftian difcipline The firft Epiftle of Timothy was partly intended to direct him in managing the affairs of the church, and choofing proper perfons for the various offices it required; and partly to caution him againft the influence of judaizing teachers, to urge him to pay a conftant regard to the interefts of practical religion, and to animate him to diligence, fidelity, and zeal. The fecond epiftle prepares Timothy for the fufferings that awaited him, forewarns him of the apoftacy that was beginning to appear in the church, and animates him to the perfevering difcharge of every part of the minifterial office. The Epiftle to Titus contains a variety of prudent inftructions and cautions. The defign of the Epiftle to the Hebrews was to confirm the Jewifh Chriftians in the faith and practice of the gofpel, which they might be in danger of deferting through the infinuation or ill-treatment of their perfecutors. St. James, in his epiftle, aims to correct thefe errors both in doctrine and practice into which the Jewifh Chriftians had fallen, which might otherwife have produced fatal confequences; and then to eftablifh the faith, and animate the hope of fincere believers under their prefent and approaching fufferings. The Epiftles of St. Peter are defigned to induce the Chriftian converts in various parts of the world to maintain a conduct inoffenfive and amiable; to fupport them under their trials, and to encourage their conftancy, notwithftanding the artifices of falfe teachers, and the perfecution of their moft inveterate enemies. The leading defign of St. John in his firft epiftle, is to evince the vanity of faith feparate from morality; to infpire the minds of Chriftians with mutual charity, and to guard them againft the fnares and efforts of Antichrift, and of all who were endued with his fpirit. The Epiftle of Jude defcribes the characters of the falfe teachers, reprefents the divine judgments which fuch perfons had reafon to expect, and thus cautions Chriftians againft being perverted by them. See Doddridge's Fam. Expofitor, vol. iv. v. and vi. in the general introduction prefixed to each epiftle. See alfo an account of the writers of thefe epiftles, and of the churches to which they were addreffed.

Epistle, *Poëtical*, a fpecies of didactic poetry, the fubjects of which are the manners and characters that occur in ordinary life, and that require to be treated with fomewhat of the eafe and freedom of converfation. When thefe epiftles are employed on moral and critical fubjects, they feldom rife into a higher ftrain of poetry than *fatires*, which fee. Many other fubjects may be difcuffed in the form of an epiftle; fuch as love poetry, or elegiac; fpecimens of which occur in Ovid's "Epiftolæ Heroidum," and his "Epiftolæ de Ponto." As thefe works are defigned to be merely fentimental, and their merit confifts in being proper expreffions of the paffion or fentiment which forms the fubject, they may affume any tone of poetry that is fuited to it. But didactic epiftles feldom admit of much elevation. The poet, commonly reftricting himfelf to obfervations on authors, or on life and characters, and not intending to compofe a formal treatife, or to confine himfelf ftrictly to regular method, gives fcope to his genius on fome particular theme, which, at the time, has prompted him to write. Much of the grace of this kind of writing confifts in a fpirited concifenefs, which gives to fuch compofition an edge and livelinefs, that ftrike the fancy and keep attention awake. Much of their merit depends alfo on juft and happy reprefentations of characters. Unfupported by thofe high beauties of defcriptive and poetical language, which adorn other compofitions, the reader expects them to entertain him with lively paintings of men and manners; and therefore in thefe a certain fprightlinefs and turn of wit find their proper place, and contribute to the beauty and effect. Of this kind of poetry Mr. Pope's ethical epiftles furnifh an almoft perfect model. In thefe his wit difcovers itfelf to fuch a degree as to give a proper feafoning to grave reflections. His paintings of characters are natural and lively; and, never was any writer fo happy in that concife fpirited ftyle, which gives animation to fatires and epiftles. His rhyme likewife adds to the ftyle an elevation which otherwife it could not have poffeffed, while at the fame time he manages it fo artfully, that it never appears in the leaft to incumber him, but, on the contrary, ferves to increafe the livelinefs of his manner. In this fpecies of writing, eafe and elegance are the diftinguifhing characters; nothing, therefore, fhould be forced or unnatural, laboured or affected, but every part of the compofition fhould manifeft an eafy, polite, and unconftrained freedom.

EPISTOLARES, among the Romans, under-fecreta- ries

ries to the "magifter fcrinii epiftolarum," or fecretary who wrote the emperor's leters. They were thirty-four in number. See MAGISTER.

EPISTOLARY, a term ufed in the phrafe epiftolary ftyle. As the matter of an epiftle is the fame with that of converfation, it fhould not differ in the manner of expreffion; and, therefore, all pomp and ftudy of language are not only needlefs but very improper: the moft plain and eafy way of conveying our thoughts muft certainly be beft, as being moft natural. Purity in the choice of words, and juftnefs of conftruction, joined with perfpicuity, are the chief properties of this ftyle: to which purpofe Cicero obferves, "that in writing letters we make ufe of common words and expreffions." (Ad Fam. lib. ix. cap. 21.) And Seneca fays, "I would have my letters be like my difcourfes, when we either fit or walk together, unftudied and eafy." (Ep. 75. ad Lucill.)

The firft and fundamental requifite in epiftolary writing is to be natural and fimple, for a ftiff and laboured manner is as bad in a letter as in converfation. This does not banifh fprightlinefs and wit. Thefe are graceful in letters as well as in converfation; when they flow eafily, and without being ftudied; when employed fo as to feafon, and not to clog. A perfon, who either in converfation or in letters affects to fhine and fparkle always, will not pleafe long. The ftyle of letters fhould be neat and correct, but not too highly polifhed. Nicety about words betrays ftudy; and on this account mufical periods, and appearances of number and harmony in arrangement, fhould be carefully avoided in letters. Thofe that are written with the greateft facility are commonly the beft. Neverthelefs, it fhould be remembered, that the eafe and fimplicity of epiftolary writing are not to be underftood as importing entire carelefsnefs. In writing to the moft intimate friend, a certain degree of attention, both to the fubject and the ftyle, is requifite and becoming. The firft requifite both in converfation and correfpondence, is to regard all the proper decorums, which our own character, and that of others demand. An imprudent expreffion in converfation may be forgotten and pafs away; but with the pen in hand, we fhould remember the well-known adage, "Litera fcripta manet."

As the fubjects of epiftles are various, they will neceffarily acquire fome variety in the manner of expreffion. If the fubject be weighty and momentous, the language fhould be ftrong and folemn; in things of a lower nature, more free and eafy; and upon lighter matters, jocofe and pleafant. In exhortations, it ought to be lively and vigorous; in confolations, kind and compaffionate; and in advifing, grave and ferious. In narratives, it fhould be clear and diftinct; in requefts, modeft; in commendations, friendly, without adulation; in profperity, chearful; and mournful, in adverfity. In a word, the ftyle ought to be accommodated to the particular nature of the fubject about which it is converfant. Although there fhould be nothing very confiderable in the fubject; yet if the fpirit and turn of the correfpondence be agreeable, if the letters be written in a fprightly manner, and with native grace and eafe, they may ftill be entertaining, more efpecially if there be any thing to intereft us in the characters of thofe who write them. As letters from one friend to another make the neareft approach to converfation, we may expect to fee more of character difplayed in thefe than in other productions, which are ftudied for public view. We are pleafed with beholding a writer fo fituated as to allow him to be at his eafe, and to give occafional vent to the overflowings of his heart. Befides, the different character of the perfon, to whom the letter is written, requires a like difference in the modes of expreffion. Superiors fhould be addreffed with refpect; inferiors, with courtefy; and equals, with civility. Old men and young, the grave and facetious, courtiers and philofophers, friends and ftrangers, require fome variety in the mode of addrefs. The epiftles of Cicero, the ftyle of which is plain and fimple, and yet pleafant and engaging, furnifh a proper model in this refpect. They are the moft valuable collection of letters in any language, as they are letters of real bufinefs, written to the greateft men of the age, compofed with purity and elegance, but without the leaft affectation; and, what adds greatly to their merit, written without any intention of being publifhed to the world. Pliny's letters are elegant and polite; and exhibit a very pleafing and amiable view of the author; but, according to the vulgar phrafe, they fmell too much of the lamp. They are too elegant and fine: and the author feems to be cafting an eye towards the public, when he is appearing to write only to his friends. His ftyle abounds fo much with turns and quibbles upon the found of words, as to render it more ftiff and affected than agrees with converfation, or than a man of fenfe would choofe to ufe in difcourfe, if it were in his power. This, indeed, was owing to the age in which he lived, at which time the Roman eloquence was funk into puns, and an affectation of wit; for Pliny was otherwife a man of fine fenfe and great learning. We need not here recommend Melmoth's tranflation of the letters of Cicero and Pliny. The moft diftinguifhed collection of letters in the Englifh language is that of Mr. Pope, Dean Swift, and their friends; publifhed partly in Mr. Pope's works, and partly in thofe of Dean Swift. Many letters in this collection are written with eafe and a beautiful fimplicity. Thofe of Dr. Arbuthnot deferve this commendation. Dean Swift's are unaffected. Several of lord Bolingbroke's and of bifhop Atterbury's letters are mafterly. Mr. Pope's are too artificial. Among the French in the laft age, Balzac and Voiture were the two moft celebrated epiftolary writers. Balzac's periods are fwelling, and his ftyle pompous; fo that his reputation foon declined. Voiture continued for a long time a favourite author. His compofition is extremely fparkling; he manifefts much wit, and trifles agreeably. His only fault is, that he is too open and profeffed a wit, to be thoroughly agreeable as a letter-writer. The letters of Madam de Sevigné are now efteemed the moft accomplifhed model of a familiar correfpondence. Trifling as are their fubjects, and overloaded as they are with compliments, they fhew fuch perpetual fprightlinefs, they contain fuch eafy and varied narration, and fo many ftrokes of the moft lively and beautiful painting, perfectly free from any affectation, that they are juftly entitled to high praife. The letters of lady Mary Wortley Montague poffefs much of the French eafe and vivacity, and retain more the character of agreeable epiftolary ftyle, than perhaps any letters which have appeared in the Englifh language. Ward's Orat. vol. ii. p. 213, &c. Blair's Lect. vol. iii. Lect. 37. See STYLE.

EPISTOLARY is fometimes alfo applied to authors who have wrote epiftles or letters. The principal epiftolary authors are Sidonius Apollinaris, Tully, the younger Pliny, Seneca the philofopher, Petrarch, Politian, Bufbequius, Erafmus, Lipfius, Muretus, Afcham, Milton, Petau, Launoi, Sarau, Balzac, Voiture, fir W. Temple, Lyttelton, &c. &c. See the preceding Article.

EPISTOMIA, in *Anatomy*, are the utmoft gapings and meetings of veffels.

EPISTOMIUM, Επιϛομιον, from επι, *upon*, and ϛομα, *mouth*, in *Hydraulics*, a plug or inftrument, by the application whereof

whereof the orifice of a veffel may be opened and fhut again at pleafure.

EPISTROPHE, Επιστροφη, in *Rhetoric*, a figure wherein that which is fuppofed of one thing is ftrongly affirmed of another, and the repetition of the fame word occurs at the end of each member or fentence.

"Since concord was loft, friendfhip was loft, fidelity was loft, liberty was loft, all was loft." Auct. ad Herenn. lib. iv. cap. 13. See alfo 2 Cor. xi. 22.

EPISTROPHEUS, in *Anatomy*, from επι, *upon*, and στρεφω, *I turn*, a name given to the fecond vertebra of the neck, round a particular procefs of which the firft vertebra turns. See SPINE.

EPISTYLE, Επιστυλιον, from επι, *upon*, and στυλος, *column*, in the *Ancient Architecture*, a term ufed by the Greeks for what we call architrave, *viz.* a maffive ftone, or a piece of wood, laid immediately over the capital of a column.

The epiftyle is the firft or loweft member of the entablature.

EPITAPH, Επιταφιον, from επι, *upon*, and ταφος, *fepulchre*; a monumental infcription, in honour or memory of a perfon defunct; or an infcription engraven or cut on a tomb, to mark the time of a perfon's deceafe, his name, family, and ufually fome eloge of his virtues or good qualities.

At Sparta, epitaphs were only allowed to people who died in battle. Boxhornius has made a collection of epitaphs, not very ample, but exceedingly well chofen. F. Labbe has likewife given a collection of the like kind in French, intitled, "Trefor des Epitaphes." Camden, Weaver, and Toldervy, have done fomething in the fame way with our Englifh epitaphs.

In epitaphs, the dead perfon is fometimes introduced by way of profopopœia, fpeaking to the living; of which we have a fine inftance, worthy the Auguftan age, wherein the dead wife thus befpeaks her furviving hufband.

"Immatura peri: fed tu, felicior, annos
Vive tuos, conjux optime, vive meos."

The French have a proverb, "Menteur comme une epitaphe; He lies like an epitaph;" an allufion to the eloges ordinarily contained therein, which are not always over-juft.

EPITAPH, is alfo applied to certain eloges, either in profe or in verfe, compofed without any intent to be engraven on tombs.

The elegance of an epitaph confifts in a nervous and expreffive brevity, and it is fometimes clofed with an epigrammatic point. It is obferved by Dr. Johnfon, in his life of Pope, that the difficulty of writing an epitaph confifts, in giving a particular and appropriate praife. This, he fays, is not always to be performed, whatever be the diligence or ability of the writer; for the greater part of mankind have no character at all, or little that diftinguifhes them from others equally good or bad; and, therefore, nothing can be faid of them, which may not with equal propriety be applied to a thoufand more.

In the Anthologies, or collections of epigrams, we have abundance of epitaphs, fome of them ludicrous and fatirical, others grave. For a fpecimen, we fhall here add a very beautiful one, compofed by Mr. Cowley, on himfelf, to be put in a little country-houfe, whither he retreated from the court and town to fpend his laft days.

"Hic, O viator, fub lare parvulo,
Couleius hic eft conditus, hic jacet
Defunctus humani laboris
Sorte, fupervacuaque vita;
Non indecora pauperie nitens,
Et non inerti nobilis otio,
Vanoque dilectis popello,
Divitiis, animofus hoftis.
Poffis ut illum dicere mortuum,
En terra jam nunc quantula fufficit
Exempta fit curis, viator,
Terra fit illa levis, precare.
Hinc fparge flores, fparge breves rofas;
Nam vita gaudet mortua floribus;
Herbifque odoratis corona
Vatis adhuc cinerem calentem."

The following epitaphs, befides many others, are worth recording. That of Alexander:

"Sufficit huic tumulus, cui non fufficeret orbis."

That of Newton:

"Ifaacum Newton
Quem immortalem
Teftantur Tempus, Natura, Cœlum,
Mortalem hoc marmor
Fatetur."

That of Dryden:

"Dryden."

Similar to which is that which the Italians have annexed to the tomb of Taffo:

"Les os du Taffe."

The following epitaph on the fifter of fir Philip Sidney, the countefs of Pembroke, and faid to be written by the famous Ben Jonfon, is diftinguifhed by its admirable conclufion:

"Underneath this noble marble hearfe
Lies the fubject of all verfe,
Sidney's fifter, Pembroke's mother:
Death, ere thou haft kill'd another
Fair, and learn'd, and good as fhe,
Time fhall throw a dart at thee."

The following alfo by the fame author is well known, and has been much admired:

"Underneath this ftone doth lie
As much virtue as could die;
Which, when alive, did vigour give
To as much beauty as could live."

Another epitaph, by Dr. Samuel Johnfon, on a celebrated mufician, deferves to be recorded, as it is equalled by few, and furpaffed by none.

"Philips! whofe touch harmonious could remove
The pangs of guilty pow'r and haplefs love,
Reft here, diftreft by poverty no more;
Find here that calm thou gav'ft fo oft before;
Sleep undifturb'd within this peaceful fhrine,
Till angels wake thee with a note like thine."

The following epitaphs are fpecimens of the fatirical or ludicrous kind:

Prior on himfelf, ridiculing the folly of thofe who value themfelves on their pedigree.

"Nobles and heralds, by your leave,
Here lie the bones of Matthew Prior,
The fon of Adam and of Eve;
Let Bourbon or Naffau go higher."

On a Miser.

" Reader, beware of immod'rate love of pelf;
Here lies the worst of thieves, who robb'd himself."

A similar epitaph by Dr. Swift.

" Beneath this verdant hillock lies
Damer, the wealthy and the wise.
His heirs, that he might safely rest,
Have put his carcase in a chest;
The very chest, in which, they say,
His other self, his money, lay.
And if his heirs continue kind
To that dear self he left behind,
I dare believe that four in five
Will think his better half alive."

We shall here subjoin the epitaph of the ingenious and laborious author of the Cyclopædia, from his tomb in the cloisters of Westminster Abbey, on the north side, written by himself:

" Multis pervulgatus,
Paucis notus;
Qui vitam inter lucem et umbram,
Nec eruditus, nec idiota,
Literis deditus transegit; set ut homo
Qui humana nihil a se alienum putat,
Vita simul et laboribus functus,
Hic requiescere voluit
Ephraim Chambers,
R. S. S.
Obiit 15 Maij, 1740."

In English thus:

" Heard of by many,
Known to few;
Who led a life between fame and obscurity;
Neither abounding nor deficient in learning;
Devoted to study; but as a man
Who thinks himself bound to all offices of humanity;
Having finished his life and labour together,
Here desires to rest.
Ephraim Chambers."

We shall close this article with some pertinent remarks on epitaphs, by an anonymous writer in the " Olla Podrida." The perusal of epitaphs is not to be considered as a light and frivolous amusement. If such only be the object of attention, as have been noticed with our applause, it is unquestionably an introduction to pleasing knowledge, and an incentive to moral improvement. What biography is to history, an epitaph is to biography. It is a sketch which marks the great outlines of character, and excites curiosity to view the portraits as painted in the pages of history. It is likewise an epitome of a sermon, which teaches the most useful truths in the most comprehensive form. Monumental inscriptions remind us, that time is on the wing, that every rank and age must fall a prey to his depredations; that the moments of life are too precious to be squandered away on trifles; that religion is the only support against the horrors of death, and the only guide to the joys of eternity.

EPITASIS, formed of επιτεινω, *intendo*, *I heighten*, in the *Ancient Poetry*, denoted the second part or division of a dramatic poem, wherein the plot or action proposed and entered upon in the first part or protasis was carried on, heightened, warmed, and worked up, till it arrives at its state or height called the catastasis.

This division is laid aside in the modern drama; in lieu whereof our plays are divided into acts. See Act.

The epitasis might ordinarily take up about our second or third act.

Epitasis, in *Medicine*, denotes the increase or growth and heightening of a disease; or the beginning of a paroxysm, particularly in a fever.

EPITHALAMIUM, Επιθαλαμιον, formed of επι, and θαλαμος, *bride-chamber*, in *Poetry*, a nuptial-song, or a composition, usually in verse, on occasion of a marriage between two persons of eminence.

The topics it chiefly insists on are the praises of matrimony, and of the married couple, with the pomp and order of the marriage solemnity: it concludes with prayers to the gods for their prosperity, their happy offspring, &c. This kind of poetry is very ancient: the 44th Psalm, and the book of Canticles have been considered as specimens of the epithalamium. Stesichorus, who flourished in the forty-second Olympiad, has been usually esteemed the inventor of the epithalamium among the Greeks, though it is known that Hesiod composed the epithalamium of Thetis and Peleus, a work now lost; but a fragment of which is preserved by an ancient scholiast. Catullus exceeded all antiquity in his epithalamiums, and the cavalier Marino all the moderns.

Among the Greeks, the epithalamium was sung by young men and maids at the door of the bed-chamber of the married pair in the evening and morning. The former sort were called επιθαλαμια κοιμητικα, and the latter εγερτικα.

EPITHEM, Epithema, from επι, *upon*, and τιθημι, *pono*, *I put*, in *Pharmacy*, a kind of fomentation or remedy, of a spirituous or aromatic kind, applied externally to the regions of the heart, liver, &c. to strengthen and comfort the same, or to correct some intemperature thereof.

There are principally three kinds of these external applications, the liquid, the solid, and the soft or poultice kind. See Cataplasm and Fomentation.

Epithem, *Volatile*, *epithema volatile*, a form of medicine prescribed in the late London Pharmacopœia, and ordered to be made of equal weights of common turpentine and spirit of sal armoniac. The turpentine is to be kept continually stirring in a mortar, and the spirit gradually dropt in till the whole is reduced to a white mass.

The spirit of sal armoniac used in this mixture must not be that made in the common way, with the addition of quick-lime, but with the alkali salt. Pemberton's Lond. Disp. p. 377.

EPITHE'SIS, from επι and τιθημι, *to lay upon*, an old term in *Surgery*, the meaning of which was the straightening of deformed limbs by mechanical contrivances.

EPITHET, Επιθετον, a noun adjective, expressing some quality of a substantive to which it is joined.

The word is formed of επι, *upon*, and θεσις, *positio*, *putting*. As a fruitful vine, a stately pile, an echoing vault, &c.

Epithets are of great use and conveniency among poets and orators, who supply in epithets what they want in other requisites. Card. Perron even blames Homer on the head of epithets, observing, that he frequently hooks in epithets without any sense or significancy at all, to help out his measures; and that he equips every hero with an epithet, not according to the exigence of the case, but the measure of the verse.

Epithet, is also used for a surname, or a person's second appellation.

Epithets were anciently bestowed very frankly, either on account of excellencies or defects of the body or mind; kings themselves were not exempted from them. Hence those thofe epithets fo frequent in hiftory, as Edward Long-fhanks, Richard Cœur de Leon, Edmund Iron-fide, Richard Crook-back, John Lack-land, &c.

Nor have the French ufed their kings any better; witnefs their Charles the Simple, Louis the Lazy, faineant (Ludovicus nihil faciens) Pepin the Short, Louis the Stammerer, le begue.

EPITHRICADIA, in *Antiquity*, a feftival in honour of Apollo.

EPITHYME. See DODDER, and EPITHEOS.

EPITOME, an abridgment, or a reduction of the principal matters of a larger book into a little compafs. See ABRIDGMENT.

The word is Greck, επιτομη, formed of επιτεμνειν, *refecare, to retrench, abridge*, or *cut off.*

The epitome of Baronius's Annals is done by De Sponde (Spondanus). Bernier has given an epitome of the philofophy of Gaffendus.

It is a popular objection againft the epitomizing of authors, that it frequently occafions the lofs of the originals. Thus the lofs of the hiftorian Trogus Pompeius is attributed to his epitomizer Juftin, and the lofs of a great part of Livy to Luc. Florus. See LIVY.

"Epitomes," fays the learned Bacon, "are the moths and corruptions of hiftory, that have fretted and corroded the found bodies of many excellent hiftories, and wrought them into bafe and unprofitable dregs."

EPITRITES, from επι, and τριτος, *third*, in *Profody*, a foot confifting of four fyllables, three long, and one fhort.

Grammarians reckon four fpecies of epitrites; the firft, confifting of an iambus and fpondee, as fălūtāntēs; the fecond, of a trochee and fpondee, as cōncĭtātī; the third, of a fpondee and an iambus, as cōmmūnĭcāns; and the fourth, of a fpondee and trochec, as īncāntārĕ.

EPITRITES, among the *Greek Muficians*, denoted a ratio, called alfo the fefquitertial ratio, the fame with that of three to four. See FOURTH.

EPITROCHASMUS, in *Rhetoric*, a figure wherein we flightly pafs over feveral things of great moment, by only mentioning them in general. Such is the faying of Cæfar, *Veni, vidi, vici.*

EPITROPE. See CONCESSION. This is one of the figures of fentences, which grants one thing to obtain another more advantageous. It is either real or feigned; and either the whole of a thing, or only a part is granted. Nothing more confounds an adverfary, than to grant him his whole argument, and at the fame time either to fhew that it is nothing to the purpofe, or to offer fomething elfe, which may invalidate it. Of the ufe of this figure we have examples in Cicero's defence of Ligarius, who was accufed by Tubero for having joined with Pompey in the civil war between him and Cæfar, (cap. 1.); and in the affair of Rofcius, where the proof depended upon circumftances; and when Cicero, who defended him, inquires what reafon could be alledged for his committing fo black a crime, as to kill his father, (cap. 27.) Cicero has alfo given us an example of a feigned or ironical conceffion in his defence of Flaccus (cap. 38.); when interceding for him on account of his former good fervices, in the time of Catiline's confpiracy, he fays in the way of irony, if fuch things are to be overlooked, "let us appeafe the ghofts of Lentulus and Cethegus; let us recall thofe who are in exile, and let us be punifhed for our too great affection and love for our country." To thefe feigned conceffions we may refer fuch modes of reafoning, by which the orator both juftifies a charge brought againft him, upon the fuppofition of its being true; and alfo proves that the charge itfelf is falfe. Thus Cicero, in his defence of Milo, reprefents the taking off of Clodius, with which Milo was accufed, as a glorious action; after he has fhewn that Milo's fervants did it without the knowledge of their mafter. (Cap. 10. and 27.)

EPITROPUS, a kind of judge, or rather an arbitrator, which the Greek Chriftians under the dominion of the Turks elect in the feveral cities, to terminate the differences that arife among them, and avoid carrying them before the Turkifh magiftrates. See ARBITRATOR.

There are feveral epitropi in each city. M. Spon, in his Travels, obferves, that at Athens there are eight taken out of the feveral parifhes, and called vecchiardi, *i. e.* old men. But Athens is not the only place where there are epitropi; they are in all the iflands of the Archipelago.

Some Latin authors of the fixth century call epitropi thofe who more anciently were called villici, and fince vidames.

In times ftill earlier, the Greeks ufed the term επιτροπος, in the fame fenfe as the Latins did *procurator, viz.* for a commiffioner or intendant.

Thus the commiffioners of provifions in the Perfian army are called by Herodotus and Xenophon epitropi. In the New Teftament, επιτροπος denotes the fteward of a houfehold, rendered in the vulgate procurator.

EPIZEUXIS, in *Rhetoric*, a figure where the fame word is repeated with vehemence in the fame fenfe, without any others intervening, and fuited to exprefs anger, furprife, forrow, and feveral other paffions: thus *age, age*; *adefte, adefte*; and that of Virgil, *nunc, nunc infurgite remis*, are inftances of it. Thus alfo, when Cicero would exprefs his indignation againft Antony for having been the chief inftrument in bringing on the civil war, he fays to him: "You, you, Antony, pufhed Cæfar upon the civil war." (Philip. ii. c. 22.) Thus he tells Catiline in his firft invective againft him; "You live, and live, not to lay afide, but to purfue your wicked defign." (Ibid. cap. 2.) See Matthew xxiii. 37. The ufe of this figure fhews the earneftnefs of the fpeaker and the great concern of his mind about what he fays, and has a natural tendency to excite the attention of the audience.

EPIZOOTIC STRATA, or *Mountains*, in *Geology*, are fuch as contain remains of animals, which a very large portion of all thofe upon the furface of the earth feem to do, although their reliquiæ are by no means equally numerous in all ftrata, probably owing to their not being preferved in every inftance, fo that their remains or impreffions can be now traced.

EPIZOOTY, a denomination given to an epidemical or contagious diftemper among horned cattle. M. de Saive, apothecary to the prince bifhop of Liege, has given the following inftructions for the prevention and cure of this diforder. As foon as any fymptoms of the diftemper are perceived, about $1\frac{1}{2}$ pint of blood fhould be taken from the beaft, unlefs he has been ill a day or two, in which cafe he fhould not be blooded; but in both cafes the following draught fhould be given, *viz.* N° 1. an ounce of the beft Venice treacle diffolved in a pint of vinegar, after which the back-bone and the whole hide muft be well rubbed with a dry hair cloth, to heat the hide and promote perfpiration. No drink fhould be given him but a white drink compofed of (N°. 2.) a handful or two of rye-meal in a pailful of clean water; and if the beaft fhould want food, mix up fome crumbs of rye bread with fome of this white drink, and give it him. The animal's mouth muft be wafhed twice a day with a cloth dipped in a mixture of (N°. 3.) equal quantity of vinegar and water, with a fpoon-

ful

ful of honey to a pint of it. If on the fecond day the beaft has not dunged, a clyfter compofed of (N°. 4.) a pint of water in which bran has been boiled, two fpoonfuls of falt, and a fmall glafs of vinegar muft be given and repeated every day till the evacuations are natural and regular. Befides the above remedies, the following cordial mixture (N°. 5.) *viz.* a pint of clear water, the fame quantity of vinegar, four fpoonfuls of honey or fyrup, and two glaffes of brandy, muft be given four times a day to facilitate and keep up perfpiration; taking particular care to repeat the friction as above directed. If the beaft fhould ftill continue low and heavy, the draught (N°. 1.) muft be repeated, unlefs he fhould be found to be hot and thirfty, in which cafe only the drink (N°. 2.) fhould be ufed. On the fourth day, if he feems more lively and free from heat, purge him with (N°. 6.); two ounces of falts and one ounce of common falt, diffolved in a pint of lukewarm water, with two fpoonfuls of honey. If this does not procure four or five evacuations, repeat the clyfter the fame day.

This mode of treatment muft be continued without intermiffion till the beaft begins to eat; then he muft have only the white drink (N° 2) and a little good fodder, or fome rye-bread dipped in ftale beer, moderately fweetened with honey or fyrup. The exterior treatment confifts in the application of fetons in the beginning of the diftemper, at the bottom of the dewlap, and of cauteries towards the horns, between which fome weight, *e.g.* a ftone of a pound weight or more, wrapped up in a cloth, muft be fixed in order to keep it fteady. This is neceffary to keep the head warm. But above all, the friction muft be carefully attended to, for determining the critical efforts of nature. It would be proper alfo to evaporate vinegar in the cowhoufe, &c. and if it could be done without rifk, blowing of a few grains of gunpowder in them twice a day would be a very ufeful fumigation. If, notwithftanding thefe aids, the beaft be not perfectly cured in ten or twelve days, they muft be continued without bleeding, unlefs the inflammation be very confiderable; but if, after all, the diftemper does not give way, the beaft muft be killed, buried very deep, and well covered with earth and turf, for the purpofe of preventing the exhalation of the putrid vapours and the fpread of the infection. The principal prefervatives from infection confift in wafhing the racks, troughs, &c. and the hide of the beaft every day, with plenty of water; and inftead of expenfive aromatic fumigations fometimes recommended, the ufe of fires made with the branches of green wood, with pitch thrown on it to quicken the flames and perfume the air. Common falt given in fmall quantities every day to horned cattle, is reckoned an excellent prefervative, particularly in a learned differtation on the contagious diftempers among horned cattle, by M. de Limborg, M.D. F.R.S. Letters, &c. on Agriculture of the Bath, &c. Society, vol. i.

EPLOYE', in *Heraldry.* An eagle eployé is what in Englifh we more ufually call an eagle difplayed, or a fpread eagle. See Displayed.

EPNEUMATOSIS, from πνευματόω, *I breathe,* in *Medicine,* the fame with expiration.

EPOBOLIA, in *Antiquity,* a fine laid upon thofe that could not prove the indictment they had brought againft their adverfaries.

It was fo called, becaufe they were obliged to pay the fixth part of the value of the thing they contended for, *viz.* an obolus out of every drachm. Some of thefe fums were depofited in all law-fuits, a very few excepted, before the trial could proceed. Potter. Archæol. Græc. lib. i. cap. 21. tom. i. p. 117.

EPOCH, in *Aftronomy,* is the mean longitude of a planet for the commencement of a given year. It is one of the principal elements of the elliptic motion. (See Element and Elliptic *Motion.*) When two obfervations of a planet are made in the mean diftances, that is, at three and nine figns of mean anomaly, it is then practicable to correct, by two fuch obfervations, both the epoch and equation of the centre. If the latter is exact, there will be no other difference between the calculation and obfervation than the epoch of the mean motion, fince the place of the aphelion does not influence the longitudes taken at the mean diftances; the error will, therefore, be equal in the two obfervations, for we fuppofe the mean motion known exactly. Thus, if the errors of the tables are found equal at three and nine figns of anomaly, it is a proof that the equation of the centre is exact, and that the error lies wholly in the epoch being improperly affumed.

EPOCHA, in *Chronology,* a term or fixed point of time, whence the fucceeding years are numbered or accounted.

The word is ἐποχη, q. d. *inhibitio, repreffio,* formed of ἐπεχειν, *to fuftain, ftop,* becaufe the epocha defines or limits a certain fpace of time. For the difference between epocha and era; fee Æra.

Different epochas obtain in different nations; and no wonder; for there being no aftronomical confideration to render one preferable to another, their conftitution is purely arbitrary. That principally regarded among Chriftians is, the epocha of the Nativity or Incarnation of Jefus Chrift; that of the Mahometans, the Hegira; that of the Jews, &c. the Creation of the World; that of the ancient Greeks, the Olympiads: that of the Romans, the Building of the City; that of the ancient Perfians and Affyrians, the epocha of Nabonaffar, &c.

The doctrine and ufe of epochas are of very great extent in chronology.

To reduce the years of one epocha to thofe of another, *i. e.* to find what year of one correfponds to a given year of another; a period of years has been invented, which, commencing before all the known epochas, is, as it were, a common receptacle of them all, called the Julian period. To this period all the epochas are reduced, *i. e.* the year of this period whereon each epocha commences is determined. All that remains, therefore, is, to add the given year of one epocha to the year of the period correfponding with its rife; and from the fame to fubtract the year of the fame period correfponding to the other epocha; the remainder is the year of that other epocha.

Epocha *of Chrift,* or *of our Lord,* is the vulgar epocha throughout Europe, commencing from the fuppofed time of our Saviour's nativity, December 25, or rather according to the ufual account, from his circumcifion, that is, from the firft of January.

Now, the year of the Julian period, wherein Chrift was born and circumcifed, is ufually computed to be the 4713th; confequently, the firft year of the era of Chrift correfponds to the year 4714 of the Julian period.

Hence, 1. If to any given year of Chrift you add 4713, the fum will be the year of the Julian period correfponding thereto, *E. gr.* If to the year 1809 be added 4713, the fum 6522 is that year of the Julian period.

2. On the contrary, fubtracting 4713 from any given year of the Julian period, the remainder is the current year of Chrift. *E. gr.* from the year of the Julian period 6522, fubtracting 4713, the remainder is the year of Chrift 1809.

In effect, the epocha of our Lord ferves not only for the computation

computation of the years elapfed fince the epocha commenced, but even of thofe before it.

Now, to find the year of the Julian period correfponding to a given year before Chrift, fubtract the given year from 4713, the remainder is the correfpondent year required. Thus, *e. gr.* the year before Chrift 752, is the year 3961 of the Julian period. On the contrary, fubtracting the year of the Julian period from 4713, the remainder is the year before Chrift.

The author of the vulgar epocha, or way of computing from Chrift, is an abbot of Rome, one DIONYSIUS *Exiguus*, (which fee,) by nation a Scythian, who flourifhed under Juftinian about the year 507, or, according to others, 527, though this Dionyfius borrowed the hint from Panodorus, an Egyptian monk. Till his time, the generality of Chriftians computed their years either from the building of Rome, or according to the order of the emperors and confuls, and by other ways in ufe with the people among whom they lived.

This diverfity occafioning a great diftraction between the churches of the Eaft and Weft; Dionyfius, to compofe the fame, firft propofed a new form of the year, with a new general era, which in a few years time was generally admitted.

Dionyfius began his account from the conception or incarnation, by us popularly called Lady-day, or the Annunciation; which method obtained in the dominions of Great Britain till the year 1752, before which time the Dionyfian and Englifh epocha was the fame; but in that year the Gregorian calendar having been admitted by act of parliament, they now reckon from the firft of January, as they do in the other countries of Europe, except in the court of Rome, where the epocha of the incarnation ftill obtains for the date of their bulls.

It muft be added, that this epocha of Dionyfius is charged with a miftake: the common opinion is, that it places our Saviour's nativity a year too late; or that he was born the winter preceding the time prefcribed by Dionyfius for his conception.

But the truth is, the fault lies on Bede, who mifinterpreted Dionyfius, and whofe interpretation we follow, as has been fhewn by Petavius from Dionyfius's own epiftles; for Dionyfius began his cycle from the year 4712, but his epocha from the year 4713, wherein the vulgar era fuppofes Chrift to have been incarnate.

The year, therefore, which, according to the vulgar epocha, is the firft year of Chrift, according to Dionyfius's era is the fecond; fo that the year which we call 1809, fhould, in juftice, be 1810, though fome chronologers, inftead of one year, will have the error two.

Others fuppofe that the Dionyfian era is four years too late; which fuppofition is confirmed by confidering that our Saviour was born before the death of Herod the Great; and during the reign of Auguftus (Matth. ii. 1. 22. Luke, ii. 1.) and according to the teftimony of Jofephus, (lib. xvii. cap. 18.) there was an eclipfe of the moon in the time of Herod's laft illnefs; which eclipfe appears to have happened in the year of the Julian period 4710, March 13, at Jerufalem. Now, as our Saviour muft have been born fome months before Herod's death, fince in the interval he was carried into Egypt, the lateft time in which we can fix the true era of his birth is about the end of the 4709th year of the Julian period.

In order to afcertain the true year of our Saviour's birth, it is neceffary to fix the precife time of Herod's death. The chief opinions concerning the time of this event are three. Some think he died a little before the paffover of A. U. 750, Julian year 42; others on Nov. 25 in that year; and others, a fhort time before the paffover A. U. 751. We learn from Jofephus, (De Bell. lib. ii. c. 1. Antiq. l. xvii. c. 9.) whofe authority we cannot reject in deciding this queftion, that Herod died but a fhort time before one of the Jewifh paffovers. That Herod died a fhort time before the paffover A. U. 750, Julian year 42, is argued in this manner. His diftemper had made great progrefs before the pulling down of the golden eagle at the temple. The Jewifh rabbies excited their fcholars to this action. News being brought that Herod was *dying* (Jof. de Bell. l. i. c. 33. § 1.) or *dead* (Jof. Ant. l. xvii. c. 6. § 3.) thefe rabbies were taken up and carried to Jericho, where Herod was, in a very infirm ftate, and where they were tried and burnt to death. On that very night there was an eclipfe of the moon, which, as we have already mentioned, happened March 13th A. U. 750. From this time Herod grew worfe and worfe; fo that he could not live long. The paffover of this year happened on the 11th of April; and the interval between the 13th of March and 11th of April would have been fufficient for every thing that Jofephus has related concerning Herod's illnefs; the fettling of his affairs, the execution of Antipater, Herod's death and funeral, which are the occurrences between the eclipfe and Archelaus's coming to Jerufalem at the paffover.

Befides, from circumftances related by Jofephus concerning Archelaus, one would be apt to conclude, that he reigned nine years complete, and that the 10th year was current when he was banifhed. Dio (l. lv. p. 567.) places Archelaus's banifhment in the 759th year of Rome. If Herod did not die, as fome imagine, till the beginning of A. U. 751, the 9th year of Archelaus's reign could not be completed in the 759th year of Rome. But if Herod be fuppofed to have died in the beginning of A. U. 760, Jofephus and Dio agree. Moreover, Jofephus fays, that Cyrenius feized Archelaus's eftate, and finifhed the affeffment in Judea in the 37th year after the defeat of Antony at Actium by Cæfar Auguftus. The victory at Actium was obtained Sept. 2, A. U. 723; therefore the 37th year from it begins Sept. 2, A. U. 759, and ends Sept. 2, 760. Suppofing then that Herod died in the beginning of A. U. 750, there is in this particular alfo a very good harmony between Jofephus and Dio. Befides, Jofephus informs us (Ant. l. xiv. c. 29.) that Herod was appointed king by the Roman fenate A. U. 714. *i. e.* 40 years before the vulgar era. The fame hiftorian obferves, that he died in the 37th year of this reign, and 34th after the death of Antigonus, *viz.* in the 42d Julian year (Antiq. l. xvii. 10.) If to 713 we add 37, the fum will be 750, the year of Rome in which this prince died.

The opinion, adopted by other learned men, that Herod died a fhort time before the paffover A. U. 751, labours under feveral great difficulties, which are pointed out by Dr. Lardner (ubi infra). Upon the whole it appears, that Herod did not die before the year 750, nor furvive the year 751, and that he died a fhort time before the Jewifh paffover of one of thefe years. It follows, that if Herod died in 750, he died three years and nine months before the vulgar Chriftian era, which commences January 1, A. U. 754; if at the time above-mentioned, in the year 751, then he died about two years and nine months before the faid era. "Which is the truth," fays Dr. Lardner, with his ufual diffidence and modefty, "I am not able to determine." Accordingly he fays, that "if Herod died in March A. U. 750, I fhould be inclined to place the nativity of Jefus in September or October, A. U. 748; if Herod died in March 751, then the nativity of Jefus might

very

very well be placed in September or October 749." The birth of Jesus must be dated about a year and five or six months before the death of Herod, *i. e.* before the latter end of the year of Rome 748 or 749, *i. e.* 4708 or 4709 of the Julian period; but for reasons already assigned, the latter date is the most probable.

We shall here add, that an objection has been urged against the 15th year of the reign of Tiberius, compared with the age of Jesus at his baptism. (Luke, iii. 1, 2. 23.) If Jesus, it is said, was born above a year, much more, if above two years before Herod's death, then the age of 30 years, here ascribed to him at his baptism, is absolutely inconsistent with the notes of time mentioned at the commencement of John the Baptist's ministry; even allowing, that *the word of God came to John* in the very beginning of the *15th year of Tiberius*, and that Jesus was baptized a few months after. Dr. Lardner observes, that the true meaning of these words, *Jesus himself began to be about* 30 *years of age*, is not that he then *entered* the 30th year of his age, but that Jesus was about 30 years of age when he began his ministry. This, he says, is now the general opinion of learned men; so the Greek word of this text is used by St. Luke in other places. The objection is thus stated: Augustus died, and Tiberius succeeded him the 19th of August, A. U. 767, Julian year 59, A. D. 14. Therefore the 15th of Tiberius began the 19th Aug. A. U. 781, A. D. 28. Herod died before the passover, in A. U. 751, Jul. year 43. If then John the Baptist began to preach in the beginning of the 15th of Tiberius, in the latter end of A. U. 781, and Jesus be supposed to have been baptized by John a few months after, on the 6th of January of the year following, *viz.* A. U. 782, Jesus must have been in the 32d year of his life, if Herod died in the spring, *viz.* A. U. 751, and if Jesus was born the 25th of December preceding, *viz.* A. U. 750. But if Herod died A. U. 750, and Jesus was born the 25th December before, *viz.* A. U. 749, then he would be at his baptism in the 33d year of his age. But it may be made to appear in several ways, that Jesus was born above a year, probably above two years before Herod died. Dr. Lardner has stated this objection in its full force; and detailed several circumstances that tend to obviate it. From some of them he infers, that there is no necessity of placing the birth of Jesus above a year and six months before the death of Herod, as we have already stated. As it is most probable that Herod died A. U. 750, we may be disposed, from other circumstances alleged by this accurate and impartial writer, to place the nativity of Jesus in September or October A. U. 748. The latter part of the summer, or the autumn season, seems to be the most likely time of the year for the birth of Jesus; nor is there any particular reason that should determine us to the 25th of December. The very depth of winter was not a very proper season for a survey and assessment, when people are to enter themselves according to their tribes or families; the autumn, when harvest and vintage are over, would be a time of general leisure. When Jesus was born in Bethlehem, *there were in the same country shepherds abiding in the field, keeping watch over their flocks by night,* (Luke, ii. 8.) This circumstance is not very favourable to the supposition, that Jesus was born the 25th of December; and we are at liberty to place it in autumn, a more likely season. (See CHRISTMAS.) It is not improbable then, that Jesus might be born some time between the middle of August and the middle of November. Cyrenius, we may suppose, came into Judea at the time, or soon after the time, that Varus became governor of Syria (before Sept. A. U. 748), and published the decree of Augustus, requiring all people to enter themselves, their dependents, and estates. This assessment could well be made in a country of such small extent as Judea in two or three months; and the short time appointed for this work may be inferred from the peculiar circumstances of Cyrenius, who wished to hasten back to Rome, and also from St. Luke's history of it. Upon the whole, we may conclude, that about a year and six or seven months before the death of Herod, soon after the arrival of Varus in the province of Syria, in August or September A. U. 748 or 749, Julian year 40 or 41, Cyrenius (or some other person of eminence) came into Judea, an assessment was made there, and in the time of it, Jesus was born at Bethlehem, in the month of September or October. In order, however, to settle satisfactorily the *15th year of the reign of Tiberius*, we should consider that the commencement of his reign may be computed from a different period than that of his sole empire, after the death of Augustus. In fact, it appears, that there were two different dates of the beginning of Tiberius's reign; one from the time of his being made colleague with Augustus, and the other from his sole empire, after the death of Augustus. Many learned writers are of opinion, that St. Luke intends the former of these two computations, referring to a period two years before the death of Augustus, *viz.* in A. U. 765, when Piso was præfect of Rome, Tiberius being prince. Archbishop Usher and Prideaux place the beginning of this government of Tiberius in this year. This epoch of Tiberius's empire was followed for some time by some persons, in the provinces at least; but it is not so certain, when this pro-consular empire began, whether about two years, or about three years before Augustus died. If Tiberius's proconsular empire began about three years before Augustus died, on the 28th of August A. U. 764, A. D. 11, then this 15th of Tiberius's reign (according to this computation of it) began August 28th, A. U. 778, A. D. 25. Supposing that John the Baptist began his ministry November following, in the same year, and that Jesus was baptized by him the 6th of Jan. following, in A. U. 779, A. D. 26; then upon the supposition that Jesus was born in Sept. A. U. 748, he would be at his baptism 30 years of age, and some months more. If Tiberius's proconsular empire commenced about two years before the death of Augustus, in A. U. 765, A. D. 12, then the 15th year of the reign of Tiberius began in A. U. 779, A. D. 26. And supposing that John the Baptist began his ministry in November of that year, and that Jesus was baptized by him the 6th of January following, A. U. 780, A. D. 27, then, upon the supposition that Jesus was born in September, A. U. 749, he would be at the time of his baptism 30 years of age, and some months more; or, if born A. U. 748, he would be somewhat more than 31 years of age. Again, if John the Baptist began his ministry in the 15th of Tiberius, A. U. 778, A. D. 25, according to the first statement, but did not baptize Jesus till the 6th of January, A. U. 780, A. D. 27, after he had preached somewhat above a year, then Jesus would be at his baptism 30 years of age and odd months, if he was born A. U. 749; 31 years of age and some odd months, if born the latter end of the year 748. Such will be the result, if we take those dates of these events, which appear most favourable to St. Luke; since it is not absolutely certain when Herod died, or when Tiberius's proconsular empire began. But if we allow on each hand the dates least favourable to St. Luke's numbers, *viz.* that Jesus was born A. U. 748, and that he was not baptized till January A. U. 780, A. D. 27; yet even then Jesus would be little more than 31 years of age; at which time a person

perſon may be ſaid very properly to be ABOUT *thirty years of age*.

The queſtion of our Lord's nativity and age at his baptiſm is amply diſcuſſed, and the difficulties which it involves accurately and impartially examined, by Dr. Lardner in his "Credibility, &c." See his Works, vol. i. See alſo Playfair's Syſtem of Chronology, p. 49, &c.

Learned men have differed in opinion concerning the preciſe time of the death of Chriſt. Some have referred this event to the 29th year of the vulgar era; others to the 31ſt; and not a few to the 33d. Playfair (with whom Blair agrees) inclines to adopt the laſt of theſe dates, for the following reaſons. 1. There is no other year beſides the 33d of the vulgar era, 78th Julian year, 4746th of the Julian period, A. U. 786, to which this event can be properly referred; for Jeſus Chriſt went to eat the paſſover with his diſciples on the evening of the 14th of the firſt month, and was crucified on the day following, *viz.* on Friday, April 3d, the 16th day of the paſchal moon, according to the true, and the 15th, according to the Jewiſh computation. 2. The 70 weeks of Daniel, which began in the 20th year of Artaxerxes Longimanus, and ended in J. P. 4746, when Meſſiah was cut off. 3. Phlegon, the freedman of Adrian, and eſteemed as an exact computer of the Olympiads, obſerved "that in the 4th year of the 202d Olympiad, there was a miraculous darkneſs; for at the ſixth hour of the day came on night, inſomuch that the ſtars of heaven were ſeen. At the ſame time, there was alſo a great earthquake in Bithynia, which threw down part of the city of Nice." (Compare this account with Matth. xxvii. 45. and Luke, xxiii. 45.) The 4th year of the 202d Olympiad anſwers to the firſt ſix months of the 33d year of our vulgar era, and to the 19th of the reign of Tiberius. Concerning the teſtimony of Phlegon; ſee PHLEGON. 4. When Chriſt ſuffered, Pontius Pilate was governor of Paleſtine (Tacit. l. xv. Joſeph. Antiq. l. xviii. c. 5.); Herod Antipas was tetrarch of Galilee (Luke, xxiii. 6. Joſeph. Antiq. l. xix. c. 7.); and Caiaphas was high-prieſt among the Jews (John, xi. 49. Luke, iii. 2. and Acts, iv. 6.) (See CAIAPHAS.) From theſe and other characters it appears, ſays Playfair, that Jeſus Chriſt lived about 36 years, 3 months, 9 days, and 15 hours, if we reckon (according to the generally received opinion concerning the month and day of his nativity) from midnight of December 25th, of the 42d Julian year commencing, to April 3d and 3 in the afternoon, of the 78th Julian year. His reſurrection took place on Sunday April 5th, and his aſcenſion on Thurſday May 14th.

To the vulgar era of our Lord's nativity, as a ſure fixed point, chronologers have been accuſtomed to reduce all the other epochas, though there is not one of them but what is controverted; ſo much uncertainty there is in the doctrine of time. We ſhall exhibit them as reduced to the Julian period.

EPOCHA *of the Creation, Orbis Conditi*, according to the computation of the Jews, called alſo the Jewiſh epocha, is the year of the Julian period 953, anſwering to the year before Chriſt 3761, and commencing on the ſeventh day of October. Hence ſubtracting 952 years from any given year of the Julian period, the remainder is the year of the Jewiſh epocha correſponding to it. Thus, *e. gr.* the year 1809 being the 6522d year of the Julian period, it is the 5570th year of the Jewiſh epocha, or ſince the creation of the world.

This epocha is ſtill in uſe among the Jews.

The EPOCHA *of the Creation*, uſed by the Greek hiſtorians, is the year before the Julian period, 787, anſwering to the year before Chriſt 5500.

Hence, to any given year of the Julian period, adding 787, the ſum gives the year of this epocha. *E. gr.* 1809 being the 6522d year of the Julian period, 7309 is that year of this epocha, or the year of the world, according to this computation.

The author of this epocha is Julius Africanus, who collected it from the hiſtorians: but when it came to be admitted into civil uſe, 8 years were added to it, that ſo every year thereof divided by 15 might exhibit the indiction, which the eaſtern emperors uſed in their charters and diplomas.

The epocha of the creation uſed by the latter Greeks and Ruſſians is the year 795 before the Julian period, or the year 5508 before Chriſt, commencing from the firſt day of September. Though the Ruſſians, having lately admitted the Julian calendar, begin their year from the firſt of January.

Hence, adding 795 to the year of the Julian period, the ſum gives the year of this epocha. Thus, *e. gr.* the Julian period of the year 1809 being 6522, that year of this epocha, *i. e.* the years from the creation on this footing are 7317. Again, from that year 7317 ſubtracting 5508, the remainder is the year of the common era 1809. This era was uſed by the emperors of the Eaſt in their diplomata, &c. and thence alſo called the "civil era of the Greeks." In reality, it is the ſame with the epocha of the Conſtantinopolitan period; whence ſome call it the "epocha of the period of Conſtantinople."

The Alexandrian EPOCHA *of the Creation* is the year 780 before the Julian period, anſwering to the year before Chriſt 5493, and commencing on the 29th day of Auguſt.

Hence, adding 5493 to the year of Chriſt 1809, the ſum 7302 gives that year of this epocha, or years elapſed ſince the creation, according to this computation.

This epocha was firſt concerted by Panodorus, a monk of Egypt, to facilitate the computation of Eaſter; whence ſome call it the "Greek eccleſiaſtical epocha."

The Euſebian EPOCHA *of the Creation*, is the year of the Julian period 486, anſwering to the year before Chriſt 4228, and commencing in autumn.

Hence, ſubtracting 486 from the year 6522 of the Julian period, or adding 4228 to the year of Chriſt 1809, the reſult 6036 will be that year of this epocha.

This epocha is uſed in Euſebius's Chronicon, and the Roman Martyrology.

The EPOCHA *of the Creation*, according to Mr. Bedford and Mr. Kennedy, is the year of the Julian period 706, anſwering to the year before Chriſt 4007.

The EPOCHA *of the Creation*, according to archbiſhop Uſher, adopted in Blair's tables, is the year of the Julian period 710, correſponding to the year before Chriſt 4004; but it muſt be allowed, that all the epochs of the creation are uncertain. See Strauchius's Brev. Chron. by Sault. p. 152, &c. See chronological table under the article CHRONOLOGY.

EPOCHA *of the Univerſal Deluge*, in the year of the creation 1656, and according to the different methods of computation; ſee the table under CHRONOLOGY, and ANTEDILUVIAN.

EPOCH *of the Olympiads*, is the year of the Julian period 3938, anſwering to the year 776 before Chriſt, commencing at the full moon next the ſummer ſolſtice, and each Olympiad containing four years.

This epocha is very famous in ancient hiſtory; it was uſed principally by the Greeks, and had its origin from the Olympic games, which were celebrated at the beginning of every

every fifth year. See the table above cited, and Olympic *Games*.

Epocha *of the Building of Rome*, or *Urbis Conditæ, U. C.* is the year of the Julian period 3961, according to Varro; or 3962, according to the Fasti Capitolini, answering to the years before Christ 753 or 752, and beginning on the 20th of April. Hence, if the years of this epocha be fewer than 754, subtracting them from 754 or 753, you have the year before Christ; and, on the contrary, if they be more than 754, you must subtract 754 to have the year of Christ, and add the year of Christ to 754 to have the year of this epocha, or the time since the building of Rome. Thus, *e. gr.* the year 1809, according to Varro, is the year of Rome 2563.

The sentiments of the earliest Roman writers, with respect to this epoch, are various; Polybius refers it to the year B. C. 751. Cato, whose opinion is adopted by Solinus, Eusebius, Dionysius Halic. &c. places it one year earlier. Fabius Pictor, who flourished in the time of the first Punic war, and who is styled by Dion. Hal. an accurate writer, brings it down to the 29th year of the olympiads, *i. e.* 747 B. C. Diodorus Siculus adopts this opinion. Sir Isaac Newton, on the testimony of some later Roman writers, observes that Rome was built in the 15th age after the destruction of Troy, that is, after the 14 kings who reigned in Alba. Allowing 21 years to the reign of every king, and computing from the year B. C. 904, when he supposes Troy to have been taken, he brings forward this epoch to the 38th olympiad, *i. e.* 627 B. C. The date of Varro has been adopted by the Roman emperors in their proclamations, by Plutarch, Tacitus, Dion, Gellius, Censorinus, Onuphrius, Baronius, and by most modern chronologers.

Epocha *of Nabonassar*, is the year of the Julian period 3967, answering to the year before Christ 747, commencing the 26th day of February of the Julian year at mid-day. The solar cycle was 19, the lunar 15, and the cycle of indiction 7.

This era takes it denomination from its institutor Nabonassar king of Babylon, and is that used by Hipparchus, by Ptolemy in his Astronomical Observations, by Censorinus, and others.

This epoch is of singular service in chronology, as it serves to connect and adjust all other epochas. The form of this era, which included a period of 424 Egyptian years from the commencement of Nabonassar's reign to the death of Alexander the Great, and which was thence carried down to the reign of Antoninus Pius, is singular. Every year consists of 365 days, and is divided into 12 months. Every month contains 30 days; five intercalary days are added to these months, and the sum composes the quantity of the Nabonassarean year. In every four Julian years, the corresponding four years of this era were evidently deficient by one day; therefore the beginning of the Nabonassarean years must have moved retrogradely; and in the space of 1460 Julian years, must have gone through every day of the year. Whence it appears, that 1460 Julian are equal to 1461 Nabonassarean years. If the first year of the era of Nabonassar began on Wednesday, Feb. 26th, the second and third years must have begun on the same day; because these two years contain 365 days each in the Julian, as well as in the Egyptian calendars. The following year, *i. e.* 744 B. C. being a bissextile, one day was added to the Julian year, consequently the Nabonassarean year began on Feb. 25th in this and the three succeeding years. In the year 740 B. C. it began on February the 24th; in 736 B. C. on February the 23d, &c. The first day of any year of the Nabonassarean era may be found by the following general rule.

Divide the given year by 4 (because in 4 years the Nabonassarean year anticipates the Julian by one day), and the quotient will be the number of days of anticipation, or of the omitted leap-days. If the quotient be less than 57 (the number of days from January 1st to February 26th), let it be subtracted. If the quotient exceeds 57, subtract it from 422, *i. e.* from 57 + the number of days in one Julian year, and the remainder will be the day of the Julian year, reckoned from January 1st, which is the Thoth, or first day of the year following the given one; (Thoth being the name of the month, which in the first year of this era corresponded to Feb. 26th of the Julian year.) From the day found, subtract 1, and the remainder will be the number of the day required.

E. G. On what day of the Julian year did the Thoth of the Nab. era 230 fall? Divide 230 by 4, and the quotient 57, subtracted from 422, leaves a remainder of 365. This shews that the Thoth of N. E. 231st falls on December 31st, or on the 365th day of the Julian year: subtract 1, and the remainder 364, or December 30th, will be the day required.

Epocha, or *Era of Constantinople*, is supposed to have commenced before the creation of the world; for the 5509th year of it answers to the 1st of the vulgar Christian era. It was adopted by the Greek church and empire, all the public acts of which are still dated by it; and the Muscovites computed by it until the reign of Peter the Great. Those who reckon by it make use of civil and ecclesiastical years. The former begin with the month of September, and the latter, sometimes with the 21st of March, and sometimes with the 1st of April.

Epoch *of New Rome*, or *Constantinople*, is usually computed from the time of the consecration of the city. Accordingly the first year of this era was the 25th of the reign of Constantine, A. M. 5838, as the modern Greeks estimate the era of the creation, Julian period 5043. Thus directed, the consecration of the city is fixed in the 330th year of the vulgar era, on the 11th of May.

Epocha, *Dioclesian*, or *Epocha of Martyrs*, is the year of the Julian period 4997, answering to the year of Christ 284, called the "era of martyrs," from the great number of Christians who suffered martyrdom under the reign of that emperor.

The Abyssinians, among whom it is still used in all ecclesiastical computations, call it the "year of grace;" though they do not reckon their years in a continued series from this epocha. But when the Dionysian period of 534 years is expired, they begin their computation afresh from 1, 2, &c.

Epocha *of the Hegira*, or *Mahometan Epocha*, is the year of the Julian period 5335, answering to the year of Christ 622. It commences on Friday the 16th of July, the day of Mahomet's flight from Mecca to Medina.

This epocha is used by the Turks and Arabs, and even all who profess the Mahometan faith. It was first introduced by Omar, the third emperor of the Turks. The astronomers Alfraganus, Albategnius, Alphonsus, and Ulugh Beigh, refer Mahomet's flight to the 15th of July; but all the people who use the epocha agree to fix it on the 16th. See Hegira.

Epocha *of the Seleucidæ*, which is used by the Macedonians, is the year of the Julian period 4402, answering to the year before Christ 312. This is reckoned from the time when Seleucus, one of the generals of Alexander's army, took Babylon and ascended the Asiatic throne.

This era is ſometimes called the Grecian era, and the era of Principalities, in reference to the diviſion of Alexander's empire. The Arabians ſtyle it "Tarik Dhilcarnaim," *i. e.* the era of Contracts, and the Greeks denominate it the Horned era. Thoſe who uſe it reckon ſometimes by Nabonaſſarean years, and ſometimes by Julian, compoſed of Roman months, to which Syrian names have been affixed. Its commencement has been variouſly ſtated, ſome date it on Tueſday March 13th. The Greeks in Syria reckon from a month correſponding to our September. Albategni, and others, reckon from the 1ſt of October. In the firſt book of Maccabees the year is ſaid to have began in Niſan, or the firſt month of ſpring; but in the ſecond book, and in other Jewiſh hiſtories, its beginning is dated in Tizri, which is the firſt month of autumn. See SELEUCIDÆ.

EPOCHA, *Perſian*, or *Yezdegerdic*, is the year of the Julian period 5345, anſwering to the year of Chriſt 632, and commencing on the 16th of June.

This epocha is taken from the death of Yezdegerdis, the laſt king of Perſia, ſlain in battle by the Saracens. See *Perſian* CALENDAR.

EPOCHA, or *Era of the Perſian Monarchy*, is referred by almoſt all ancient hiſtorians to the 1ſt year of the 55th olympiad, *i. e.* 560 B. C. Of this opinion are Diodorus Siculus, Thallus, Caſtor, Polybius, Phlegon, and Euſebius. From the beginning of the Nabonaſſarean era to the firſt year of the reign of Cyrus over Babylon, Ptolemy reckons 209 years. If this number be ſubtracted from 747, the remainder 538 will be the Babylonian epoch of Cyrus; and the monarchy ſtood, according to Agathias, from the firſt year of Cyrus 228 years. That this was its duration is evident from a paſſage of Plutarch (in Vit. Alex.) which mentions an eclipſe of the moon that happened 11 days before the laſt battle between Darius and Alexander, in the month Boedromion. This eclipſe is found, by calculation, to have coincided with the 446th olympic year, Sept. 20. If, therefore, the difference be computed between the 550th olympiad, *i. e.* the 217th olympian year, when the Perſian empire began, and the 446th, when it ended, it will appear to have flouriſhed 228 or 229 years.

EPOCHA, *Gelalæan*, called alſo *Royal Epocha*, and *Epocha of the Sultans*, began in the year of the Julian period 5787, A.D. 1074, on the 14th day of March, at the time of the equinox, and was eſtabliſhed for the convenience of finding the vernal equinox, at which time the Perſians celebrated their great feaſt, called *Neuruz*. See *Perſian* CALENDAR.

EPOCHA *of the eſtabliſhment of the Roman Conſular dignity*. The republican form of government in Rome owed its origin to the tyranny of Tarquin the ſeventh king; in conſequence of which the ſovereign authority was divided, and two magiſtrates were elected under the denomination of conſuls. The conſular dignity was conferred on Brutus and Collatinus, 244 years after the building of the city. The names of the conſuls were regiſtered in the calendars until A. D. 541; and in the 15th year of Juſtinian the order was aboliſhed. See CONSUL.

EPOCHA, *Julian*, or *Epocha of Julian years*, is the year of the Julian period 4668, anſwering to the year before Chriſt 46.

This epocha had its origin from the year of the reformation of the calendar under Julius Cæſar, called the "year of confuſion."

EPOCHA, *Gregorian*. See GREGORIAN.

EPOCHA, *Spaniſh*, is the year of the Julian period 4676, anſwering to the year before Chriſt 38.

This era commenced at the time of the ſecond diviſion of the Roman provinces among the Triumviri, and is reckoned from the 1ſt of January in the year 38 B. C. ſo that the firſt year of the Chriſtian coincides with the 39th year of the Spaniſh era. The moſt famous ſynods of Spain and Africa have been diſtinguiſhed and deſcribed according to the computation of this era; but by a decree of the council of Tarragon, A. D. 1180, the Chriſtian era was ſubſtituted in its room, though it continued in uſe till the year 1383. The Portugueſe were the laſt people who computed by this era, and they gave it up A. D. 1415 or 1422. See ÆRA.

EPOCHA, *Actiac*, or *Actian*, is the year of the Julian period 4684, anſwering to the year before Chriſt 30, commencing in Egypt on the 29th day of Auguſt, and on the 1ſt of September among the Greeks of Antioch; but among the Romans on the 1ſt of January in the year of Rome 724.

EPOCHA *of the Reformation*. See REFORMATION.

For other epochas or eras, and the dates of remarkable events, ſee the table under CHRONOLOGY.

EPOCHETEUSIS, from ἐποχετεύω, *I draw through a canal*, of ὀχετός, *canal*, a word uſed by Hippocrates, and others of the old writers in *Medicine*, to expreſs the derivation of the blood, or juices, from one part to another.

EPODE, Ἐπῳδός, in *Lyric Poetry*, the third or laſt part of the ode; the ancient ode, or ſong being divided into ſtrophe, antiſtrophe, and epode.

According to its moſt common acceptation, it ſignified a number of Lyric verſes of different conſtruction, compriſed in a ſingle ſtanza; and it was ſung by the prieſts, ſtanding ſtill before the altar, after all the turns and returns of the ſtrophe and antiſtrophe. The invention of epodes is aſcribed to Archilochus.

The epode was not confined to any preciſe number, or kind of verſes, as the ſtrophe and antiſtrophe were: but when the ode contained ſeveral epodes, ſtrophes, &c. they were all alike.

As the word epode, then, properly ſignifies the end of the ſong; and as in odes, what they called the epode finiſhed the ſinging, it became cuſtomary, as M. Dacier ſhews, for any little verſe which, being put after another, cloſed the period, and finiſhed the ſenſe which had been ſuſpended in the firſt verſe, to be called epode, ἐπῳδός.

And hence it is, that the ſixth book of Horace's Odes is entitled "Liber Epodon, Book of epodes," becauſe the verſes thereof are all alternately long and ſhort; and the ſhort one, generally, though not always, cloſes the ſenſe of the long one. The name of epode was likewiſe given to a ſmall Lyric poem, compoſed of trimeters or iambics, of ſix feet, and dimeters of four feet alternately. Of this kind were the epodes of Archilochus, mentioned by Plutarch. But the ſignification of the word is extended ſtill farther; epode being become a general name for all kinds of ſhort verſes, that follow one or more long ones; and in this ſenſe, a pentameter is an epode, after an hexameter, which in reſpect thereof is a pro-ode.

EPODOS, from ἐπί, and ᾠδή, *ſong*, in *Medicine*, a word uſed to expreſs the curing of diſeaſes by incantation.

EPOICODOMESIS, from ἐποικοδομέω, *I build upon*, in *Rhetoric*, is ſometimes uſed for what is otherwiſe called climax.

EPOISSES, in *Geography*, a ſmall town of France, in the department of the Côte d'Or, 9 miles W. of Semur.

EPOMIS, Ἐπωμίς, in *Anatomy*, the upper part of the ſhoulder, reaching up to the neck.

The word is Greek, ἐπωμίς, which primarily ſignifies a ſhort cloak or mantle made to cover the ſhoulders.

Some authors apply the word epomis to the upper part of the

the os humeri; but the ancient Greek phyficians only ufe it for the mufcular, or flefhy part, placed as above mentioned. See Deltoides.

EPOMPHALION, from επι, *upon*, and ομφαλος, *navel*, any medicine which purges, on being applied to the navel.

EPOPOEIA, Εποποιια, in *Poetry*, the hiftory, action, or fable, that makes the fubject of an epic poem.

The word is derived from the Greek επος, *carmen*, *verfe*, and ποιεω, *facio*, *I make*.

In the common ufe of the word, however, epopoeia is the fame with epos, or epic poem itfelf: in which fenfe it is defined a difcourfe invented with art, or a fable agreeably imitated from fome important action, and related in verfe, in a probable and furprifing manner; with a view to form the manners, &c. See Epic *Poem*.

EPOPS, in *Ornithology*, a name by which fome of the ancient writers have called the bird we call the upupa, or hoopoe. See Upupa, of which it is a fpecies.

EPORA, in *Ancient Geography*, a town of Spain, 28 miles from Caftulon, according to the Itinerary of Antonine. Pliny calls it Ripepora. It is thought to be *Montoro* in the diocefe of Cordova. M. D'Anville places it on the river Bœtis, in Bœtica, N. E. of Corduba.

EPOREDIA, Ivrée a town of Gallia Tranfpadana, fituated towards the weft, on the Doria Major.

EPOTIDES, in the *Ancient Ship-Building*, two large thick pieces of wood on each fide of the prow of a galley, which refembled two ears, whence they had their name.

The epotides were chiefly defigned to ward off the blows of the roftra of the enemies' veffels.

EPPHA, or Epha, in *Ancient Geography*, a country of Arabia, in the vicinity of the Midianites.

EPPING, in *Geography*, a market town in the hundred of Waltham, in the county of Effex, England, is irregularly built, and confifts of two parts or affemblages of houfes; one round the church, called Epping Upland; the other, nearly a mile and a half fouth-eaft from the church, called Epping Street. The latter is by far the largeft, and confifts of one wide ftreet, nearly a mile in length, fituated on the high road from London to Newmarket, on a ridge of hills extending to a confiderable diftance north and fouth. Here a market is held on Fridays: the chief commodities expofed for fale, are butter and poultry, which are chiefly purchafed for the ufe of the metropolis. At the weft end of the ftreet is a fmall new chapel: and near the middle are the fhambles. The inns and public houfes are numerous. Epping is 17 miles from London; contains, in both divifions, 315 houfes, inhabited by 1726 perfons; it has two annual fairs.

Epping *Foreft*, is an extenfive tract of good woodland, deriving its prefent name from the town, but was formerly called Waltham Foreft, and in very remote ages the Foreft of Effex. Since it obtained the latter appellation, it has, however, been greatly curtailed, many thoufand acres having been grubbed up, and the land cultivated. This foreft is under the jurifdiction of a lord warden and four verderers: the wardenfhip is hereditary in the family of fir James Tilney Long, bart.: the verderers are elected by the freeholders of the county, and retain their offices during life. The foreft rights are as various as the tenures of the different manors that furround it. In this foreft, though fo near to London, wild ftags are yet found; and a ftag is annually turned out on Eafter Monday, under an eftablifhment patronized by the principal merchants of the city. The hunt is well fupported: the kennel for the hounds, and the building belonging to the hunt, have been lately erected at the expence of feveral thoufand pounds.

At a fmall diftance to the fouth-eaft is Hainault Foreft, famous through many centuries for a venerable tree, called Fairlop Oak, which is remarkable for its fize, and alfo for an annual fair held on the firft Friday in July under its branches, which overfpread an area nearly 300 feet in circumference: the ftem, which is rough and irregular, meafures 36 feet in girth. Morant's Hiftory of Effex. Beauties of England and Wales, vol. v.

Epping, a town of Germany, in the archduchy of Auftria; 4 miles S. of Aigen.

Epping, a poft town of America, in Rockingham county, New Hampfhire, taken from the N. W. part of Exeter, and incorporated, in 1741. It contains 1121 inhabitants, and lies 6 miles N. W. of Exeter and 23 W. of Portfmouth.

EPPINGEN, a fmall town of the kingdom of Bavaria, in the palatinate on the river Elfatz, 21 miles N. E. of Philipfburg, and 18 miles N.W. of Heilbrun. N. lat. 49° 12'.

EPROUVETTE, is a machine, of which there are feveral varieties, ufed for proving the ftrength of gun-powder. The principle of this invention, in whatever form it may be applied, is to afcertain how far a certain meafure or weight of gun-powder is capable of overcoming the refiftance either of a certain weight, or of a fpring, whofe preffure againft the explofion is computed. The former is evidently the moft regular, and, confequently, the beft adapted to military purpofes, wherein the ftrength of the powder is often of the greateft moment, not only on account of the advantages gained by the greateft concentration of force, but becaufe in the mortar and howitzer practice it is neceffary to have a very accurate knowledge of the powers of expanfion in the powder when ignited; by which means fhells may be thrown, with the greateft precifion, to any intended diftance; whence the explofion takes the greateft poffible effect.

In our arfenals, an eight inch mortar is ordinarily employed as an eprouvette: being charged with two ounces of powder, and an iron ball of fixty-four pounds, the latter fhould be projected at leaft 150 feet; the elevation of the piece being 45°, and the bed being placed perfectly horizontal. We confider this to be a fair ftandard; though fome powder made from the beft materials, and frefh from the mill will fometimes exceed even 180 feet; while, on the other hand, weak powder, that is, fuch as has not been kept very dry, or that has been re-ftored, will rarely make a range equal to 120, and generally not exceeding even 110 feet.

The above mode of proof relates to cannon-powder; that intended for the ufe of mufketry is afcertained by an eprouvette of a different defcription; namely, a mufket barrel, of which the interior is highly polifhed. This fhould, with a charge of only four drachms, impel a fteel ball through fifteen wet elm boards, each a quarter of an inch in thicknefs, and placed at ¾ of an inch afunder; the firft being 39 feet and 10 inches diftant from the muzzle of the barrel. We muft confefs this exact number of inches in the diftance, appears to be more faftidious than neceffary, for we are apt to believe, that, in experiments of this nature, the odd two inches, neceffary to complete the fortieth foot, would by no means derange the procefs.

The French eprouvette for cannon powder comes very clofe to our's, they ufing a brafs ball of 60lb. (French weight) whofe diameter is 7 inches and 9 points, or ¾ of a line, (French meafure) with one line of windage, (or fpace between the fhot and the fides of the bore.) The chamber holds precifely three ounces; which quantity of their beft powder will throw the ball full 180 yards; their re-ftored powder throwing it about 160 yards. But Monf. Lombard's bard's experiments give a refult of 250 yards, with the powder now manufactured at the French mills; the eprouvette being always elevated to 45°.

Fine powder is fometimes tried by means of a fmall machine refembling a piftol, of which the barrel is very fubftantial, and the bore not more than the eighth of an inch in diameter. Over the barrel is a circular plate, acted upon ftrongly by a fpring, which offers confiderable refiftance to the revolution caufed therein, by the action of the powder on a projection which fhuts down clofe upon the muzzle. The bore being filled with powder, and the wheel, or plate, turned fo that its projection clofes the muzzle, the explofion will, in proportion to its force, throw up the projection, and caufe the wheel to revolve: the power of the powder is fuppofed to be afcertained by means of figures on the circumference, which indicate how much the wheel has been thrown round.

But fuch a machine cannot poffibly give a correct ftandard; it being fo fubject to variation; as is alfo that contrivance which caufes the powder to act underneath the hammer of a piftol lock. The pan being filled, the powder fhould have force enough to throw the hammer back. We need not comment on the uncertainty of fuch an eftimate.

EPSOM, or Ebbesham, in *Geography*, a parifh and formerly a market town in the hundred of Copthorpe, Surrey, England, is fifteen miles S.E. from London. In the year 1800 it contained 414 houfes, and 2404 inhabitants. The houfes are difpofed chiefly on two fides of a long wide ftreet, or public road, and are fituated on the weft fide of Banftead Downs. Thefe are diftinguifhed for their fine fweet verdure, which is moftly grazed by fheep; and the Banftead mutton is much efteemed for its flavour. On thefe downs are annual horfe-races, which are much frequented by gamblers and fharpers, from the metropolis. The church, above a mile from the centre of the village, was ferved for many years by the late Rev. Jonathan Boucher, who died here in the year 1804. A large old feat near the church, called *Durdans*, was originally built by George, the firft earl of Berkley, with the materials brought from the palace of Nonfuch, when that celebrated royal manfion was taken down. The firft houfe being deftroyed by fire, another was erected, and fubfequently poffeffed by the earl of Guildford. Several other fpacious feats, and pleafant villas, are found in the vicinity of Epfom, among which are Woodcote Park, the late lord Baltimore's; and Pit's-place, which receives its name from being fituated within the excavation of a chalk pit. It is a fingular and curious place.

Epsom, a poft town of America, in Rockingham County, New Hampfhire, E. of Pembroke, adjoining, 10 miles E. of Concord, and 45 N. W. of Portfmouth. It was incorporated in 1727, and in 1800 contained 1034 inhabitants.

Epsom *Salt and Water*. This fo much celebrated falt was firft extracted from the purgative mineral fpring at Epfom in Surrey, which had long been celebrated for its medicinal qualities, by Dr. Nehemiah Grew in 1675, who publifhed a treatife concerning it (De Natura Salis Cathartici Amari.) Dr. Grew gave it the appropriate name of fal catharticus amarus, or bitter purging falt; which is ftill retained, together with the names of Epfom falt, magnefia vitriolata, or fulphat of magnefia of modern chemical nomenclature; which fee for the chemical properties of this falt.

The original Epfom falt, or that which was procured by the evaporation of the Epfom water, was fold in London at a very high price. Afterwards it was prepared, very extenfively, by chemifts of the name of Moult, about the year 1700, by evaporating the water of fome fprings at the foot of Shooter's-hill; which were found to refemble that at Epfom. Soon after it was difcovered, as appears by Haukwitz, a celebrated trading chemift in London, that the fame falt could be procured from the bittern of fea-water; and in a few years the fecret tranfpired, and the fame was prepared from fea-water at Portfmouth, Lymington, and at Newcaftle; by which the falt from the Shooter's-hill fprings was underfold, and the works were abandoned. Epfom falt was for a long time only prepared in this country, and the continent was fupplied from hence; on which account it became known in Europe under the name of Epfom, or Englifh falt; but Bergman afterwards difcovered the fame in the Sedlitz or Seydfchutz waters in Bohemia, whence the name Sedlitz falt was added to its other appellations.

A confiderable confufion prevailed for a long time between this falt and Glauber's Sal Mirabile (fulphat of foda,) the acid of both being the fame, and the medicinal ufes of each, and comparative dofes, not materially differing. In fact it appears, that fometimes the true Glauber's falt was made fmall grained, by ftirring it as it began to cryftallize; and fometimes the true Epfom falt was made large grained to imitate Glauber's; and each was occafionally paffed off for the other as either happened to be in moft requeft. This kind of fraud indeed is ftill practifed pretty extenfively on parts of the continent where the Epfom falt is not eafily procured. Some chemical difference between the two falts was very foon afcertained. Dr. Grew gives it as characteriftic of the Epfom falt, that it coagulates with an alkali; but the nature of the earth that forms this coagulum, was not fully underftood till the refearches of Black and Bergman proved it to be the earth magnefia.

Epfom falt is a highly and juftly efteemed purgative medicine, and is in very conftant ufe. The tafte is falt and bitter, attended, however, with a peculiar flavour approaching to fweetnefs. Notwithftanding its naufeous tafte, it is often found to remain on the ftomach when rhubarb and moft other medicines are rejected, and in general it operates fpeedily, effectually, and without griping or debilitating. The ufual dofe for an adult is from half an ounce to an ounce; but it fhould be pretty largely diluted in gruel, broth, or any mucilaginous liquor.

EPSTEIN, in *Geography*, a fmall town of Germany, formerly in the Landgraviate of Heffe Darmftadt, but fince the peace of Luneville, in the territory of the princes of Naffau Dietz. It is fituated at no great diftance from the confluence of the Rhine and Mayn, 18 miles N.W. of Francfort on the Mayn; and is chiefly remarkable for fome good iron mines in its neighbourhood.

EPTACTIS, in *Natural Hiftory*, a name given by Linkius, and fome other authors, to a fpecies of ftar-fifh, of the aftrophyte kind, whofe rays, or branches, at their firft going out from the body, are only feven in number; but which very foon fpread into more. See Star-*fifh*.

EPTAMERIDES, in *Mufic*, a name given by M. Sauveur to one of the intervals of his fyftem, inferted in the Mem. de l'Acad. des. Sc. for 1701.

This author begins by dividing the octave into 43 parts or merides, then each of thefe into 7 eptamerides, fo that the octave entire comprehends 301 eptamerides, which he ftill fubdivides. (See Decameride.) The word is formed of επτα, *feven*, and of μερις, *a part*. In Sauveur's fubdivifion the octave is $= 23\frac{10}{301}\Sigma + \frac{21}{301}f + \frac{53}{301}m$: and its common logarithm is = .9989999.0035. or .9990000.0000 according to the affumption of M. Sauveur, wherein the octave = .6990000.0000 and its reciprocal .3010, &c.

EPTE, in *Geography*, a fmall river of France in the

 department

department of the Eure, which has its source near Bernay, and falls into the Seine below Vernon.

EPULÆ. See Entertainments.

EPULARES, in *Antiquity*, an epithet given to those who were admitted to the sacred epulæ or entertainments, it being unlawful for any to be present at them who were not pure and chaste.

EPU'LIS, (from ἐπι, *upon*, and ουλα, *the gums*,) in *Surgery*, a tubercle on the gums. There are two kinds; one of a benign nature, and free from pain; the other more malignant, being very troublesome, and occasionally becoming, according to the descriptions of surgical writers, of a cancerous quality. Some of the excrescences are represented as having a narrow pedicle, while others are connected with the gum by means of a broad base.

The best plan of treatment consists in extirpating an epulis, as soon as the nature of the case manifests itself. The object may be accomplished either with caustic, or the knife. The latter mode is that, to which we should generally give the preference, because attended with the greatest degree of certainty, and not more pain.

Some writers advise us to tie the excrescence, when its neck is narrow. However, in such a case, the knife, or a pair of scissars, might also be very conveniently employed.

EPULO, in *Antiquity*, the name of a minister of sacrifice among the Romans.

The pontifices, not being able to attend all the sacrifices performed at Rome, to so many gods as were adored by that people, appointed three ministers, whom they called epulones, because they conferred on them the care and management of the epulæ, feasts in the solemn games and festivals.

To them belonged the ordering and serving the sacred banquet offered on such occasions to Jupiter, &c. They wore a gown bordered with purple, like the pontifices, their number was at length augmented from three to seven, and afterwards by Cæsar to ten.

Their first establishment was in the year of Rome 558, under the consulate of L. Furius Purpureo, and M. Claudius Marcellus.

EPULO'TICS, (from ἐπουλοω *to cicatrize*), in *Surgery*, topical applications, which dispose wounds and ulcers to heal.

EPULUM, in *Antiquity*, *banquet*, a holy feast prepared for the gods.

The statues of the gods were commonly laid upon a bed, and served in the epula, as if they had been very hungry; to perform which was the function of the ministers of sacrifice, hence called epulones.

EPWORTH, in *Geography*, a market town in Lindsey division of Lincolnshire, England, is situated 158 miles from London: it is built in a straggling irregular manner; and contains, according to the late population return, 275 houses, and 1434 inhabitants, who are chiefly employed in spinning hemp and flax, of which great quantities are grown here, and in the manufacture of sacking and bagging, which is the chief trade of the town. A weekly market is held on Thursdays, and two fairs annually. Quantities of large oaks, firs and other trees, some of which appear to have been burnt, and others cut down, are frequently found here three feet beneath the surface of the earth. The rectory of Epworth was held by the Rev. Samuel Wesley, the father of the distinguished leaders of the Arminian Methodists, John and Charles Wesley.

EQUABLE Motion, is that whereby the moveable body proceeds with the same continued velocity; neither accelerated nor retarded.

Equable *Pulse*. See Pulse.

Equable *Style*. See Style.

EQUABONA, in *Ancient Geography*, a town of Spain, in Lusitania, according to the Itinerary of Antonine, situated on the left side, and at the mouth of the Tagus, not far from the sea.

EQUAL, a term of relation between two or more things of the same magnitude, quantity, or quality.

Wolfius defines equals to be those things which may be substituted for each other, without any alteration of their quantity. It is an axiom in geometry, that two things which are equal to the same third, are also equal to each other. And again, if to or from equals you add or subtract equals, the sum or remainder will be equal.

Equal *Altitudes*, in *Practical Astronomy*. One of the most practicable and certain methods of determining the time, and thus ascertaining the error of a clock or chronometer, is by observing equal altitudes of the sun, or of a fixed star. For this purpose all that is necessary is to observe the instant the sun or star is at any altitude towards the east, before the meridian passage; and the instant must likewise be marked when the same object attains exactly the same altitude towards the west, after the meridian passage: the mean between the above quantities will be the instant marked by the clock at the moment the sun or star was on the meridian. The preceding operation, however, supposes, that the declination of the object has not varied during the elapsed interval, but this with the sun seldom happens. The observation, therefore, must be corrected by a table, or by a direct calculation.

Let P (*Plate* XII. *Astronomy*, *fig.* 106.) be the elevated pole, Z the zenith, S the sun, S B an arc parallel to the horizon H O, so that the points B and S have the same altitude; P S the polar distance of the sun in the morning, P B its polar distance in the evening (supposed to have become less). When the sun in the afternoon arrives at the point B, whose altitude suppose 20°, the same as the morning, the hour angle Z P B, or the distance of the sun, and its hour angle from the meridian P Z, will be greater than the morning hour angle Z P S. We have, therefore, two triangles, Z P S, Z P B, which have each the side P Z common, and the sides Z S, Z B, each equal to 70°, since they are the complements of the altitudes, 20° in each case. The sides P S, P B, differ by a quantity which is equal to the change of the sun's declination in the interval between the two observations. If the two triangles be resolved separately, the two hour angles will be found different: the half of this difference is the correction, which must be applied to the middle point of time to obtain the exact instant of the sun's passage over the meridian. This correction is given in the annexed table, which is taken from the last edition of La Lande's Astronomy. It is calculated from the following differential analogy.

$$\frac{\delta x}{30}\left(\frac{\text{tang. latitude}}{\text{sin. hour-angle}} \pm \frac{\text{tang. dec. } \odot}{\text{tang. hour-angle}}\right)$$

TABLE

TABLE OF EQUATION OF EQUAL ALTITUDES.

Argument ½ the elapsed Time.

Sun's Long. S. D.	$1^h\ 40'$	$2^h\ 0'$	$2^h\ 20'$	$2^h\ 40'$	$3^h\ 0'$	$3^h\ 20'$	$3^h\ 40'$	$4^h\ 0'$
O 0	15″.58	15″.80	16″.07	16″.39	16″.76	17″.19	17″.68	18″.24
Sub. 10	15.28	15.50	15.76	16.08	16.44	16.86	17.35	17.90
20	14.60	14.81	15.06	15.36	15.71	16.11	16.57	17.10
I. 0	13.52	13.72	13.95	14.23	14.55	14.92	15.35	15.84
Sub. 10	12.06	11.24	12.44	12.69	12.98	13.31	13.69	14.13
20	10.22	10.37	10.55	10.76	11.00	11.28	11.61	11.98
II. 0	8.04	8.15	8.29	8.45	8.65	8.87	9.12	9.41
Sub. 10	5.55	5.62	5.72	5.83	5.97	6.12	6.29	6.50
20	2.83	2.87	2.92	2.98	3.05	3.12	3.22	3.32
III. 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Add 10	2.83	2.87	2.92	2.97	3.04	3.12	3.21	3.31
20	5.52	5.60	5.70	5.81	5.94	6.10	6.27	6.47
IV. 0	7.99	8.11	8.24	8.41	8.60	8.82	9.07	9.36
Add. 10	10.15	10.30	10.47	10.68	10.92	11.20	11.52	11.89
20	11.96	12.13	12.34	12.58	12.87	13.20	13.68	14.01
V. 0	13.39	13.59	13.82	14.09	14.41	14.78	15.20	15.69
Add 10	14.45	14.65	14.92	15.20	15.54	15.94	16.40	16.92
20	15.12	15.33	15.59	15.90	16.26	16.68	17.16	17.70
VI. 0	15.40	15.62	15.89	16.20	16.57	16.99	17.48	18.04
Add 10	15.29	15.51	15.77	16.09	16.45	16.87	17.36	17.91
20	14.78	14.99	15.25	15.55	15.90	16.31	16.78	17.31
VII. 0	13.85	14.04	14.28	14.57	14.90	15.28	15.72	16.22
Add 10	12.48	12.66	12.88	13.13	13.43	13.77	14.17	14.62
20	10.68	10.83	11.02	11.24	11.49	11.79	12.13	12.51
VIII. 0	8.46	8.59	8.73	8.90	9.11	9.34	9.61	9.91
Add 10	5.88	5.96	6.07	6.19	6.33	6.49	6.67	6.89
20	3.02	3.06	3.11	3.17	3.25	3.33	3.42	3.53
IX. 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub. 10	3.02	3.06	3.12	3.18	3.25	3.33	3.43	3.54
20	5.90	5.99	6.09	6.21	6.35	6.51	6.70	6.91
X. 0	8.51	8.63	8.78	8.95	9.16	9.39	9.66	9.97
Sub. 10	10.76	10.91	11.10	11.32	11.57	11.87	12.21	12.60
20	12.59	12.77	12.99	13.24	13.54	13.89	14.29	14.74
XI 0	13.98	14.18	14.42	14.71	15.04	15.42	15.87	16.37
Sub. 10	14.93	15.14	15.40	15.71	16.06	16.47	16.95	17.49
20	15.42	15.64	15.91	16.22	16.59	17.02	17.51	18.06

Sun's Long. S. D.	$1^h\ 40'$	$2^h\ 0'$	$2^h\ 20'$	$2^h\ 40'$	$3^h\ 0'$	$3^h\ 20'$	$3^h\ 40'$	$4^h\ 0'$	Log. of Diurn. Mot. in Declin.
O. 0	0″.00	0″.00	0″.00	0″.00	0″.00	0″.00	0″.00	0″.00	3.1529
Add 10	0.96	0.93	0.90	0.85	0.81	0.75	0.69	0.62	3.1446
20	1.82	1.76	1.70	1.62	1.53	1.42	1.31	1.18	3.1247
I. 0	2.49	2.41	2.32	2.21	2.09	1.95	1.79	1.61	3.0915
Add 10	2.90	2.81	2.70	2.57	2.43	2.27	2.08	1.87	3.0419
20	2.97	2.88	2.77	2.64	2.49	2.32	2.13	1.92	2.9701
II. 0	2.68	2.59	2.49	2.38	2.25	2.09	1.92	1.73	2.8655
Add 10	2.03	1.97	1.89	1.80	1.70	1.59	1.46	1.31	2.7044
20	1.09	1.06	1.02	0.97	0.92	0.86	0.79	0.71	2.4124
III. 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sub. 10	1.09	1.06	1.02	0.97	0.92	0.85	0.78	0.71	2.4116
20	2.03	1.96	1.88	1.80	1.70	1.58	1.45	1.31	2.7027
IV. 0	2.66	2.58	2.48	2.37	2.23	2.80	1.91	1.72	2.8630
Sub. 10	2.95	2.86	2.75	2.62	2.47	2.31	2.12	1.90	2.9669
20	2.87	2.78	2.68	2.55	2.41	2.25	2.06	1.86	3.0381
V. 0	2.46	2.39	2.30	2.19	2.07	1.93	1.77	1.59	3.0873
Sub. 10	1.80	1.74	1.68	1.60	1.51	1.41	1.29	1.66	3.1201
20	0.95	0.92	0.89	0.85	0.80	0.74	0.68	0.61	3.1398
VI. 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.1479
Add 10	0.96	0.93	0.90	0.85	0.81	0.75	0.69	0.62	3.1449
20	1.84	0.78	1.72	1.64	0.55	1.44	0.33	1.20	3.1300
VII. 0	3.55	2.47	2.38	2.27	2.14	2.00	1.83	1.65	3.1017
Add 10	3.00	2.90	2.79	2.66	2.51	2.34	2.15	1.94	3.0567
20	3.10	3.01	2.89	2.76	2.60	2.43	2.23	2.00	2.9890
VIII. 0	2.82	2.73	2.62	2.51	2.37	2.21	2.02	1.82	2.8880
Add 10	2.15	2.08	2.01	1.91	1.80	1.68	1.54	1.39	2.7297
20	1.17	1.13	1.09	1.04	0.98	0.91	0.84	0.75	2.4399
IX. 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sub. 10	1.17	1.13	1.09	1.04	0.98	0.91	0.84	0.75	2.4406
20	2.15	2.09	2.01	1.92	1.81	1.69	1.55	1.39	2.7314
X. 0	2.83	2.75	2.64	2.52	2.38	2.22	2.04	1.83	2.8903
Sub. 10	3.12	3.03	2.91	2.78	2.62	2.44	2.24	2.02	2.9921
20	3.02	2.93	2.88	2.69	2.54	2.36	2.17	1.95	3.0603
XI. 0	2.57	2.49	2.40	2.29	2.16	2.01	1.85	1.66	3.1059
Sub. 10	1.86	1.80	1.73	1.65	1.56	1.46	1.34	1.20	3.1345
20	0.97	0.94	0.90	0.86	0.81	0.76	0.70	1.63	3.1486

☞ Multiply the Tangent by the Latitude, and if it is South, change the Signs.

EQUAL-*Altitude Inſtrument*, is an inſtrument uſed in *Aſtronomy* for aſcertaining the exact time at any place, by means of equal altitudes of any heavenly body, as obſerved ſucceſſively at the oppoſite ſides of the meridian. Formerly, the inſtrument uſed excluſively for this purpoſe was a refracting teleſcope of conſiderable length, attached to a vertical axis of motion, placed truly perpendicular to the horizon by means of a plumb-line or ſpirit-level, ſo that when the teleſcope had a given elevation, it might be fixed at that elevation, and deſcribe a parallel of altitude as the vertical axis turned round; which method was equally ſimple and accurate, as it required no graduated circles for reading either horizontal or vertical angles; but then its utility was limited to the ſingle operation of determining the inſtant when any celeſtial body on the weſtern ſide of the meridian had the ſame altitude that it had at a given inſtant on the eaſtern ſide, and hence the intermediate inſtant when the ſaid body was on the meridian, provided its declination had not ſenſibly altered during the interval. But in the preſent improved ſtate of aſtronomical and nautical inſtruments, almoſt any of them will meaſure equal altitudes with great preciſion, and at the ſame time indicate the quantity of the altitudes obſerved, ſo that an inſtrument to take equal altitudes only is no longer a deſideratum, and its origin and conſtruction may now be conſidered as matter of curioſity, or as a link in the hiſtorical chain of aſtronomical inſtruments, but yet at the time was a link of great importance. When ſir Iſaac Newton preſented to the obſervatory at Trinity college, Cambridge, an excellent pendulum clock for the uſe of the profeſſor, it became a matter of great importance to have the ready means of adjuſting the rate of the clock to exact time; profeſſor Cotes, therefore, contrived an equal-altitude inſtrument, which was made at very little expence, and which yet fully anſwered its purpoſe. This inſtrument is deſcribed in Dr. Robert Smith's Optics, and alſo another, which is an improvement on it, as being at that time in the poſſeſſion of the earl of Ilay. As we preſume it will not be unacceptable to our readers to ſee how an inſtrument, that does not indicate any meaſure, will yet determine equal altitudes with accuracy, we ſhall give in ſucceſſion brief deſcriptions of the two inſtruments we have already named, accompanied by correſponding figures.

Profeſſor Cotes' Equal-altitude Inſtrument.—*Fig.* 3. of *Plate* XVII. of *Aſtronomical Inſtruments*, is a repreſentation of Mr. Cotes' equal-altitude inſtrument, as applied in taking an obſervation. A B is a ſtrong wooden axis in a vertical poſition about ſix feet long, and having the extreme ends of well-tempered ſteel; the ſuperior end A has a cylindrical pivot, and the lower end a conical one, both reſting in adjuſtable pieces of metal, that are not neceſſary to be deſcribed; two ſtrong bars, C D and D E, are firmly attached to the axis, ſo as to form a right angle where they are united at D; in like manner two other bars are fixed together and to the axis, namely, G F and F E, making a right angle at F; and below theſe a thick pin Y paſſes quite through the axis. Near the top at T is a piece of tapped wire ſcrewing into the axis, and ſupporting a plumb-line T V, which falls at the point of a fine needle inſerted a little out of the centre of the thick pin Y; ſo that by turning this wooden pin round, the needle point may be brought into contact with the line whenever it does not touch it: the bar C D has half a dozen tapering pins or pegs turned round, inſerted into holes at equal diſtances, or nearly ſo, and the bar E F has one ſuch pin. The pin at F ſupports the lower end of the teleſcope P Q, and the upper or object end hangs by one of the ſix pins on the arm C D, as the elevation in any obſervation may require; the piece I L K M, that carries the peg N, by which the teleſcope hangs, being made faſt to its tube. The teleſcope, not being an achromatic at that time, was five feet long, and therefore required the axis of motion to be at leaſt ſix feet. When the pivots of the axis were nicely adjuſted with reſpect to eaſt and weſt, and alſo to north and ſouth, which was known by the plumb-line hanging in apparent contact with the needle point, during the whole of an entire revolution, then the object-end of the teleſcope deſcribed an exact parallel to the horizon, or parallel of altitude, and whatever bodies appeared in the centre of the eye-glaſs, which we ſuppoſe to have been a ſingle one, had all equal apparent altitudes.

The Earl of Ilay's Equal-altitude Inſtrument.—The inſtrument ſaid to have been in the poſſeſſion of the earl of Ilay, is repreſented by *fig.* 4. of *Plate* XVII. We know not who was the maker, otherwiſe we ſhould have given his name in preference. The axis *a b* is of ſteel ſquared, thirty inches long; the upper end of it, *a*, bears a ſextantal arch *c d*, fixed at *a* immoveably; the teleſcope N is thirty inches long alſo, and is moveable together with its graduated ſemi-circle round the ſame point *a* as a centre of motion: this ſemi-circle may be fixed to the ſextantal arch at any elevation of the teleſcope, by the finger-nuts *c* and *d*, paſſing through the circular aperture of the ſemi-circle, and ſcrewing into the ſextantal arch. Immediately under the ſemi-circle is a ſpirit-level *l m*, with ſcrews of adjuſtment, and at *e* under it, the axis, for a ſhort way down, is cylindrical, about an inch in diameter, and well-poliſhed. The lower end of the axis is conical, and the eye-piece of the teleſcope has in its focus five vertical wires at equal diſtances, parallel to each other, and two parallel croſs wires, as repreſented in *fig.* 5. When the inſtrument here deſcribed is uſed, its axis is let down into a ſtand of the ſhape of a long hollow parallelopiped, wanting two ſides. Its other ſides *f*, *g*, are a couple of braſs plates, equal in length to the part *b e* of the axis, and are ſcrewed together edgeways, but the centre of the upper ſquare end piece *h*, four inches ſquare, is a round hole, juſt large enough to receive without touching it, and over this hole is fixed another plate with a triangular hole, concentric, one of the ſides of which triangle is moveable by an adjuſtment ſcrew, to make the cylinder bear alike on all ſides: on the lower ſquare, or baſe *i*, lies another adjuſtable piece, with a fine conical hole to bear the point *b* of the axis, and to adjuſt the axis vertical by means of its ſcrews, as pointed out by the level. The frame, thus furniſhed with the inſtrument, is then firmly faſtened to a ſolid pillar K, by means of a niche made in it to receive the braſs plates. The axis is known to be truly perpendicular when the bubble of the level will remain in the middle of the tube during every part of an entire revolution of the axis. If the axis of this inſtrument were to be placed parallel to the earth's axis, and in the true meridian, its conſtruction is equally adapted for an equatorial teleſcope, in which caſe the ſemi-circle would in every ſituation be a ſecondary to the equator, or would meaſure declinations. The croſs wires in the teleſcope are very uſeful for taking five pairs of obſervations, from which a mean may be taken with greater accuracy than one pair of obſervations alone would give, and in cloudy weather will afford five chances of ſeeing the body at the proper inſtants of required altitude. For the methods of applying the corrections for equal altitudes, and of aſcertaining the exact time as deduced from the obſervations, the reader is requeſted to conſult our article CHRONOMETER, where the requiſite problems are exemplified. It is ſcarcely neceſſary to add, that a common Hadley's ſextant or octant is a good

inſtrument

inſtrument for taking equal altitudes, provided the obſerver have a good artificial horizon, when his obſervations are taken on the land; the imperfection of the graduations being of no importance, except when the exact meaſure is wanted for other purpoſes.

Equal *Angles*, are thoſe whoſe containing lines are inclined alike to each other; or which are meaſured by ſimilar arches of their circles.

Equal *Arches*. See Arch.

Equal *Arithmetical Ratios*, are thoſe wherein the difference of the two leſs terms is equal to the difference of the two greater. See Ratio.

Equal *Circles*, are thoſe whoſe diameters are equal. See Circle.

Equal *Curvatures*, are ſuch as have the ſame or equal radii of curvature. See Curvature.

Equal *Figures*, are thoſe whoſe areas are equal, whether the figures be ſimilar or not.

The ſegments of a ſphere, or circle, are of an equal concavity, or convexity, when they have the ſame ratio, or proportion to the diameters of the ſpheres, or circles, whereof they are parts.

Equal *Geometrical Ratios*, are thoſe whoſe leaſt terms are ſimilar, aliquot, or aliquant parts of the greater.

Equal *Hours*. See Hour.

Equal *Hyperbolas*, are thoſe, all whoſe ordinates to their indeterminate axes, are equal to each other; taken at equal diſtances from their vertices.

Equal *Solids*, are thoſe which comprehend, or contain, each as much as the other; or whoſe ſolidities, or capacities, are equal. See Solid.

Equal *Beating*, in *Muſic*, is ſaid of ſuch tempered concords as beat equally quick, or make the ſame number of *wa, wa, wa, wa's*, in a given ſpace of time, when ſounding. The firſt who mentions, or makes any uſe of equal-beating concords, is Dr. Robert Smith, who obſerves, (Harmonics, p. 188.) "if ſeveral imperfect conſonances of the ſame name, as Vths, for inſtance, (by which the whole ſcale is uſually tuned,) beat equally quick, they are not equally harmonious, or tempered; to make them ſo, the higher in the ſcale ought to beat as much quicker than the lower, as their baſes vibrate quicker (prop. xi. cor. 2.); that is, if a Vth be a minor tone higher than another, it ſhould beat quicker, in the ratio of 10 to 9, or (if a major tone) 9 to 8 nearly; if a IIId higher, in the ratio of 5 to 4; if a Vth higher, in the ratio of 3 to 2; if an VIIIth higher, of 2 to 1, &c.

In ſchol. 2. to prop. xx., the doctor gives a table of beats to be made in fifteen ſeconds of time, by four ſucceſſive 5ths above C reſpectively, in order to form a ſyſtem for the common inſtruments with twelve notes in an octave, wherein every IIId ſhall beat ſharp, as faſt as the Vth to the ſame baſe beats flat: let it be obſerved, however, that this will not be the caſe in the IIIds or Vths affected by the beating notes, or reſulting 5th, after this method has been purſued through eleven 5ths.

In the ſame table we have the number of beats for the above ſucceſſion of 5ths, ſo calculated, that the Vths and VIths to the ſame baſs may beat equally quick, the former flat, and the latter ſharp; which will give the notes of the doctor's ſyſtem of equal harmony in three octaves, as far as the ſame can be applied on a defective or douzeave inſtrument. At page 220, mention is made of another equal-beating ſyſtem, wherein the IIIds and the VIths to the ſame baſs beat equally quick, and which is ſaid to approach ſo near to the ſyſtem of equal harmony, as not to need a particular table.

In the directions given by earl Stanhope, pages 13 and 14, of his ſtereotype "Principles of the Science of Tuning," for adjuſting his two ſucceſſive biequal 3ds, and three ſucceſſive triequal quints; his lordſhip directs that theſe ſhall be made to beat equally quick reſpectively; and falls into the miſtake of ſuppoſing that this would produce the equal temperament of thoſe IIIds and the Vths reſpectively, that he had previouſly calculated for them, by mean proportionals, for his monochord ſyſtem, contrary to the demonſtrations of Dr. Smith above; and in a printed "Letter to the Duke of Cumberland reſpecting the Stanhope Temperament," this error being perſiſted in, after it had been pointed out by Mr. Farey in the Philoſophical Magazine, vol. xxvii. p. 203, it becomes neceſſary for us to point out (as could not be done under Biequal *Third*, in our work), that the ratios $\frac{4}{5}$, $\frac{12}{19}$, and $\frac{1}{2}$, exactly repreſent the notes E, ♭A and *c* reſpectively, when the two ſucceſſive 3ds (which his lordſhip calls biequal) E, ♭A and ♭A *c*, whoſe ratios are $\frac{15}{19}$ and $\frac{19}{24}$, make an equal number of beats in a ſecond of time; and this number of beats, when C makes 240 complete vibrations in 1″, is exactly ten times in a ſecond. Thus we ſee, that there are three different intervals, called by his lordſhip biequal thirds, whoſe ratios are $\frac{19}{24}$, $\frac{\sqrt{10}}{4}$, and $\frac{15}{19}$, and their common logarithms are .8985423.5924, .8979400.0867, and .8973376.5811 reſpectively, or in the new notation $206.228\ \Sigma + 4f + 18\ m$, $207.5\ \Sigma + 4f + 18\ m$, and $208.772\ \Sigma + 4f + 18\ m$ nearly reſpectively: and there are, indeed, others which ariſe from the new inſtructions which his lordſhip gives in the letter to the duke of Cumberland above referred to, for tuning equally-tempered concords by means of the *abſence* of "beating between the two beatings;" which new ſpecies of equal beating is conſidered in the Philoſophical Magazine, vol. xxxiii. p. 297, and is ſhewn to produce other intervals than the above, and which yet come under the appellation of biequal thirds, as defined by earl Stanhope.

Equal *Harmony*, has been applied by Dr. Robert Smith to the different concords V, VI, and III, (or their complements 4th, 3d, and 6th,) when they are ſo tempered, as to be equally harmonious or pleaſant to the ear, as tempered concords; and the reſult of his laborious calculations for forming a ſyſtem, wherein every concord within the compaſs of *three* octaves ſhall be equally and the moſt harmonious, (Harmonics, p. 140.) is, that each V, VI, and III, are to be tempered $\frac{-5}{18}$, $\frac{+3}{18}$, and $\frac{-2}{18}$ parts of a major comma reſpectively: or, in a ſyſtem of four octaves of equally harmonious concords, theſe temperaments are to be $\frac{-11}{40}$, $\frac{+7}{40}$, and $\frac{-4}{40}$ parts of a comma for the V, VI, and III, reſpectively. But it is to be obſerved, that theſe temperaments are applicable only to inſtruments with 21 ſtrings, or pipes, in each octave, and not to the common piano-fortes, organs, &c. in uſe, with only 12 ſtrings, or pipes, of different pitches within the compaſs of an octave.

The term equal harmony has been, as we think, improperly applied by Mr. Emerſon, and others, to the *iſotonic* or *equal temperament* ſyſtem of intervals (which ſee); it being obſervable that Dr. Smith's deſign is to effect an equal harmony among the different concords, and the equal temperament makes an equal harmony among the different keys, which are in effect very different ſyſtems, and ought not to bear the ſame name.

Equal harmony alſo denotes the tuning by perfect 5ths without temperament, making all the keys participate equally

equally of the imperfection of the ſcale on keyed inſtruments. By this method of tuning, the thirds will, at firſt, ſeem very harſh and crude; but by a little uſe the ear will accommodate itſelf to the evil, and indulge the abbé Rouſſier, or his manes, with the *triple progreſſion*, by which Pythagoras formed the ſcale, and by which the Chineſe, in the moſt remote antiquity, according to Pere Amiot, produced the few ſounds with which their imperfect ſcale is furniſhed. See TEMPERAMENT and TRIPLE *Progreſſion*.

EQUAL *Temperament*, is a ſyſtem of twelve intervals within an octave, all equal to each other; each of which has the ratio of $\frac{1}{\sqrt[12]{2}} = 51\,\Sigma + f + 4\tfrac{5}{12}\,m$, (ſee Philoſophical Magazine, vol. xxix. p. 347.) the common logarithm of each of ſuch mean ſemitones being = .9749141.6703. This ſyſtem is often called the iſotonic, and ſometimes that of Merſennus, by M. Couperin, M. Marpurg, Mr. Emerſon, Mr. Cavallo, Mr. Davis, and others, who have written in its favour. Dr. Robert Smith, who diſapproves of this ſyſtem, ſtates the temperaments of its V and 4th, its VI and 3d, and its III and 6th, to be $\frac{1}{10}$, $\frac{7}{10}$, and $\frac{6}{10}$ parts of a major comma reſpectively (Harmonics, p. 167.), but theſe are incorrect, and ought to have been $\frac{1}{11}$, $\frac{7}{11}$, and $\frac{6}{11}$ of a comma, the temperaments of theſe concords, very nearly, as ſtated in the firſt column of Tab. II. page 158, of the ſame work. Mr. Emerſon, in his "Algebra," prob. ccii. calculates the beats which the concords in this ſyſtem make, in the octave above the G of the baſs cliff, and ſtates theſe at − 15, + 11, + 1½, − 1, − 18, and + 13 in one ſecond of time, made by the 3d, III, 4th, V, 6th, and VI reſpectively, the flat temperaments being marked — and the ſharp ones +.

The equal temperament of Mr. Farey, (Philoſophical Magazine, vol. xxviii. p. 65, and xxx. p. 6.) differs only in an inſenſible degree from the above, his half note being $51\,\Sigma + f + 5\,m$ between the notes C and ♭D, ♭E and E, F and ♭G, G and ♭A, and ♭B and B; and $51\,\Sigma + f + 4\,m$ between the notes ♭D and D, D and ♭E, E and F, ♭G and G, ♭A and A, A and ♭B, and B, &c.; yet this very ſlight variation enables an organ tuner to tune the twelve notes of this ſyſtem, by help of certain combinations of perfect Vths, 4ths, and IIIds! In this method of obtaining an equal temperament, the ſucceſſive 5ths C G, G D, D A, A E, E B, B ♭G, G ♭D, and D ♭A, are to be tuned upwards, each by aſcending (on a ſpare range of pipes or different ſtop to the one intended to be tuned) five ſucceſſive perfect 4ths, and from the higheſt note of theſe deſcending two perfect 5ths and one major 3d, which laſt or loweſt note is to be transferred to the G of the ſtop intended to be tuned. From this ſame note, G, five 4ths up, and two V + III down, are to be tuned to get D, and ſo on to ♭A. The remaining 5ths *c* F, F ♭B, and ♭B ♭E, are to be tuned downwards, by deſcending from *c* five ſucceſſive 4ths, and thence aſcending two Vths and a IIId to obtain F, from which note, repeating the ſame proceſs until the note ♭E is obtained; when, if the operations have been carefully performed, and *no beats* ſuffered to remain in any of the perfect 4ths, 5ths, 3ds, or uniſons, or in the octave C *c*, &c. the reſulting 5th, or that between the beating notes ♭A and ♭E, will be found, but in an almoſt inſenſible degree flatter than all the other fifths in the ſcale; the difference being only *m*, or leſs than $\frac{1}{1400}$th part of a major comma! between this V and each of the other eleven Vths: this being $357\,\Sigma + 7\,f + 30\,m$, and each of the others $375\,\Sigma + 7\,f + 31\,m$. The logarithm of the firſt or largeſt of the half-notes in this ſyſtem is = .9749119.1920, and of the ſmalleſt .9749157.7262. See TEMPERAMENT.

EQUAL, in *Optics*. We ſay, that things ſeen under equal angles are equal. Equal parts of the ſame interval, or magnitude, if unequally diſtant from the eye, appear unequal. Equal objects, and at equal diſtances, only the one placed directly, and the other obliquely, ſeem unequal; and that placed directly, the bigger.

Maſonry by EQUAL *Courſes*. See MASONRY.

EQUALITY, in *Algebra*, is a compariſon of two quantities, that are equal both really and repreſentatively, *i. e.* which are ſo both in effect and letters.

A compariſon of two quantities equal in effect, but unequal in letters, to render them equal, is called an *equation*, which ſee.

EQUALITY is uſually denoted by two parallel lines, as =: thus 2 + 2 = 4, *i. e.* 2 plus 2 are equal to 4. This character was firſt introduced by Robert Recorde. Des Cartes, and ſome after him, in lieu thereof, uſe ∝: thus, 2 + 2 ∝ 4; ſo *z* − y ∝ b + c, ſignifies that *z* minus y is equal to b plus c.

From an equation we arrive at an equality, by changing an unknown letter into another, whereby the two members of the equation, *i. e.* the two quantities compared together, and connected by the ſign of equality, are rendered equal. Thus, in the equation a a x = b c d; ſuppoſing $x = \frac{bcd}{aa}$, we change *x* into $\frac{bcd}{aa}$, and by this ſubſtitution arrive at the equality bcd = bcd.

In the ſolution of a numerical problem, which is to be rendered rational, if there be only one power to be equalled to a ſquare, or other higher power, it is called ſimple equality.

Where there are two powers to be equalled, each to a ſquare, it is called double equality, &c.

Diophantus hath given us a method for double equalities, and F. de Billy, another for triple equalities, in his Diophantus Redivivus.

EQUALITY, in *Aſtronomy*. *Circle of* EQUALITY, or the *equant*. See CIRCLE and EQUANT.

EQUALITY denotes the exact agreement of two or more things in reſpect of quantity. Thus, figures are equal which may occupy the ſame ſpace, by the fluxion or tranſpoſition of their parts. See on this ſubject an elaborate diſſertation by Dr. Barrow, in the 11th and 12th of his Mathematical Lectures.

EQUALITY, *ratio*, or *proportion of*, in *Geometry*, is that between two equal numbers, or quantities.

Proportion of EQUALITY *evenly ranged*, or *ex æquo ordinata*, is that in which two terms in a rank, or ſeries, are proportional to as many terms in another ſeries, compared to each other in the ſame order, *i. e.* the firſt of one rank to the firſt of another; the ſecond to the ſecond, &c.

Proportion of EQUALITY *evenly diſturbed*, called alſo *ex æquo perturbata*, is that in which more than two terms of one rank are proportional to as many terms of another compared to each other, in a different and interrupted order; *viz.* the firſt of one rank to the ſecond of another; the ſecond to the third, &c.

EQUALITY, *Union of*. See UNION.

EQUALITY, in *Law*, the law delights in equality; ſo that when a charge is laid upon one, and divers ought to bear it, he ſhall have relief againſt the reſt. 2 Rep. 25.

EQUANIMITY, in *Ethics*, denotes an even, uniform temper of mind, amidſt all the varieties and revolutions of time and chance. This virtue, together with prudence, forms the character which Horace gives of Ariſtippus:

"Omnis

"Omnis Ariſtippum decuit color & ſtatus & res."

EQUANT, or ÆQUANT, in *Aſtronomy*, a circle, formerly imagined by aſtronomers, in the plane of the deferent, or eccentric; for regulating and adjuſting certain motions of the planets, and reducing them more eaſily to a calculus. See APOGEE, CIRCLE, DEFERENT, and EXCENTRIC.

EQUATED ANOMALY. See ANOMALY and ELLIPTIC *Motion*.

EQUATED *Bodies*. On Gunter's ſector there are ſometimes placed two lines, anſwering to one another, and called the lines of equated bodies: they lie between the lines of ſolids, and ſuperficies, and are noted with the letters D, I, C, S, O, T, for dodecahedron, icoſihedron, cube, ſphere, octahedron, and tetrahedron.

The uſes of theſe lines are, 1. When the diameter of the ſphere is given, to find the ſides of the five regular bodies, ſeverally equal to that ſphere. 2. From the ſide of any of the bodies being given, to find the diameter of the ſphere, and the ſides of the other bodies, which ſhall be equal ſeverally to the firſt body given.

If the ſphere be firſt given, take its diameter, and apply it over in the ſector in the points S, S: if any of the bodies be firſt given, apply the ſide of it over in its proper points; ſo the parallels taken from between the points of the other bodies ſhall be the ſides of thoſe bodies, equal ſeverally to the firſt body given.

EQUATION, in *Algebra*, is when two equal quantities, differently expreſſed, are compared together, by means of the ſign $=$ placed between them.

Thus, $9 - 4 = 5$, is an equation expreſſing the equality of $9 - 4$ and 5; and $a + b - c = d$, is an equation denoting that the difference between the ſum of $a + b$, and c, is equal to d; the quantities between which the ſign $=$ is placed being called the two ſides of the equation.

It is ſometimes cuſtomary, however, to place all the quantities on one ſide of the equation, and to make them equal to 0, or zero, on the other ſide; as $a - b = c$, or $a + b - c = 0$, &c. which is only ſetting down the difference of two equal quantities and putting it equal to 0.

The *terms* of an equation, are the ſeveral quantities or parts of which it is compoſed: thus, in the equation $a + b = c$, the terms are a, b, and c; and the ſenſe or meaning of the expreſſion is, that ſome quantity repreſented by c, is equal to the ſum of two others, repreſented by a and b.

When a quantity ſtands alone, on one ſide of an equation, the terms on the other ſide are ſaid to be a *value* of that quantity. Thus, in the equation $x = a - b$, the difference of the two numbers repreſented by a and b is called the value of x.

Equations are alſo diſtinguiſhed by the denominations of *ſimple* and *compound*, or, as they are frequently called, *ſimple* and *affected*; which latter term, however, it would be better to diſcard, as being leſs natural and appropriate than that of *compound*.

A ſimple equation, is that which contains only one power of the unknown quantity; as $x + a = b$, or $a x^2 + b = c$, or $2 x^3 + 3 a^3 = 4 b$, &c. where x denotes the unknown quantity, and the other letters or figures ſuch quantities as are known.

A compound equation, is that which contains two or more powers of the unknown quantity; as $x^2 + a x = b$, or $x^3 + a x^2 - b x = c$, &c.

Equations are likewiſe divided into different *orders*, according to the higheſt power of the unknown quantity contained in any one of their terms; as *quadratic*, *cubic*, *biquadratic*, &c. thus,

A quadratic equation, is that in which the unknown quantity riſes to two dimenſions, or that contains both the unknown quantity and its ſquare; as $x^2 + 10 x = 30$, or $a x^2 + b x = c$.

A cubic equation, is that in which the unknown quantity is of three dimenſions, or that riſes to the cube or third power; as $x^3 - 3 x = 1$, or $x^3 + 2 x^2 = 4$, or $a x^3 + b x^2 + c x = d$.

A biquadratic equation, is that in which the unknown quantity is of 4 dimenſions, or that riſes to the fourth power; as $x^4 + 2 x = 5$, or $x^4 + 3 x^2 = 10$, or $x^4 + 4 x^2 + 7 x = 50$, or $a x^4 + b x^3 + c x^2 + d x = e$. And ſo on, for the 5th, 6th and other higher order of equations; which are all denominated according to the higheſt power of the unknown quantity contained in any one of their terms.

The root of an equation, is that quantity, whether poſitive, negative, or even imaginary, that when ſubſtituted for the unknown quantity, will make both ſides of the equation vaniſh, or become equal to 0.

Thus, in the equation $x^2 - 6 x = 72$, either $+ 12$ or $- 6$ is a root, or value, of the unknown *quantity*; for if each of theſe numbers be ſeparately ſubſtituted for x, they will be found to ſatisfy the conditions of the equation.

In the reſolution of an equation, containing only one unknown quantity, ſeveral previous operations are often required to be performed, in order to adapt it to the rule to which it belongs; the greater part of which may be performed by means of a few ſelf-evident and obvious principles; namely, that if equal quantities be added to, or ſubtracted from, equal quantities, the ſums or remainders will be equal; if equal quantities be multiplied or divided by the ſame quantity the products or quotients will be equal; or if equal quantities be raiſed to the ſame power, or have the ſame root extracted, the reſults will ſtill be equal.

From theſe ſimple conſiderations are derived the following rules, which will equally apply to equations of all orders, and are alone ſufficient for the reſolution of ſimple equations.

Rule 1.—Any quantity may be tranſpoſed from one ſide of the equation to the other by changing its ſign.

$$\begin{aligned} &\text{Thus, if } x - 5 = 8 \\ &\text{Then } x = 8 + 5 \\ &\text{Or } x = 13 \\ &\text{And if } 4 x - 8 = 3 x + 7 \\ &\text{Then } 4 x - 3 x = 7 + 8 \\ &\text{Or } x = 15 \end{aligned}$$

From this rule it alſo follows that if any quantity be found on each ſide of the equation, with the ſame ſign, it may be left out of both. And that the ſigns of all the terms of an equation may be changed into the contrary ones, without affecting the truth of the equation.

$$\begin{aligned} &\text{Thus, if } x + 2 = 7 + 2 \\ &\text{Then } \quad x = 7 \\ &\text{And if } a - x = b - c \\ &\text{Then } x - a = c - b \\ &\text{Or } x = a + c - b \end{aligned}$$

Rule 2.—If the unknown quantity, in an equation, be multiplied by any quantity, that quantity may be taken away, by dividing all the reſt of the terms by it.

$$\begin{aligned} &\text{Thus, if } 7 x = 49 \\ &\text{Then } x = \frac{49}{7} = 7 \\ &\text{And if } a x = b - c \\ &\text{Then } x = \frac{b - c}{a} \end{aligned}$$

Rule 3.—If any term of an equation be a fraction, its denominator

nominator may be taken away, by multiplying all the reft of the terms by it.

$$\text{Thus, if } \frac{x}{2} = 3$$
$$\text{Then } x = 6$$
$$\text{And if } \frac{x}{a} - b = c$$
$$\text{Then } x - ab = ac$$
$$\text{Or } x = a(b + c)$$

Or the denominators may be taken away from feveral terms of an equation, by one operation, if all the terms be multiplied by any number which is a multiple of each of the denominators.

$$\text{Thus, if } \frac{x}{2} + \frac{x}{3} + \frac{x}{4} = 6$$

Then, if all the terms be multiplied by 12, which is a multiple of 2, 3 and 4,

$$\text{We fhall have } 6x + 4x + 3x = 72$$
$$\text{And } 13x = 72$$
$$\text{Or } x = \frac{72}{13} = 5\frac{7}{13}$$

It alfo appears, from this rule, that if each of the terms of an equation be either multiplied or divided by the fame quantity, that quantity may be left out of them all.

$$\text{Thus, if } ax = ab + ac$$
$$\text{Then } x = b + c$$
$$\text{And if } \frac{x}{a} + \frac{b}{a} = \frac{c}{a}$$
$$\text{Then } x + b = c$$
$$\text{Or } x = c - b$$

4. If the unknown quantity, in any equation, be in the form of a furd, let it be made to ftand alone on one fide of the equation, and the remaining terms on the other; then involve each fide to a power denoted by the index of the furd, and the quantity will thus be rendered free from any furd expreffion.

If, for example, $\sqrt{x} + 2 = 5$

Then, by tranfpofition, $\sqrt{x} = 5 - 2 = 3$

And, by fquaring both fides, $x = 9$

In like manner, if $\sqrt{x^2 + a} - x = b$

Then, by tranfpofition, $\sqrt{x^2 + a} = b + x$

And by fquaring $x^2 + a = b^2 + 2bx + x^2$

And by leaving out x^2 on each fide $a = b^2 + 2bx$

Or $a - b^2 = 2bx$

Or $x = \dfrac{a - b^2}{2b}$

5. Any analogy, or proportion, may be converted into an equation, by making the product of the two extremes equal to that of the two means.

$$\text{Thus, if } 3x : 16 :: 5 : 7$$
$$\text{Then } 3x \times 7 = 16 \times 5$$
$$\text{Or } 21x = 80$$
$$\text{Or } x = \frac{80}{21} = 3\frac{17}{21}$$

Having thus fhewn the manner in which a fimple equation, containing only one unknown quantity, may be folved, it will be proper, in the next place, to explain the methods by which two or more equations of this kind may be reduced to a fingle one, and thence refolved by fome of the foregoing rules; obferving, in this cafe, that there muft always be the fame number of equations as there are unknown quantities, otherwife the queftion will admit of a variety of anfwers.

The principal methods, made ufe of for this purpofe, as far as regards the refolution of two fimple equations, are the three following:

1. Obferve which of the unknown quantities is the leaft involved, and find its value in each of the two equations by the methods already explained.

This being done, let the values, thus found, be put equal to each other; and there will arife a new equation, with only one unknown quantity in it, the value of which may be found as before.

As an example in this cafe, let it be required to determine x and y from the two following equations.

$$2x + 3y = 23$$
$$5x - 2y = 10$$

$$\text{Then, from the 1ft equation } x = \frac{23 - 3y}{2}$$
$$\text{And from the 2d, } x = \frac{10 + 2y}{5}$$

Hence, if thefe two values be put equal to each other,

$$\text{We fhall have } \frac{10 + 2y}{5} = \frac{23 - 3y}{2}$$
$$\text{Or } 20 + 4y = 115 - 15y$$
$$\text{Therefore } 15y + 4y = 115 - 20$$
$$\text{Or } 19y = 95$$
$$\text{And confequently } y = \frac{95}{19} = 5$$
$$\text{And } x = \frac{10 + 2y}{5} = \frac{10 + 10}{5} = \frac{20}{5} = 4$$

2. Confider which of the unknown quantities you would firft exterminate, and find its value in that equation where it is the leaft involved.

Then fubftitute this value for its equal in the other equation, and there will arife a new equation, with only one unknown quantity in it, the value of which may be found as before.

Thus, taking the fame example as in the former rule,

$$2x + 3y = 23$$
$$5x - 2y = 10$$
$$\text{Then, from the 1ft equation, } x = \frac{23 - 3y}{2}$$

And, if this value be fubftituted for x in the 2d equation, we fhall have

$$5\left(\frac{23 - 3y}{2}\right) - 2y = 10$$
$$\text{Or } 115 - 15y - 4y = 20$$
$$\text{And confequently } 115 - 20 = 15y + 4y$$
$$\text{Or } y = \frac{95}{19} = 5$$
$$\text{And } x = \frac{23 - 3y}{2} = \frac{23 - 15}{2} = \frac{8}{2} = 4$$

3. Let the given equations be multiplied or divided by fuch numbers or quantities as will make the term which contains one of the unknown quantities the fame in both equations.

Then, by adding or fubtracting the two equations, as occafion may require, there will arife a new equation with only one unknown quantity in it, which may be refolved as before.

Thus, taking the fame example as in the two former methods.

$$2x + 3y = 23$$
$$5x - 2y = 10$$

Then, to exterminate x, let the firft equation be multiplied by 5, and the 2d by 2, and we fhall have

$10x$

$$10x + 15y = 115$$
$$10x - 4y = 20$$

And fubtracting the latter of thefe two equations from the former, the refult will be

$$19y = 95$$

And confequently $y = \frac{95}{19} = 5$

And if this be fubftituted for y in the laft of the two given equations, we fhall have

$$5x - 2 \times 5 = 10$$
$$\text{Or } 5x = 10 + 10 = 20$$
$$\text{Or } x = \frac{20}{5} = 4$$

As another example of this third method, which is commonly more eafy and expeditious in practice than either of the other two,

Let there be given $\left\{\begin{matrix} ax + by = c \\ dx + fy = g \end{matrix}\right\}$ to find x and y

Then, in order to exterminate y, let the firft equation be multiplied by f, and the fecond by b, and we fhall have

$$afx + bfy = cf$$
$$bdx + bfy = bg$$

And by taking the difference of thefe two equations, there will arife

$$afx - bdx = cf - bg$$
$$\text{Or } (af - bd)\,x = cf - bg$$
$$\text{And confequently } x = \frac{cf - bg}{af - bd}$$

In like manner, if the firft of the two given equations be multiplied by d, and the fecond by a, we fhall have

$$adx + bdy = cd$$
$$adx + afy = ag$$

And, the difference of thefe equations being taken as before, will give

$$bdy - afy = cd - ag$$
$$\text{Or } (bd - af) = cd - ag$$
$$\text{And confequently } y = \frac{cd - ag}{bd - af}$$

In which cafe, x and y are here found in general terms: and confequently the folution will hold true, whatever numbers may be fubftituted for a, b, c, d, e, f, and g.

If it be required to exterminate three unknown quantities, or to reduce the three fimple equations containing them to a fingle one, it may be done as follows:

Find the value of one of the three unknown quantities in each of the three fimple equations containing it; then compare the firft of thefe values with the fecond, and the fecond with the third, and there will arife two new equations, containing only two unknown quantities, the values of which may be found by either of the former rules.

Let there be given, for example, the three following equations, to find x, y, and z.

$$x + y + z = 53$$
$$x + 2y + 3z = 105$$
$$x + 3y + 4z = 134$$

Then, if x be exterminated in each of thefe equations, we fhall have,

$$x = 53 - y - z$$
$$x = 105 - 2y - 3z$$
$$x = 134 - 3y - 4z$$

And by comparing the firft of thefe with each of the other two, there will arife the two following equations:

$$53 - y - z = 105 - 2y - 3z$$
$$53 - y - z = 134 - 3y - 4z$$

From which, by tranfpofition, and the rules of addition and fubtraction, we fhall readily find,

$$y = 52 - 2z$$
$$y = \frac{81 - 3z}{2}$$

And confequently, by equating thefe two values of y, we fhall obtain,

$$\frac{81 - 3z}{2} = 52 - 2z$$
$$\text{Or } 81 - 3z = 104 - 4z$$
$$\text{Or } 4z - 3z = 104 - 81 = 23$$
$$\text{Hence } z = 23$$
$$y = 52 - 2z = 52 - 46 = 6$$
$$x = 53 - y - z = 53 - 6 - 23 = 24$$

And if the three following equations be propofed, in general terms,

$$ax + by + cz = d$$
$$a'x + b'y + c'z = d'$$
$$a''x + b''y + c''z = d''$$

Then the values of x, y, and z, found in a fimilar manner, will be as below:

$$z = \frac{ab'd'' - ad'b'' + da'b'' - bad'' + bd'a'' - db'a''}{ab'c'' - acb'' + ca'b'' - ba'c'' + bc'a'' - cb'a''}$$

$$y = \frac{ad'c'' - ac'd'' + ca'd'' - da'c'' + dc'a'' - cd'a''}{ab'c'' - ac'b'' + ca'b'' - ba'c'' + bc'a'' - cb'a''}$$

$$x = \frac{db'c'' - dc'b'' + cdb'' - bd'c'' + bc'd'' - cb'd''}{ab'c'' - ac'b'' + ca'b'' - ba'c'' + bc'a'' - cb'a''}$$

Where, if any numbers whatever be fubftituted in the place of the literal coefficients, the equation will hold: and in a manner analogous to this, we may exterminate four or more unknown quantities in general terms; and thence, by fubftitution, determine their values in any numeral equations that may be propofed.

Having thus fufficiently fhewn the method of folving fimple equations, it will next be proper to proceed to the refolution of quadratic equations, or thofe of the fecond power, which, omitting the fimple cafe $x^2 = a$, and confining ourfelves only to fuch as are compound, may always be reduced to one of the three following forms:

1. $x^2 + ax = b$
2. $x^2 - ax = b$
3. $x^2 - ax = -b$

Where the value of the unknown quantity x, in each of the equations, taken according to the order in which they ftand, may be exhibited as below:

1. $x = -\frac{a}{2} \pm \sqrt{\frac{a^2}{4} + b}$
2. $x = +\frac{a}{2} \pm \sqrt{\frac{a^2}{4} + b}$
3. $x = +\frac{a}{2} \pm \sqrt{\frac{a^2}{4} - b}$

Or the general equation $ax^2 \pm bx = \pm c$, which comprehends all the three cafes above-mentioned, may be refolved by means of the following rule:

Tranfpofe all the terms that involve the unknown quantity to one fide of the equation, and the known quantities to the other; obferving to arrange them fo, that the term which contains the fquare of the unknown quantity may be pofitive, and ftand firft in the equation.

Then, if the fquare of the unknown quantity have any coefficient prefixed to it, let all the reft of the terms be divided by it, fo that the coefficient of the fquare of the unknown quantity may be 1.

This

This being done, add the ſquare of half the coefficient of the unknown quantity itſelf to both ſides of the equation, and the ſide which involves the unknown quantity will now be a complete ſquare.

Laſtly, extract the ſquare root of both ſides of the equation, by which means it will be reduced to a ſimple one; and if the unknown quantity be made to ſtand alone, on one ſide of the equation, and the known terms on the other, its value will be determined as was required.

Note. The ſquare root of the firſt ſide of the equation is always equal to the ſum or difference of the unknown quantity, and half the coefficient of the ſecond term, according as that term is + or —.

It may alſo be obſerved, that all equations, in which there are two terms involving the unknown quantity, and which have the index of the one juſt double that of the other, are ſolved like quadratics, by completing the ſquare.

Thus, $x^4 - ax^2 = b$, or $x^{2n} - ax^n = b$, are the ſame as quadratics; their roots being as below.

$$x = \sqrt{\frac{a}{2} \pm \sqrt{\frac{a^2}{4} + b}},\quad x = \sqrt[n]{\frac{a}{2} \pm \sqrt{\frac{a^2}{4} + b}}$$

As an illuſtration of the rule for quadratics given above, the following ſimple examples in numbers will be found ſufficient.

1. Given $x^2 + 4x = 140$, to find x.

Here $x^2 + 4x + 4 = 140 + 4 = 144$, by completing the ſquare.

And $\sqrt{x^2 + 4x + 4} = \sqrt{144}$, by extracting the root.

Or, which is the ſame thing, $x + 2 = 12$.

And conſequently $x = 12 - 2 = 10$.

2. Given $x^2 - 6x + 8 = 80$, to find x.

Here $x^2 - 6x = 80 - 8 = 72$, by tranſpoſition.

Then $x^2 - 6x + 9 = 72 + 9 = 81$, by completing the ſquare.

And $x - 3 = \sqrt{81} = 9$, by extracting the root.

Whence $x = 9 + 3 = 12$.

3. Given $2x^2 + 8x - 20 = 70$, to find x.

Here $2x^2 + 8x = 70 + 20 = 90$, by tranſpoſition.

Then $x^2 + 4x = 45$, by dividing by 2.

And $x^2 + 4x + 4 = 45 + 4 = 49$, by completing the ſquare.

Whence $x + 2 = \sqrt{49} = 7$, by extracting the root.

And conſequently $x = 7 - 2 = 5$.

4. Given $\frac{x^2}{2} - \frac{x}{3} + 20\frac{1}{2} = 42\frac{2}{3}$.

Here $\frac{x^2}{2} - \frac{x}{3} = 42\frac{2}{3} - 20\frac{1}{2} = 22\frac{1}{6}$, by tranſpoſition.

And $x^2 - \frac{2}{3}x = 44\frac{1}{3}$, by dividing by $\frac{1}{2}$, or multiplying by 2.

Whence $x^2 - \frac{2}{3}x + \frac{1}{9} = 44\frac{1}{3} + \frac{1}{9} = 44\frac{4}{9} = \frac{400}{9}$, by completing the ſquare.

And $x - \frac{1}{3} = \sqrt{\frac{400}{9}} = \frac{20}{3}$.

Therefore $x = \frac{20}{3} + \frac{1}{3} = \frac{21}{3} = 7$.

It muſt here, however, be obſerved, that ſince the ſquare root of any quantity may be either poſitive (+) or negative (—), it follows that all quadratic equations will admit of two ſolutions. Thus, the ſquare root of a^2 (or $\sqrt{a^2}$) is either $+a$ or $-a$; for $(+a) \times (+a)$ or $(-a \times -a)$ are each equal to a^2, by the rules for the ſigns in multiplication. So, in like manner, if there be given $x^2 + ax = b$, where $x + \frac{a}{2}$ is found $= \sqrt{b + \frac{1}{4}a^2}$, the root may be $+\sqrt{b + \frac{1}{4}a^2}$, or $-\sqrt{b + \frac{1}{4}a^2}$, ſince either of them being multiplied by itſelf will produce $b + \frac{1}{4}a^2$. And this ambiguity is uſually expreſſed by writing the uncertain ſign $\pm$ before $\sqrt{b + \frac{1}{4}a^2}$, by which means we have $x = \pm\sqrt{b + \frac{1}{4}a^2} - \frac{1}{2}a$; and the ſame mode of reaſoning is equally applicable to any literal or numeral quadratic equation whatever. Thus, in the firſt numeral equation above, $x^2 + 4x = 140$, it has been found that $x + 2 = \sqrt{144} = 12$; but if the uncertain ſign $\pm$ be put before $\sqrt{144}$, it will become $x + 2 = \pm\sqrt{144} = +12$ or -12; and conſequently $x = +12 - 2 = 10$ or $-12 - 2 = -14$, which are the two roots of the equation $x^2 + 4x = 140$, as will be found by ſubſtituting either of them for x; the reſult in both caſes being 144.

In addition to this, it may be ſtill farther remarked, that a quadratic equation may be propoſed of ſuch a form, or have its coefficients ſo related to each other, that the value of the unknown quantity can only be exhibited by means of the ſquare root of a negative quantity, which, it is plain, cannot be determined; as there is no quantity, either poſitive or negative, which being multiplied by itſelf produces ſuch a form of expreſſion. If, for example, the value of x were required from the equation $x^2 + 13 = 4x$, or $x^2 - 4x = -13$, we ſhould find $x = 2 \pm \sqrt{-9}$; and as it is here neceſſary to extract the ſquare root of -9, which cannot be determined, the queſtion is ſhewn to be impoſſible, or to involve a contradiction.

But although imaginary expreſſions of this kind are of no other uſe in the reſolution of quadratic equations, than to ſhew that a particular problem cannot be ſolved, they muſt not, on this account, be altogether rejected; as they are well known to be of the greateſt uſe in many mathematical inveſtigations, particularly in ſome of the higher branches of the ſcience, where no other mode of reaſoning could be ſo ſucceſsfully or advantageouſly employed.

Thus, if e be made to repreſent the number of which the hyperbolic logarithm is 1, it is well known, as a theorem in trigonometry, that

$$\text{Coſ. } x = \frac{e^{x\sqrt{-1}} + e^{-x\sqrt{-1}}}{2}$$

$$\text{Sin. } x = \frac{e^{x\sqrt{-1}} - e^{-x\sqrt{-1}}}{2\sqrt{-1}}$$

Where the ſine and coſine of any arc x is exhibited in a very commodious manner, by means of imaginary exponential expreſſions; which formulæ, though objected to, and ridiculed by certain writers, are conſidered, by the celebrated Lagrange (Leçons, ſur des Fonct. Analytiques) as one of the fineſt analytical diſcoveries of the eighteenth century.

Having thus ſufficiently explained the nature of quadratic equations, it will be neceſſary, before we proceed to the reſolution of cubics and thoſe of higher dimenſions, to ſhew how the ſecond term of any equation may be taken away, in order to fit it for a ſolution; which is done as follows:

Divide the coefficient of the ſecond term of the propoſed equation by the exponent of the firſt term, and add the quotient, with its ſign changed, to ſome new unknown quantity: then if this ſum be ſubſtituted for the unknown quantity in the propoſed equation, a new equation will ariſe, which will want the ſecond term, as required.

For example, let the quadratic equation $x^2 - 8x + 15 = 0$, be that of which it is required to take away its ſecond term.

Then ſince $\frac{8}{2} = 4$, if x be put $= y + 4$, we ſhall have,

$x^2 =$

$$x^2 = y^2 + 8y + 16$$
$$-8x = \quad -8y - 32$$
$$+15 = \quad +15$$

Whence $y^2 - 1 = 0$, the equation required.

From which it appears, that any quadratic equation may be ſolved without completing the ſquare, by only taking away the ſecond term; for ſince in the above reduced equation $y = \sqrt{1} = 1$, we ſhall have $x = y + 4 = 1 + 4 = 5$.

Again, let the equation $x^3 - 9x^2 + 26x - 34 = 0$ be given, to exterminate the ſecond term.

Then ſince $\frac{9}{3} = 3$, if x be put $= y + 3$, we ſhall have,

$$x^3 = y^3 + 9y^2 + 27y + 27$$
$$-9x^2 = \quad -9y^2 - 54y - 81$$
$$+26x = \quad +26y + 78$$
$$-34 = \quad -34$$

Whence $y^3 - y - 10 = 0$, or $y^3 - y = 10$, the equation required.

In like manner, let the following literal equations of the fourth power $x^4 + px^3 + qx^2 + rx + s = 0$ be given, to exterminate the ſecond term.

Then, by putting $x = y - \frac{p}{4}$, we ſhall have,

$$x^4 = y^4 - py^3 + \frac{3p^2}{8}y^2 - \frac{p^3}{16}y + \frac{p^4}{256}$$
$$px^3 = \quad + py^3 - \frac{3p^2}{4}y^2 + \frac{3p^3}{16}y - \frac{p^3}{64}$$
$$qx^2 = \quad + qy^2 - \frac{pq}{2}y + \frac{qp^2}{16}$$
$$rx = \quad + ry - \frac{rp}{4}$$
$$s = \quad + s$$

Hence $y^4 + \frac{8q - 3p^2}{8}y^2 + \frac{8r - 4pq + p^2}{8}y + \frac{256s - 64rp + 16qp^2 - 4p^3 + p^4}{256} = 0$, the reduced equation required. And the ſame method of ſolution may be applied to the taking away the ſecond term of any equation whatever.

Another ſpecies of transformation, of uſe in reducing equations to their ſimpleſt form, is that of converting ſuch of the terms as have fractional coefficients into others that ſhall be integral; which is done by ſubſtituting a new unknown quantity, divided by the product of all the denominators, inſtead of the unknown quantity in the equation; and then, by proper reductions, the equation will be found to have the form required.

Thus, let $x^4 + \frac{p}{a}x^3 + \frac{q}{b}x^2 + \frac{r}{c}x + \frac{s}{d} = 0$, be the given equation.

Then, if x be aſſumed $= \frac{y}{abcd}$, we ſhall have, by ſubſtitution,

$$\frac{y^4}{a^4b^4c^4d^4} + \frac{py^3}{a^4b^3c^3d^3} + \frac{qy^2}{a^2b^3c^2d^2} + \frac{ry}{abc^2d} + \frac{s}{d} = 0.$$

And by multiplying the whole equation by $a^4b^4c^4d^4$ it will become

$y^4 + bcdpy^3 + a^2bc^2d^2qy^2 + a^3b^3c^2d^3ry + a^4b^4c^4d^3 = 0$, which is of the form required.

This preparation being made, it will now be proper to proceed to the ſolution of *cubic equations*, or thoſe of which the higheſt power is of three dimenſions; all of which, when expreſſed in general terms, are of the form

$$x^3 \pm px^2 \pm qx \pm r = 0.$$

Or, if the ſecond term be taken away, by means of the above-mentioned rule, any equation of this kind may be exhibited under the form

$$x^3 \pm px = \pm q$$

And, in this caſe, the value of the unknown quantity x, according to the rule uſually aſcribed to Cardan, is as follows:

$$x = \sqrt[3]{\tfrac{1}{2}q + \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}} + \sqrt{\tfrac{1}{2}q - \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}}$$

Or

$$x = \sqrt[3]{\tfrac{1}{2}q + \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}} - \frac{\tfrac{1}{3}p}{\sqrt[3]{\tfrac{1}{2}q + \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}}}$$

the values of p and q being always ſuppoſed to be taken with the ſign $+$ or -1 according as they are found in the given equation.

The rule may be demonſtrated thus:

Let the equation, whoſe root is to be determined, be

$$x^3 + px = q$$

Then if x be aſſumed $= y + z$, we ſhall have, by ſubſtitution,

$$x^3 = y^3 + 3yz(y + z) + z^3$$
$$px = \quad p(y + z)$$

Or $x^3 + px = y^3 + 3yz + p \times \overline{y + z} + z^3 = q$

And if, in this laſt equation, $3yz$ be taken $= -p$, we ſhall have the two following equations for determining the values of y and z: *viz.*

$$3yz = -p$$
$$y^3 + z^3 = q$$

Where, ſince in the firſt of them, $z = -\frac{p}{3y}$, if this value be ſubſtituted in the ſecond, it will become

$$y^3 - \frac{p^3}{27y^3} = q$$

Or by multiplying by y^3, and then tranſpoſing the terms,

$$y^6 - qy^3 = (\tfrac{1}{3}p)^3$$

And as this equation is now in the form of a quadratic, on account of the index of the higheſt term being double that of the ſecond, we ſhall have, by the rule already given for that purpoſe, and by ſimple equations.

$$y = \sqrt[3]{\tfrac{1}{2}q \pm \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}}$$
$$z = \frac{\tfrac{1}{3}p}{\sqrt[3]{\tfrac{1}{2}q \pm \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}}}$$

Whence $x = y + z = \sqrt[3]{\tfrac{1}{2}q \pm \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}} - \frac{\tfrac{1}{3}p}{\sqrt[3]{\tfrac{1}{2}q \pm \sqrt{(\tfrac{1}{2}q)^2 + (\tfrac{1}{3}p)^3}}}$

as was to be ſhewn.

As a practical application of the rule, let there be given the equation $x^3 + 6x = 20$, to find the value of x.

Thus, if p be put $= 6$, and $q = 20$, the analytical expreſſion will become

$$\sqrt[3]{10 + \sqrt{100 + 8}} - \frac{2}{\sqrt[3]{10 + \sqrt{100 + 8}}} = \sqrt[3]{10 + \sqrt{108}} - \frac{2}{\sqrt[3]{10 + \sqrt{108}}}$$

$$= \sqrt[3]{10 + 10.3923} - \frac{2}{\sqrt[3]{10 + 10.3923}} = \sqrt[3]{20.3923} - \frac{2}{\sqrt[3]{20.3923}}$$

$$= 2.732$$

$= 2.732 - \frac{2}{2.732} = 2.732 - .732 = 2$, which is the required value of x.

It happens, however, that the value of the unknown quantity is here only found by approximation; but this, when the root is a whole number, may always be avoided, for ſince in the preſent inſtance, $\sqrt[3]{10 + \sqrt{108}} = 1 + \sqrt{3}$, as may be proved by raiſing it to the third power, if this be ſubſtituted in its proper place, in the above expreſſions, we ſhall have $\sqrt[3]{10 + \sqrt{108}} - \frac{2}{\sqrt[3]{10 + \sqrt{108}}} = 1 + \sqrt{3}$

$$- \frac{2}{1+\sqrt{3}} = \frac{(1+\sqrt{3})^2 - 2}{1+\sqrt{3}} = \frac{1 + 2\sqrt{3} + 3 - 2}{1+\sqrt{3}}$$

$= \frac{2 + 2\sqrt{3}}{1+\sqrt{3}} = 2$, as before.

Again, as a ſecond example, let there be given $x^3 - 6x = -q$, to find the value of x.

Here $p = -6$ and $q = -q$

Then, by ſubſtituting theſe values in the above formula, we have

$$x = \sqrt[3]{-4\tfrac{1}{4} + \sqrt{20\tfrac{1}{2} - 8}} - \frac{-2}{\sqrt[3]{-4\tfrac{1}{4} + \sqrt{20\tfrac{1}{2} - 8}}}$$

$$= \sqrt[3]{-4\tfrac{1}{2} + 3\tfrac{1}{2}} + \frac{2}{\sqrt[3]{-4\tfrac{1}{2} + 3\tfrac{1}{2}}} = \sqrt[3]{-1} + \frac{2}{\sqrt[3]{-1}}$$

$= -1 + \frac{2}{-1} = -1 - 2 = -3$, the required value of x.

But as a quadratic equation has been ſhewn to have two roots, or values, of the unknown quantity, ſo, in like manner, it may be proved that the unknown quantity, in a cubic equation, has three values or roots, each of which will be found to anſwer the conditions of the queſtion.

Thus, in the firſt equation $x^3 + 6x - 20 = 0$, given above, where x has been found $= 2$, or $x - 2 = 0$, if $x^3 + 6x - 20 = 0$ be divided by $x - 2$, we ſhall have $x^2 + 2x + 10 = 0$, or $x^2 + 2x = -10$, the roots of which equation, found according to the rule for quadratics, are $-1 + 3\sqrt{-1}$, and $-1 - 3\sqrt{-1}$, each of which, as well as the former root 2, are values of the unknown quantity, as will be found by ſubſtituting them for x in the given equation.

It muſt be obſerved, however, that neither the formula of Cardan, nor any other that has yet been diſcovered, will be found ſufficient to determine the numerical value of the unknown quantity in every cubic equation that can be propoſed; for when the coefficient of the ſecond term of the equation is negative, and the cube of $\frac{1}{3}$ of it is greater than the ſquare of half the abſolute term, the expreſſion for the root becomes imaginary; and therefore no intelligible reſult can be derived from it.

Thus, if the equation propoſed, were $x^3 - 3x = 1$, the analytical expreſſion, when converted into numbers, will become $x = \sqrt[3]{\tfrac{1}{2} + \sqrt{\tfrac{1}{4} - 1}} - \frac{1}{\sqrt[3]{\tfrac{1}{2} + \sqrt{\tfrac{1}{4} - 1}}} =$

$\sqrt[3]{\tfrac{1}{2} + \tfrac{1}{2}\sqrt{-3}} - \frac{1}{\sqrt[3]{\tfrac{1}{2} - \tfrac{1}{2}\sqrt{-3}}}$, the value of which cannot be determined either in integers, fractions, or rational ſurds; although, by ſubſtituting it for x in the given equation, the terms will all vaniſh as they ought; and conſequently, in a certain ſenſe, it may be ſaid to be a root of the equation.

This defective ſtate of Cardan's formula, or that in which it fails as a general rule, has commonly been called the *irreducible caſe of cubic equations*; and notwithſtanding the reiterated efforts of the moſt celebrated analiſts in Europe, from the time when the want of generality in the rule was firſt obſerved, to the preſent day, no remedy has been found for this defect, except by a method of ſolution which is derived from the triſection of an angle, or by converting the expreſſion into an infinite ſeries; in which latter caſe that part of the quantity which is imaginary diſappears, and by that means enables us to compute the root to any degree of exactneſs. For it is to be remarked, that although the unknown quantity cannot be determined from the formula itſelf, yet all the three roots are, in this caſe, real, and can be found, at leaſt approximately, by either of the two methods laſt-mentioned.

Leaving this part of the ſubject, for the preſent, we ſhall next proceed to *biquadratic equations*, or thoſe of the fourth power; any one of which, when the ſecond term is taken away, may be repreſented, in general terms, by $x^4 + ax^2 + bx + c = 0$; and the rule for the reſolution of any equation of this form, is as follows:

Find the value of y in the cubic equation $y^3 - \frac{a^2 + 12c}{3}y = b^2 + \frac{2a}{27}(a^2 - 36c)$, by the rule before given for this purpoſe; and let the root, thus determined, be denoted by v.

Then find each of the values of x in the two following quadratic equations,

$$x^2 + (\sqrt{v - \tfrac{2}{3}a})x = -[\tfrac{1}{2}a + \tfrac{1}{2}(v - \tfrac{2}{3}a)] + \frac{b}{2\sqrt{v - \tfrac{2}{3}a}}$$

$$x^2 - (\sqrt{v - \tfrac{2}{3}a})x = -[\tfrac{1}{2}a + \tfrac{1}{2}(v - \tfrac{2}{3}a)] - \frac{b}{2\sqrt{v - \tfrac{2}{3}a}}$$

And the values of x, thus found, will be the four roots of the biquadratic equation $x^4 + ax^2 + bx + c = 0$, as was required.

The rule, which is here given in a more commodious form than that of Des Cartes, may be readily demonſtrated, by making the given equation $x^4 + ax^2 + bx + c = 0$, equal to the product of two quadratic equations, and then equating the coefficients of the homologous terms. Thus, if $x^2 + px + q$ be multiplied by $x^2 - px + r$, and the product thence ariſing put $= 0$, we ſhall have $x^4 + (r + q - p^2)x^2 + p(r - q)x + rq = 0$.

Hence $r + q - p^2 = a$, $p(r - q) = b$, and $rq = c$; and conſequently $2r = a + p^2 + \frac{b}{p}$, and $2q = a + p^2 - \frac{b}{p}$.

And if theſe values be ſubſtituted in the equation $rq = c$, or its equal $4rq = 4c$, we ſhall obtain, after proper reduction, the equation $p^6 + 2ap^4 + (a^2 - 4c)p^2 = b^2$.

Or, by putting $p^2 = y - \frac{2}{3}a$, and ſubſtituting it in the latter equation, we ſhall have for the reſult the cubic equation $y^3 - \frac{a^2 + 12c}{3}y = b^2 + \frac{2a}{27}(a^2 - 36c)$, which is that given in the rule.

Hence, if the value, or root of y, in this equation, be put $= v$, we ſhall have, from the equations given above, $p = \sqrt{v - \tfrac{2}{3}a}$, $q = \tfrac{1}{2}a + \tfrac{1}{2}(v - \tfrac{2}{3}a) - \frac{b}{2\sqrt{v - \tfrac{2}{3}a}}$, and $r = \tfrac{1}{2}a + \tfrac{1}{2}(v - \tfrac{2}{3}a) + 2\sqrt{v - \tfrac{2}{3}a}$. And by

ſubſtituting

ſubſtituting theſe values in the two quadratic equations $x^2 + px + q = 0$, and $x^2 - px + r = 0$, they will become $x^2 + (\sqrt{v - \frac{2}{3}a})\, x = -\frac{1}{2}a - \frac{1}{2}(v - \frac{2}{3}a) + \frac{b}{2\sqrt{v - \frac{2}{3}a}}$, and $x^2 - (\sqrt{v - \frac{2}{3}a})\, x = -\frac{1}{2}a - \frac{1}{2}(v - \frac{2}{3}a) - \frac{b}{2\sqrt{v - \frac{2}{3}a}}$; the roots of which equations will be the 4 roots of the propoſed biquadratic equation $x^4 + ax^2 + bx + c = 0$. As a practical example for the exerciſe of this rule, let there be given $x^4 - 6x^2 - 16x + 21 = 0$, to find the 4 values of x.

Then, if the numbers -6, -16, and 21 be ſubſtituted in the place of a, b, c, in the cubic equation $y^3 - \frac{a^2 + 12c}{3} y = b^2 + \frac{2a}{27}(a^2 - 36c)$, it will become $y^3 - \frac{36 + 252}{3} y = 256 - \frac{12}{27}(36 - 756)$, or $y^3 - 96y = 576$, where the value of y, as determined by the preceding rule for cubic equations, will be found $= 12$.

Hence, if 12 be put for v, -6 for a, and -16 for b, in the two quadratic equations,

$$x^2 + (\sqrt{v - \tfrac{2}{3}a})\, x = -\tfrac{1}{2}a - \tfrac{1}{2}(v - \tfrac{2}{3}a) + \frac{b}{2\sqrt{v - \frac{2}{3}a}}$$

$$x^2 - (\sqrt{v - \tfrac{2}{3}a})\, x = -\tfrac{1}{2}a - \tfrac{1}{2}(v - \tfrac{2}{3}a) - \frac{b}{2\sqrt{v - \frac{2}{3}a}}$$

they will become,

$$x^2 + (\sqrt{12 + 4})\, x = 3 - 8 - 2 = -7$$
$$x^2 - (\sqrt{12 + 4})\, x = 3 - 8 + 2 = -3$$

Or,

$$x^2 + 4x + 7 = 0$$
$$x^2 - 4x + 3 = 0$$

In the firſt of which $x = -2 + \sqrt{-3}$, or, $-2 - \sqrt{-3}$. And in the ſecond, $x = 3$ or 1, which are the roots of the given equation $x^4 - 6x^2 - 16x + 21 = 0$; there being always as many values of the unknown quantity, in any equation, as there are units in the index of its higheſt power; as will be ſhewn in a ſucceeding part of this article.

But before we proceed to any enquiries of this kind it will be proper to obſerve, that no general rule has hitherto been found for reſolving equations of the 5th, 6th, or other higher orders, notwithſtanding the numerous attempts that have been made for this purpoſe; ſo that in this reſpect we have not been able to advance a ſingle ſtep beyond what had been done by Louis Ferrari, Bombelli, and others in the early part of the 17th century, who were all acquainted with the method of reſolving biquadratic equations; which is ſtill the boundary that the moſt ſkilful analiſts, aſſiſted by all the advantages of a more comprehenſive and commodious calculus, have not been able to paſs.

But although no general reſolution has hitherto been given of equations higher than thoſe of the 4th power, there are, notwithſtanding, ſome particular equations, of all orders, which, on account of certain relations ſubſiſting between the coefficients of their different terms, may be reſolved by the rules which have been given for thoſe of the firſt four orders.

This is particularly the caſe with what have been uſually called *reciprocal equations*, which are ſuch that the coefficients of the terms form the ſame numerical ſeries, whether taken in a direct or an inverted order; or that remain the ſame when the reciprocal of the unknown quantity, or $\frac{1}{x}$ is ſubſtituted for x.

Thus, for example, the equations $x^5 + px^4 + qx^3 + qx^2 + px + 1 = 0$, $x^4 + px^3 + qx^2 + px + 1 = 0$, &c. which are of this kind, may always be transformed into others of a degree denoted by half the exponent of the higheſt power of the unknown quantity, if it be an even number, or by half the exponent diminiſhed by 1, if it be an odd number.

Thus, let the laſt of the two equations given above, $x^4 + px^3 + qx^2 + px + 1 = 0$, be taken in the form $x^2 + \frac{1}{x^2} + p(x + \frac{1}{x}) + q = 0$, to which it can be readily reduced; then if $x + \frac{1}{x}$ be put $= z$, we ſhall have $x^2 + 2 + \frac{1}{x^2} = z^2$, or $x^2 + \frac{1}{x^2} = z^2 - 2$; and if this be ſubſtituted in the original equation $x^4 + px^3 + qx^2 + px + 1 = 0$, it will become $z^2 + pz = 2 - q$. And ſince $x + \frac{1}{x} = z$, we ſhall have $x^2 - zx + 1 = 0$. Hence, if the two roots of the equation $z^2 + pz = 2 - q$, be denoted by r and r', we ſhall have the two following equations $x^2 - rx + 1 = 0$, and $x^2 - r'x + 1 = 0$; the roots of which will be the four roots of the given biquadratic equation $x^4 + px^3 + qx^2 + px + 1 = 0$.

And in a ſimilar way may any other equation of this kind be reſolved, when the index of the greateſt power of the unknown quantity is an even number.

And if the index of the unknown quantity be an odd number, as in the equation $x^5 + px^4 + qx^3 + qx^2 + px + 1 = 0$, it is obvious from inſpection only, that -1 is a root of the equation; and, conſequently, if $x^5 + px^4 + qx^3 + qx^2 + px + 1 = 0$, be divided by $x + 1$, it will be reduced to the form $x^4 + (p - 1)x^3 - (p - q - 1)x^2 + (p - 1)x + 1 = 0$, which is another reciprocal equation, a degree lower than the former; and having the index of its higheſt power an even number, it is conſequently reſolvible in the manner above explained.

Alſo, when two or more roots of any equation are equal to each other, the equation may always be reduced to another of an inferior degree, and the roots, by that means, determined.

Thus, if the cubic equation $x^3 - px^2 + qx - r = 0$, has two equal roots, each of them will be $x = \frac{pq - 9r}{p^2 - 6q}$.

For, let the three roots be denoted by a, a and b; then by the compoſition of equations we ſhall have $x^3 - (2a + b)x^2 + (a^2 + 2ab)x - a^2 b = 0$; where $2a + b = p$, $a^2 + 2ab = q$, and $a^2 b = r$; and if theſe values be ſubſtituted in the above form, it will become $x = \frac{pq - 9r}{p^2 - 6q} = \frac{2a^3 + 4a^2 b + a^2 b + 2ab^2 - 9a^2 b}{8a^2 + 8ab + 2b^2 - 6a^2 - 12ab} = \frac{2a^3 - 4a^2 b + 2ab^2}{2a^2 - 4ab + 2b^2} = a$, as was to be ſhewn.

Thus, let the equation $x^3 + 5x^2 - 32x + 36 = 0$, which has two equal roots, be the one propoſed to be reſolved.

Then ſince $p = -5$, $q = -32$, and $r = -36$, if theſe values be ſubſtituted in the formulæ $x = \frac{pq - 9r}{p^2 - 6q}$, it will become $x = \frac{-5 \times -32 - 9 \times -36}{2 \times 25 - 6 \times -32} = \frac{160 + 324}{50 + 192} = \frac{484}{242} = 2$, which is one of the equal roots of the equation.

And

And in a ſimilar manner may the equal roots of equations of the higher orders be determined; but though the ſubject conſidered as a branch of analyſis is highly curious, and on that account has been far more completely and ſcientifically inveſtigated than in the caſe here given, its practical importance is too trifling to render any farther elucidation of it neceſſary, in an article ſo confined as the preſent. The ſame may alſo be ſaid of the method uſually given for determining the roots of an equation by means of the diviſors of its laſt term, and other ſimilar proceſſes, which are moſtly tentative, and only adapted to the finding ſuch roots of the equation as are rational, and for that reaſon readily diſcovered by a few trials.

It remains, therefore, only to ſhew how the roots of any numeral equation whatever may be determined by approximation; for which purpoſe, it will be ſufficient to give the rule firſt employed by Newton and Ralphſon, which, though attended with ſome defects, is as commodious, when conſidered as a general method of ready and eaſy application, as any one that has yet been propoſed. The rule is as follows.

Find, by trial, a number nearly equal to the root required, which call r; and let z be put equal to the difference between r and the true root x.

Then, inſtead of x in the given equation, ſubſtitute its equal $r \pm z$, and there will ariſe a new equation, affected only with z, and known quantities.

This done, reject all thoſe terms in which there are two or more dimenſions of z, and the value of z will then be found by means of a ſimple equation.

And if the value of z, thus found, be added to, or ſubtracted from, that of r, according as r was aſſumed too great or too little, it will give the root required *nearly*.

And if this root ſhould not be thought ſufficiently near the truth, the operation muſt be repeated, by ſubſtituting the laſt reſult inſtead of r, in the equation exhibiting the value of z; by which a ſecond correction of the root will be obtained more accurate than the former, and ſo on to any degree of exactneſs required.

As a practical example, for the illuſtration of the rule, let there be given the equation $x^3 + x^2 + x = 90$, to find the value of x by approximation.

Here it is ſoon found, by a few trials, that the root is ſomething greater than 4.

Let, therefore, $4 = r$, and $r + z = x$, then,

$$x^3 = r^3 + 3r^2z + 3rz^2 + z^3$$
$$x^2 = r^2 + 2rz + z^2$$
$$x = r + z$$

And conſequently by rejecting the terms $z^3 + 3rz^2 + z^2$, we ſhall have $r^3 + 3r^2 z + r^2 + 2rz + r + z = 90$;

$$\text{or, } z = \frac{90 - r^3 - r^2 - r}{3r^2 + 2r + 1} = \frac{90 - 64 - 16 - 4}{48 + 8 + 1} = \frac{6}{57} = .10,$$

and $x = 4 + .10 = 4.1$, nearly.

And again, if 4.1 be ſubſtituted in the place of r, in the laſt equation, we ſhall have.

$$z = \frac{90 - r^3 - r^2 - r}{3r^2 + 2r + 1} = \frac{90 - 68.921 - 16.81 - 4.1}{50.43 + 8.2 + 1} = \frac{78.121}{59.63}$$

$= .00283$; and $x = 4.1 + .00283 = 4.10283$.

And by proceeding in this manner, the root may be obtained to any degree of accuracy required.

The chief defect in this rule is, that it does not ſhew the progreſs made in the approximation at each operation, and that when the roots are ſmall and ſome of them nearly equal to each other, they may be paſſed over, by this method of operating, without their being perceived; both of which circumſtances have been particularly noticed by Lagrange, who has given an improved method of approximation in his excellent work on the "Réſolution des Equations Numériques," to which we muſt refer the reader, as being but little ſuſceptible of that kind of conciſe elucidation which neceſſarily belongs to an article like the preſent.

It, therefore, only remains to give ſome account of the general theory of equations; in which it will be firſt neceſſary to ſhew, that every equation, of any order whatever, has as many roots as there are units in the index of the higheſt power of the unknown quantity in that equation.

For this purpoſe, let us take the general equation $x^n + Px^{n-1} + Qx^{n-2} \ldots\ldots + Tx + U = 0$, to which all others can be readily reduced: then if a root of this equation be denoted by a, the firſt ſide of it will be diviſible by $x - a$.

For, ſince $x^n + Px^{n-1} + Qx^{n-2} \ldots + Tx + U = 0$:

And $a^n + Pa^{n-1} + Qa^{n-2} \ldots + Ta + U = 0$.

Therefore, by ſubſtraction, $(x^n - a^n) + P(x^{n-1} - a^{n-1}) + Q(x^{n-2} - a^{n-2}) \ldots T(x - a) = 0$.

But any expreſſion of the form $(x^n - a^n)$, where n denotes any whole poſitive number, is $= (x - a) \times (x^{n-1} + ax^{n-2} + a^2x^{n-3} \ldots a^{n-2}x + a^{n-1})$, as may be readily proved by multiplication. Whence, if the quantities $x^n - a^n$, $x^{n-1} - a^{n-1}$, $x^{n-2} - a^{n-2}$, &c. be each divided by $x - a$, we ſhall have

$$\begin{array}{rrrl}
x^{n-1} + a\,x^{n-2} & + a^2x^{n-3} & \ldots\ldots & + a^{n-1} \\
x^{n-2} & + a\,x^{n-3} & \ldots\ldots & + a^{n-2} \\
 & + \;\; x^{n-3} & \ldots\ldots & + a^{n-3} \\
 & & \ldots\ldots\ldots\ldots & \\
 & & & + 1
\end{array}$$

Or, if the ſame expreſſions be arranged according to the powers of x, they will become

$$\begin{array}{rrrl}
x^{n-1} + a\,x^{n-2} & + a^2x^{n-3} & \ldots\ldots & + \;\; a^{n-1} \\
+ Px^{n-2} & + Pa\,x^{n-1} & \ldots\ldots & + Pa^{n-2} \\
 & + Qx^{n-1} & \ldots\ldots & + Qa^{n-3} \\
 & \ldots\ldots\ldots\ldots & & \\
 & & & + T
\end{array}$$

Where, by putting $P' = a + P$, $Q' = a^2 + aP + Q$, &c. we ſhall have $x^n + Px^{n-1} + Qx^{n-2} \ldots + Tx + U = (x - a) \times (x^{n-1} + P'x^{n-2} + Q'x^{n-3}, \text{ \&c.}) = 0$.

And if b be ſuppoſed to be a root of the equation $x^{n-1} + P'x^{n-2} + Q'x^{n-3}$, &c. $= 0$, the former of theſe will become $x^n + Px^{n-1} + Qx^{n-2}$, &c. $= (x - a) \times (x - b) \times (x^{n-2} + P''x^{n-3} + Q''x^{n-4}, \text{ \&c.})$; which latter equation may be ſhewn to have a ſimilar factor, $x - c$; and by proceeding in the ſame manner, the original equation may be decompoſed into as many factors, $x - a$, $x - b$, $x - c$, $\ldots\ldots\ldots x - l$, as there are units in the exponent n of its higheſt term.

Hence, by conſidering equations as formed by the product of certain factors, $x - a$, $x - b$, $x - c$, &c. we are enabled to diſcover a number of relations which ſubſiſt between its roots and coefficients.

Thus ſuppoſing a, b, c, d to be the roots of the biquadratic equation $x^4 + px^3 + qx^2 + rx + s = 0$, if this be repeſented by its factors $(x - a) \times (x - b) \times (x - c) \times (x - d) = 0$, we ſhall have, by multiplying them together, $x^4 - (a + b + c + d)x^3 + (ab + ac + ad + bc + bd + cd)x^2 - (abc + abd + acd + bcd)x + abcd = 0$; and by proceeding in the ſame manner, a ſimilar reſult may be obtained for any equation whatever.

Hence, from the bare inſpection of this equation, the following conſequences are readily derived.

1. The coefficient of the ſecond term of any equation, taken with a contrary ſign, is equal to the ſum of all the roots of that equation.

2. The coefficient of the third term is equal to the ſum

ſum of the products of all the roots, multiplied together, two by two.

3. The coefficient of the fourth term, taken with a contrary ſign, is equal to the ſum of the products, of all the roots, multiplied together, three by three; and ſo on to the laſt term, which is equal to the product of all the roots with contrary ſigns.

From this it alſo follows, that in an equation wanting its ſecond term, there muſt be both poſitive and negative roots, and that the ſum of the former is equal to that of the latter.

And in the ſame way, a number of other properties of the various orders of equations may be derived, which will be found of great uſe, not only with reſpect to their reſolution, but as furniſhing the materials for a complete inveſtigation of this curious and intereſting branch of analyſis.

We ſhall only farther add, that beſides the ſimple factors into which any equation may be decompoſed, it may likewiſe be produced by multiplying together factors of any degree, provided the ſum of their dimenſions be equal to that of the propoſed equation.

For the application of the principles and rules, illuſtrated in the preceding article, to the ſolution of arithmetical, geometrical, and other queſtions and problems, we refer to Reduction of *Equations*, Application of *Algebra*, &c.

Equation, in *Aſtronomy*, is a term uſed to expreſs the correction, or quantity, to be added to or ſubtracted from the mean poſition of a heavenly body, to obtain the true; it alſo, in a more general ſenſe, implies the correction ariſing from any erroneous ſuppoſition whatever. *E. g.* The time of noon, determined by taking equal altitudes of the ſun, is firſt obtained by ſuppoſing the ſun's declination conſtant during the whole interval, which falſe ſuppoſition is corrected by an appropriate equation. Moſt of the principal equations will be found under their different articles, in the various tables to which they belong.

Equations, *Conſtruction of.* See Construction *of Equations*.

Equations, *Converſion of.* See Conversion *of Equations*.

Equations, *Abſolute, adfected* or *affected, differential, eminential, exponential, fluential, fluxional, literal, numeral*, and *tranſcendental*. See the adjectives.

Equation *of a Curve*, is an equation ſhewing the nature of a curve, by expreſſing the relation between any abſciſs and its correſponding ordinate, or elſe the relation of their fluxions, &c. Thus, the equation for the circle is $ax - x^2 = y^2$, where a is its diameter, x any abſciſs or part of that diameter, and y the ordinate at that part of the diameter; and the equation denotes, that whatever be the abſciſs expreſſed by x, the ſquare of its correſponding ordinate will be $ax - x^2$. Thus alſo the equation for the ellipſe is $\frac{p}{a} \times \overline{ax - x^2} = y^2$; for the hyperbola $\frac{p}{a} \times \overline{ax + x^2} = y^2$; and for the parabola $px = y^2$; in all which a is an axis, and p the parameter. This method of expreſſing the nature of curves by algebraical equations was firſt introduced by Des Cartes, who, by thus connecting together the two ſciences of algebra and geometry, made them naturally ſubſervient and auxiliary to each other, and thus laid the foundation of the moſt conſiderable improvements that have been made in every branch of them ſince that time. See Application of *Algebra*, &c. See alſo Curve.

Equation *of Payments*, in *Arithmetic*, is the method of reducing ſeveral debts payable at different times, and bearing no intereſt till after the term of payment of a ſingle debt or payment, to be diſcharged at once, without loſs either to debtor or creditor, allowing ſimple intereſt; or, it is the method of finding the equated term at which theſe ſeveral debts ſhould be paid in one ſum. Cocker, Hatton, Kerſey, ſir Samuel Moreland, and Ward, have given rules for this purpoſe, which Mr. Malcolm has examined and found to be erroneous; and though the error reſulting from any of the rules which they have propoſed is not very conſiderable, the following proceſs furniſhes one more accurate.

Let the debt firſt payable be called	d	The laſt payable debt	D
The diſtance of the term of payment	t	The diſtance of the term	T

The diſtance of the equated time x
The rate of intereſt, or 1 year's intereſt of 1*l.* r
The diſtance of the time t and x is $x - t$
The diſtance of the time T and x is $T - x$ } for x lies between them.

Then the intereſt of d for the time $x - t$ is $dr \times \overline{x - t}$, or $drx - drt$, dr being one year's intereſt of d; and $\frac{DTr - Drx}{1 + \overline{Tr - rx}}$ is the diſcount of D for the time $T - x$, becauſe $Tr - rx$ is the intereſt of 1*l.* for that time, which is conſequently the diſcount of $1 + Tr - rx$ for the ſame time; conſequently, from the nature of the queſtion, we ſhall have $drx - drt = \frac{DTr - Drx}{1 + Tr - rx}$; which being reduced, gives $\overline{T + t + \frac{D + d}{dr}} \times x - x^2 = \frac{DT + dt}{dr} + Tt$. Then make $T + t + \frac{D + d}{dr} = a$, and $\frac{DT + dt}{dr} + Tt = s$, and $ax - x^2 = s$; and reſolving this quadratic equation, $x = \frac{a}{2} \pm \sqrt{\frac{a}{4} - s}$.

E. gr. Suppoſe 100*l.* payable one year hence, and 105*l.* payable three years hence; what is the equated time, allowing ſimple intereſt at 5 *per cent. per annum?*

Here $\begin{matrix} d = 100 \\ t = 1 \end{matrix} \left\{ \begin{matrix} D = 105 \\ T = 3 \end{matrix} \right\}$ $r = .05$.

Then $D + d = 205$, $dr = 5$, and $\frac{D + d}{dr} = \frac{205}{5} = 41$.

And $T + t + \frac{D + d}{dr}$, or $a = 4 + 41 = 45$.

And s or $\frac{DT + dt}{dr} + Tt = \frac{315 + 100}{5} + 3 = 83 + 3 = 86$. Conſequently,

$x = \frac{45}{2} \pm \sqrt{\frac{2025}{4} - 86} = \frac{45}{2} \pm \sqrt{506.25 - 86} = 22.5 \pm \sqrt{420.25} = 22.5 \pm 20.5 = 43$ or 2: but 43 cannot be the true anſwer by the conditions of the queſtion, ſince it is greater than the diſtance of the laſt term in the queſtion; and therefore 2 is the anſwer required.

If there are more debts than two you muſt firſt find an equated time for the two that are firſt payable; then conſider their ſum as a debt payable at that equated time, and find another equated time for that debt and the next of the given debts, &c. See Malcolm's Arithm. book vi. § 5, or p. 616—621.

Equation *of the Centre.* This is the firſt and moſt conſiderable of all the equations that are applied to the mean motion of a planet. It ariſes immediately from the nature of the ellipſe. If the orbit of a planet was perfectly circular

circular it would have no equation of the centre; and a ſpherical body, revolving round a centre of force in an elliptic orbit, undiſturbed by the motion of other bodies, would require no other equation to correct its mean motion than the equation of the centre.

The neceſſity of applying this equation to the motion of the ſun, in its apparent orbit, was known to the early aſtronomers; for, in fact, no very accurate obſervations were neceſſary to ſhew that the ſun did not perform equal parts of its annual motion in equal portions of time. When, by means of gnomons, the length of the year and the obliquity of the ecliptic were pretty well eſtabliſhed, it muſt have been eaſy, with the ſame inſtrument, to have obſerved the declination of the ſun every day, and from thence to have computed its longitude. The firſt aſtronomers who undertook this examination muſt naturally have expected to find a regular increaſe in the ſun's longitude for every day in the year; but when they found that in the courſe of three months the obſerved longitude differed near two degrees from that which they had computed, it became then evident, that if the ſun's orbit was circular, and its motion uniform, at leaſt the earth was not placed in the centre of it.

This difference, which we now call the equation of the centre, was named by the ancient aſtronomers προσθαφαιρεσις, from προσθεσις, *addition*, and αφαιρεσις, *ſubtraction*, becauſe this equation is ſometimes additive and ſometimes ſubtractive, a name almoſt applicable to all equations, but applied to the equation of the orbit as the moſt conſiderable of all. Hipparchus was acquainted with this unequality in the motion of the ſun, which had not long been diſcovered before his time. He obſerved, that from the equinox of ſpring to the ſummer ſolſtice, there was an interval of $94\frac{1}{2}$ days, and from the ſolſtice to the next equinox $92\frac{1}{2}$ days; that is, two days leſs, notwithſtanding theſe points were equally 90° from each other. The motion of the ſun in two days is 1° 58′, which is nearly the quantity of the greateſt equation. To explain this difference, and to aſſign the exact proportion to every day in the year, the ancient aſtronomers either placed the earth out of the centre, at a ſufficient diſtance to produce the greateſt equation, or imagined an epicycle to revolve upon the circular orbit, on whoſe circumference the ſun was ſuppoſed to move. Theſe ſuppoſitions would give the ſun's longitude near enough the truth to ſatiſfy the imperfect obſervations of thoſe days, and when ſimilar unequalities were obſerved in the moon and planets, new cycles and epicyles were invented to explain them. But theſe contrivances, however ingenious, had very little pretenſion to be claſſed as theories or hypotheſes, capable of giving a ſatiſfactory explanation of the cauſes of theſe phenomena. An ingenious mechanic may make a clock, that ſhall repreſent all the inequalities of ſolar time, and by a proper application of ſome very ſimple principles in practical mechanics, we may repreſent the moſt complicated ſyſtem of motions; yet theſe machines would give us no inſtructions as to the original motions which they imitated; and in proportion as they became complicated, ſhould we be the leſs inclined to ſuppoſe any reſemblance between their mechaniſm, and that of the motions they repreſented.

Nevertheleſs, in the ſimple caſe that we are now conſidering, had obſervation accurately agreed with the ſuppoſition, there would have been no reaſon for not admitting it; it would have reſted on the ſame ground as Kepler's elliptic hypotheſis, before Newton had demonſtrated how obviouſly it is derived from one general law of nature.

For the method of calculating the greateſt equation of excentric orbits, we refer the reader to De la Lande's Aſtronomy, vol. ii.

We ſhall here only explain the nature of this equation in an orbit perfectly elliptical. The equation of the orbit of a planet is evidently nothing at the apſides; beginning to reckon from the aphelion it augments rapidly; as the true or real motion being there the ſloweſt, differs moſt from the mean motion, it continues to increaſe, but leſs and leſs rapidly, till the planet has arrived at ſome point about three ſigns, and ſomething more from the aphelion, at which point the true and mean motions are equal. At this time the equation is the greateſt, it begins then ſlowly to diminiſh, and the diminution becomes more and more rapid, as it approaches the perihelion, at which time the real motion exceeds the mean motion by the greateſt quantity. When it arrives at the aphelion the equation is again nothing. In the ſame manner it increaſes again to a maximum, and then diminiſhes till its return to the aphelion, where it is again nothing. The equation is ſubtractive in the firſt ſix ſigns from the mean motion, and additive in the others.

The greateſt equation may be derived directly from obſervation; or if the excentricity be known it may be computed, and at the ſame time the degree of anomaly in which it happens. For this purpoſe it is ſufficient to find the point M (*Plate* XII. *Aſtronomy*, *fig.* 107.) where the planet is at its mean diſtance. For it is evident, that the moment the planet arrives at the point where its angular velocity D F M is equal to its mean velocity, the mean longitude will ceaſe to gain upon the true longitude, but their difference will be a maximum; becauſe till that moment the real velocity, which was leaſt, had continually cauſed the mean velocity to accelerate upon the true, but from the moment they are equal, the real velocity begins to accelerate upon the mean, and to regain the quantity which it had before loſt: from this time the true and mean place approach each other, and the equation begins to diminiſh. Thus the problem conſiſts in finding the point M, and the true anomaly A F M of the planet, at the moment that its true velocity is equal to the mean angular velocity.

Take F M a mean proportional between the two ſemi-axes of the orbit. With the focus F as a centre, and diſtance F M, deſcribe a circle M N, which circle will have a ſurface equal to the ellipſe. Suppoſe a body to deſcribe uniformly this circle in the ſame time in which the planet deſcribes its ellipſe, its angular velocity will always be equal to the mean angular velocity of the planet in the ellipſe; and the area deſcribed in the circle will be always equal to the area deſcribed in the ellipſe, becauſe the planet always deſcribes equal areas in equal times. For example, if the planet deſcribes in one day an area D F R $=\frac{1}{365}$ th part of the elliptic ſurface, the area E F O, deſcribed in the circle, will likewiſe be the $\frac{1}{365}$th part of the area of the circle; and the real velocity of the planet, or the angle D F R, will be equal to the mean velocity in M, that is, to the angle E F O; for there are two equal ſectors having the ſame length E M, the ſame ſurface, and conſequently the ſame angle. Beſides the equal triangles M E D, M R O, which are the one without, and the other within the circle, ſhew that the elliptic ſector is preciſely equal to the circular ſector, that has the ſame angle in F. Therefore to find the point of the mean velocity, we muſt find at what degree the interſection of the ellipſe correſponds with the circle equal to it in ſurface. From the point M let the ſtraight line M B be drawn to the other focus of the ellipſe, then in the triangle B E M three ſides will be known; namely, B F, which is the double of the excentricity, F M, which is the mean proportional between the two ſemi-axes, and B M, which is the difference between

4 FM,

F M, and the greater axis, becauſe the two lines E M and M B are together equal to the greater axis. By reſolving this triangle the angle F may be found, which will be the true anomaly of the planet, at the time of its greateſt equation.

In the caſe of the greateſt equation, the reſolution of the above triangle gives the following rule. From the aphelion diſtance take ſeparately the mean proportional of the two ſemi-axes, and the third ſide B M (difference between the greater axis and the mean). Take the logarithms of theſe differences, and ſubtract the leaſt from the greateſt; from this difference take the difference of the logarithms of the aphelion and perihelion diſtances; the half of the remainder is the logarithmic tangent of half the true anomaly. By the method of coſines take the logarithms of the aphelion diſtance, and of the difference of the ſide B M; add the complements of the logarithms of B E and F M, the half of the ſum is the logarithmic coſine of half the true anomaly. If the angle is ſmall, this method of the coſines is leſs exact; but when the angle is large, it is preferable to the other, being ſomewhat ſhorter.

Having thus deſcribed the method of calculating the greateſt equation, we have now to conſider the manner of obſerving it.

From the inſtant a planet departs from its aphelion A, to the time it arrives at the point M of its greateſt equation, its real velocity is leſs than its mean velocity; therefore, the true anomaly is leſs than the mean anomaly, and differs from it more and more. When the planet has paſſed the point P, or its perihelion, and arrives at the point G, having about nine ſigns of anomaly, its true diſtance A F G from the aphelion is in the ſame manner leſs than its mean diſtance, by a quantity equal to the greateſt equation. If we obſerve two true longitudes of the planet in G and M, they will differ from each other by the angle G F M, which is the ſum of two true anomalies: but the ſum of two mean anomalies will be greater by the double of the equation, ſince each true diſtance is leſs than the mean diſtance by the whole of the equation. It is eaſy to calculate the ſum of two mean anomalies without knowing the place of the aphelion A, becauſe the ſum of two mean anomalies is equal to the mean motion of the planet for this interval of time, which is found by taking its proportion of the whole revolution: thus, the exceſs of the mean motion, calculated over the true diſtance obſerved, will be double the greateſt equation, provided the two obſervations are made in M and G, the times that the mean velocities equal the true. It will, on the contrary, be the true or obſerved motion that will exceed the mean, if the obſervations are taken on each ſide the perihelion. To determine the time and the obſervations moſt ſuitable to this inveſtigation, an obſerver, who ſhould be ſuppoſed to have no previous knowledge of the ſituation of the orbit, muſt begin by collecting a great number of obſerved poſitions, and compare them two and two together, and obſerve how much the obſerved motion differs from the mean for each interval: in this manner the greateſt of the obſerved diſtances will be found double the greateſt equation; but if this compariſon is made with a ſingle obſervation, then the greateſt difference additive and the greateſt ſubtractive, added together, will give double the equation. But ſince at preſent we know very nearly the place of the apſides, and of the mean diſtances of all the planets, we can immediately ſelect the obſervations that are made about the time of the greateſt equation.

Example.—The 7th October, 1751, the place of the ſun obſerved by La Caille, was, after three ſucceſſive obſervations - - - - and the 28th March, 1752:

vations - - - -	6	13	47′	13″.7
And the 28th March, 1752 - -	0	8	9	25.5
The difference is - - -	5	24	22	11.8
The mean motion calculated for this interval is - - - - -	5	20	31	43.2
Difference, or double the equation -	0	3	50	28.6
The half is the equation required -	0	1	55	14.3

This would be exactly the greateſt equation, if the obſervations had been made exactly at the moment of the greateſt equation; but having calculated by the tables theſe equations, it was found that 18″.6 muſt be added to have the greateſt equation, which will make the above quantity $1^\circ\ 55'\ 33''$.

With reſpect to this 18″.6 it may be remarked, that an error of ſeveral minutes in the equation of the tables would have produced no ſenſible alteration in this correction, as the error would be the ſame for the given day as for the greateſt of all which happened extremely near it.

As it is extremely rare to meet with two obſervations which are preciſely ſituated in the two points M and G of the mean time, ſo it is not eaſy to find by the firſt calculation the exact value of the equation; but after having found it very nearly, and likewiſe the place of the apſide, the equation may be calculated for the times of obſervation, and likewiſe the greateſt equation; by the method explained above, it may be then ſeen how much the equation derived from the obſervations ſhould differ from the greateſt. It was by this means that La Caille, in the preceding example, found the above correction 18″.6. The greateſt equation of the ſun is that which may be obſerved the moſt frequently, and with the greateſt eaſe. A perſon ſtudying aſtronomy, and deſirous of making himſelf converſant with the methods by which all theſe elements of the planetary motions have been obtained, may deduce them himſelf from the Nautical Almanac, or other ſimilar publications; he may regard the longitudes and latitudes of the planets there found as ſo many obſervations, and by computing from them, the original elements ſhould be found, from which the tables themſelves were calculated. If the minutes and ſeconds be omitted, or the neareſt half or quarter of a degree only taken, they will repreſent the obſervations of the early aſtronomers, and it will then be ſeen what very imperfect theories were ſufficient to explain ſuch inaccurate obſervations.

Theſe methods of finding the greateſt equation cannot be applied to Mercury, as we never can obſerve its heliocentric longitude but when on the ſun's diſc. Its elongation, and that of Venus, is found by obſerving the greateſt digreſſion when the planet is in the apſides. For a farther account of this method conſult De la Lande's Aſtronomy.

Caſſini employed the tranſits of Mercury obſerved in 1661, 1690, and 1697, and found the greateſt equation $24^\circ\ 3'$. De la Lande, from the tranſits of 1740, 1743, and 1753, found $23^\circ\ 27'\ 51'$. But theſe obſervations are not well ſuited, as the three points of the orbit are not diſpoſed at diſtances ſufficiently great. The equation of the centre does not remain for ever the ſame; by compariſon with ancient obſervations the equation of the earth's orbit appears to have undergone a diminution, and the theory of attraction explains the cauſe, and aſſigned the quantity more correctly than can be obtained by obſervation. La Place makes the diminution for the earth's orbit $0^\circ.0058$ decimals in a century;

tury; this phenomenon fuppofes a correfponding diminution in the excentricity, for if the excentricity was nothing, the equation would be nothing. The correfponding diminution of the excentricity is 0.000045553, the femi-axis major being taken as unity.

This is nearly equal to 1548 French leagues in a century, or 40 Englifh miles in a year. Thus, fractions which appear infenfible in the heavens, become confiderable when compared with our known meafures. If this diminution was always progreffive, the folar ellipfe would in time be changed into the circumference of a circle, and in the end, the excentricity decreafing always, the earth, after a great number of ages, would fall into the fun; but the theory of attraction indicates that the variation in the equation of the orbit and excentricity are periodic, and that after having diminifhed for a certain period, they will again increafe and take the fame values they had before, and will thus ofcillate within narrow limits; but the periods of thefe ofcillations are ftill unknown, and thus the fyftem might be eternally maintained, except fome exterior and unknown caufe fhall come to change the fyftem of the world, and new-modify its laws.

TABLE of the greateft Equation of the Centre according to different Aftronomers.

	Bouillaud, 1645.	La Hire, 1702.	Halley, 1719.	Caffini, 1740.	La Lande, 1750.	Annual Variation.
Mercury - - -	24° 17′ 20″	24° 16′ 52″	23° 42′ 36″	24° 2′ 58″	23° 40′ 0″	+ 0″.02
Venus - - -	0 54 36	0 50 0	0 48 0	0 49 6	0 47 20	− 0.25
The Sun - -	2 2 41	1 55 42	1 56 20	1 55 51	1 55 36.5	+ 0.188
Mars - - -	10 36 12	10 40 40	10 40 2	10 39 19	10 40 40	+ 0.37
Jupiter - - -	5 34 0	5 36 54	5 31 36	5 31 17	5 30 38.3	+ 0.5536
Saturn - - -	6 37 10	6 30 00	6 32 4	6 31 40	6 26 42	− 1.1.1
Herfchel - - -					5 27 16	− 0.11

EQUATION, *Secular, of the Mean Motion of the Moon.* The motion of the moon, and its elements, do not remain conftant, but undergo progreffive alterations, which would foon render the tables inaccurate, if we were obliged to improve merely by comparifon with recent obfervations. The only method of avoiding this inconvenience is to calculate the elements of the lunar motion for different periods very remote from each other, to deduce the variations they have undergone, and then to inveftigate the laws proper to reprefent them.

We may apply thefe confiderations to the mean and fecular motion of the moon, which has been determined with great exactnefs by modern obfervations, and which ferves as a bafis for all the other refults, and compare it with ancient obfervations, to fee if it is the fame, or if it has materially changed. The method of making this comparifon confifts in confidering the ancient obfervations of the moon as fo many obferved longitudes; the place of the moon is then calculated by the tables for this diftant epoch, and the refult compared with the obfervation.

The moft ancient eclipfe upon record may be taken as an example. It was obferved by the Chaldeans 721 years before the Chriftian era, and recorded by Ptolemy. The obfervation was made at Babylon the 19th March: the moon began to be eclipfed about an hour after its rifing. At the middle of the eclipfe the longitude of the moon was equal to that of the fun; this latter is eafy to calculate by the folar tables; thus the longitude of the moon is given at the period of the eclipfe. Now, if the place of the moon be calculated by the tables for this epoch, it will be found lefs advanced in its orbit, than it muft have been by the obfervation: the difference is about one degree and a half; and as this is too great an error to be attributed to the inaccuracy of the tables, we muft conclude that the motion of the moon is now accelerated: fo that in referring it to a diftant period, we throw it too far back in its orbit, which diminifhes its longitude.

And this refult acquires additional confirmation, by making fimilar comparifons with obfervations made at intermediate periods; for if the motion of the moon is really accelerated, we fhould ftill find the longitude calculated by the tables too fmall, though the error fhould be lefs as the interval is fmaller; and this appears to be the cafe by a fimilar comparifon with an eclipfe obferved at Cairo by Ibn-junis, an Arabian aftronomer of the 10th century.

This coincidence leaves no doubt as to the reality of the phenomenon; and it appears certain, that the motion of the moon has accelerated from the time of the Chaldeans to the Arabians, and from that time to the prefent. To reprefent this acceleration, a third term, proportional to the time, muft be added to the fecular motion of the moon, and another leffer term proportional to the cube; this, together, is what is called the fecular equation of the moon. According to La Place, (Mecanique celefte, vol. iii. p. 273.) if n be the number of centuries elapfed fince 1750, the formula for the correction will be $31''.424757\, n^2 + 0''.05721742\, n^3$. Thefe feconds are according to the decimal divifion.

But we are not to infer that this acceleration will always be increafing, or that the preceding formula will always reprefent it; the theory of attraction, in making known the caufe, has fhewn that it is periodic, and connected with the variations of the excentricity of the terreftrial orbit. See EXCENTRICITY, and EQUATION *of the Centre.*

This acceleration, after increafing to a certain limit, will be changed into a retardation, but the extent of this period is very confiderable; and the interval, which feparates us from the moft ancient obfervations, has yet only developed an extremely fmall part of this revolution. The inequalities which will refult in the motion of the moon will amount at leaft to a 40th part of the circumference of her orbit. Pofterity, who will obferve thefe great phenomena, may remark, and not without gratitude, that the geometricians of the prefent age have forefeen, calculated, and prepared for their fucceffors the means of judging of the paft and future ftate of the fyftem of the world, with the fame certainty as in the age in which they lived.

It was the celebrated Dr. Halley who firft difcovered the effects of this acceleration; and La Place, by a moft profound

found analyſis, has explained both the cauſe and the law. The obſerver and the geometrician are each entitled to admiration. If the reſult of the latter is more ſatisfactory and uſeful to ſcience, it muſt be confeſſed, that it was a proof of no ſmall ſagacity in the former to be the firſt to doubt of the uniformity of the mean motions which had been admitted as an eſtabliſhed principle for above two thouſand years.

Equations, *Secular, which affect the Elements of the Orbit of the Moon.* The motion of the lunar perigee is not uniform, but ſubject to a ſecular equation analogous to that of the mean motion, and depending on the ſame cauſe. The compariſon of ancient obſervations with the modern leaves no doubt of this fact; but it is to the theory of attraction that we are indebted for the diſcovery. This equation is equal to that of the mean motion, multiplied by the coefficient — 3.00052, that is to ſay, that if k repreſent the ſecular equation of the mean motion, the term — 3.00052 k muſt be added to the mean longitude of the perigee, calculated from the duration of a tropical revolution. Mec. celeſte, vol. iii. p. 247.

The motion of the nodes is likewiſe ſubject to a ſimilar inequality, and the equation has the ſame ſign as that of the perigee, it is equal to the equation of the mean motion multiplied by — 0.735452, that is, to the mean longitude of the node add — 0.735452 k. Theſe reſults are confirmed by obſervation.

It appears from this, that the ſecular equation diminiſhes the longitude of the perigee and of the nodes when it augments the mean motion of the node, and reciprocally; hence the motion of the perigee and of the nodes becomes ſlower, when that of the moon is accelerated, and on the contrary is accelerated when that of the moon is retarded. Moreover, theſe inequalities are connected together by very ſimple analogies, ſince they are repreſented by the numbers 1; 3.00052; — 0.735452.

The anomaliſtic revolution, depending at the ſame time on the motion of the moon and of the perigee, is likewiſe modified by the ſecular variation. It is the ſame with all the quantities which depend on the apogee, and on the nodes.

The theory of attraction indicates, that the diſtance of the moon from the earth, the excentricity, and the inclination to the orbit, are equally ſubject to ſecular equations, which are connected with that of the mean motion. But hitherto their effect is ſcarcely perceptible; nevertheleſs, in the courſe of ages, it will become neceſſary to attend to them, and they have been calculated in advance. The expreſſion for the greater axis of the orbit contains no inequality of this kind. This likewiſe is the reſult of theory. The cauſe of all theſe extremely curious facts has been explained by La Place, who was led to them by the diſcovery of the original cauſe which produced the ſecular equation of the moon. For the ſecular equations of the other celeſtial bodies, ſee their reſpective names, and Secular.

Equation-*Clock*, in *Horology*, is a clock contrived ſo as to indicate both *mean* and *equated* ſolar time, and conſequently their difference, which at any inſtant is the *equation of time.* Various contrivances have been invented to anſwer this purpoſe by ingenious men, who at one time were ſeized with a rage for inventing ſuch uſeleſs appendages of the clock, but the dictatorial power of faſhion has nearly baniſhed ſuch ſuperfluities, that are now conſidered as mere matters of curioſity. For a deſcription of a clock of this ſort by Enderlin, ſee our article Clock, and *Plate* XXIV. of *Horology.*

Equation-*Mechaniſm*, in a planetarium or orrery, is a mechanical contrivance for repreſenting the alternate accelerations and retardations of motion in the requiſite parts of the reſpective orbits of the different planets, which contrivance has been variouſly effected by different ingenious men. If the motions of the heavenly bodies had been in concentric circles, and perfectly equable in every point of their orbits, the conſtruction of a common planetarium would have been well calculated to exhibit all the phenomena in a natural and exact manner, provided the trains of wheelwork were accurately calculated for the reſpective periods, and the length of the arms proportional to the reſpective diſtances; but as all the planets that have conſiderable excentricity, and conſequently conſiderable equations of the centre alternately *plus* and *minus*, have their motions conſtantly varying in angular velocity, a common planetarium, without equation-mechaniſm, is a very imperfect machine, and by no means competent to ſolve any of the phenomena, in a particular way, that depend on the relative velocities; for when the heliocentric motions are improperly repreſented, the geocentric appearances depending on them are deranged, and no dependance can be placed in the *times* pointed out of the apparent conjunctions, oppoſitions, ſtations, retrogradations, longitude, or latitude of any of the heavenly bodies. For inſtance Mercury, which planet performs its period through the ecliptic in ſomewhat leſs than 88 days, inſtead of continuing 44 days in each half of its orbit, at oppoſite ſides of the conjugate axis, as it does reſpectively in thoſe at each ſide of the tranſverſe axis, continues about $55\frac{1}{2}$ days in the aphelion portion, and only $32\frac{1}{2}$ in the perihelion portion, ſo that the times of conjunction with the earth or other planet, even allowing the motion of that planet to be equable, would from this cauſe alone become very irregular, exceeding or falling ſhort of the mean ſynodic period by many days, according to circumſtances. It is evident, therefore, that the variations of velocity depending on the equation of the centre of both orbits of two planets, one received from the other, require to be taken into conſideration, and allowed for in the conſtruction of any mechaniſm that profeſſes to be accurate in the repreſentation of planetary motion.

Contrivances by Mr. Huygens.—The earlieſt attempt that we have met with, to produce the requiſite inequalities of planetary motion by mechaniſm, is that of Mr. Huygens, the Dutch mathematician and philoſopher, which he has deſcribed in his Latin treatiſe on the conſtruction of his *Automaton*, or ſelf-moving planetarium; he has availed himſelf of two different applications of the ſame principle, that are reſpectively applicable to different degrees of inequality of motion, that the excentricity of an orbit may require; his account and demonſtration of both which methods we ſhall give in a free tranſlation from his own words, which will probably be intereſting to thoſe who cannot read the original, particularly as there has been no notice taken of them by any writer, or inſtrument-maker, except perhaps Rowley, during the laſt century.

"It remains now," ſays our very ingenious author, "that we explain how the true anomalies may be repreſented by wheelwork; for this purpoſe let A N P, *fig.* 1. of *Plate* III. of *Planetary Machines*, be the orbit of a planet, the centre of which is C with the ſun at S, and let the point E be taken any where in the line S C, ſo that the excentricity S C may be to the radius C A, as C E is to E D; with which radius and centre E let the circle D M be deſcribed. Now let it be underſtood, that upon the centre of the circle A L there be fixed immoveably the contrate wheel D M with equal teeth, which therefore will neceſſarily revolve round the point C as a centre; let it be alſo ſuppoſed that the arbor of the long pinion K H be directed to C, and turned equally with its teeth adapted to thoſe of the wheel D M, which will agree ſufficiently, although on account of the excentricity of this wheel it will not always have the pinion at right angles; by this motion, I ſay, a planet will be be carried unequably in its orbit, and in ſuch a manner that its motion will very nearly correſpond to Kepler's hypotheſis, For having taken in the circle D M, deſcribed from the point E, any arc D O, let the teeth of that arc paſs over to the line C D by turning the pinion K H, and the line C O will coincide with the line C A D, but not ſo that the point O may fall on the point D, but within at R, becauſe C D, which is equal to both C E and E O, is greater than C O : now whatever may be the angle O C D, ſuch will be that over which the line C A D has moved round the centre C; therefore if we make the angle D C T equal to the angle D C O, C T will be the right line into which C A D will have advanced, ſo that the planet will have proceeded from A to the point N, where the right line C T cuts the circumference of the circle A N deſcribed from the centre C. But the circle D M, having its centre E advanced to F by making F T equal to E D, will have the ſame ſituation as the circle T R : and it appears that on account of the equality of the angles O C D and D C T, the arc D M, which the right line C T cuts in the circumference of O D M, is equal to the arc D O; ſo that M and E being joined, the angle M E D will be equal to D E O. If, therefore, the arc A L be made to contain as many degrees as the arc D M, and C F be joined, this line will be parallel to E M.

"In the triangles C E M and S E L, therefore, the angles L C S and M E C will be equal, and the ſubtending ſides proportional; for by conſtruction S C is to C L, as C E is to E M, C L being equal to C A, and E M to E D. Alſo the angles M C E and L S C are equal, and conſequently the lines C M and S L are parallel.

"Now by this rotation of the circles D M and A L, the planet placed in A will be moved through the circle A L, very nearly according to Kepler's hypotheſis, as may be thus ſhewn. Let the planet be ſuppoſed to have moved from A to N, the ſpace or area N S A will be equal to its mean anomaly; but ſeeing the lines S L and C N are parallel, the triangles N S C and C L N will be equal, at leaſt their difference will be inſenſible; the ſpace or area, therefore, C L A, and conſequently the arc A L, will anſwer to the mean anomaly when the planet has advanced from A to N. If, however, we make A Q P the elliptic orbit of Kepler, the planet will be in Q, where the perpendicular N Q falling on A P cuts the ellipſe A Q P, and not in N; but the ellipſes are ſo like circles, that the variation in a machine is imperceptible, N will, therefore, be the true place of the planet correſponding to the mean motion A L, which arc is equal to D O or D M.

"Again, if the pinion be placed in any other point, as at G, equally diſtant from the centre C, to which the arbor is directed, and the point D, which is the moſt diſtant from the centre C, in the wheel O D M, be placed under the pinion, the planet being again at its aphelion A, it appears that the ſame angles are formed round the centre C by an equable motion of the pinion placed in G as in D. Wherefore in whatever ſituation the pinion be placed, the motion of the planet will be unequable, notwithſtanding the teeth of the wheel D M are made equal among themſelves, provided the pinion that points to the centre C have its teeth made long enough to act with all the teeth of the wheel which come ſucceſſively to it at different diſtances from the centre C, and provided that the planet be put to its aphelion point of its orbit, when the longeſt line, or radius, drawn from C to D M, is in contact with the pinion.

"But ſince in our machine (automaton) all the pinions are placed on one common arbor, it cannot be placed properly towards the centres of more than two planets; we muſt, therefore, conſider how the ſame effect can be produced by *unequal teeth:* for this end let us ſuppoſe the circle D M divided into the equal parts D *a*, *a b*, *b* M, and M *g*, and right lines be drawn to them from the point C, theſe lines C *a*, C *b*, C M, C *g*, will divide A N L, the orbit of the planet, into the unequal parts A *d*, *de*, *e* N, N *f*. By this method as many unequal teeth may be determined in the circle A N L, as there are equal ones in the circle D M. If now the pinion be applied to theſe teeth, cut into the ſame number as in the former caſe, they will work together pretty well, though ſome are too large and others too ſmall for the pinion, and the wheel A N will move unequably as the wheel D M did before, which has been proved to be according to the hypotheſis of Kepler."

This is a faithful tranſlation of Mr. Huygens' account and demonſtration of his two methods of repreſenting the irregularities of a planet's motion in its orbit, concerning which we have to obſerve, that, though both of them manifeſt great ingenuity as to the originality of the projects, yet they fall ſhort of producing ſeparately that full effect which he attributes to them, and which he ſeems to have credited; whereas the truth is, that inſtead of effecting the *whole* equation of the centre, the methods juſt deſcribed effect each only *one half* thereof; for agreeably to Kepler's theory, which ſuppoſes equal areas in equal times, biſhop Ward has proved that *double the excentricity* of a planet's orbit ſubtends very nearly its greateſt equation, and that, according to his elliptic hypotheſis, which is an excellent approximation to the truth, if the angular velocity of a planet round one focus of the ellipſe be uniformly equable, its angular velocity, as ſeen from the other focus, will be ſo unequable, that one will repreſent the mean and the other the true or equated anomaly very nearly; but the diſtance between the two foci of any ellipſe is its excentricity laid off both ways from the centre, or *doubled;* whereas the method of Mr. Huygens' propoſes the excentricity to be taken only *once*, ſo that he has demonſtrated rightly enough, but from wrong data; for if he had made the diſtance C E equal to double the excentricity, then the whole of the equation would have been very nearly repreſented. The demonſtration which Mr. Olinthus Gregory of Woolwich, then of Cambridge, has given in the 2d vol. of Mr. Nicholſon's Philoſophical Journal of the 8vo. ſeries, to which we beg leave to refer, has proved with great perſpicuity what the Rev. W. Pearſon of Parſon's Green had before aſſerted, that "the excentricity of any planet's orbit is very nearly equal to the ſine of one half only of its greateſt equation." It may be conſidered as a ſingular circumſtance that a man of Mr. Huygens' genius and mathematical ſkill, whoſe whole life was devoted to the ſciences, ſhould not diſcover that the methods which he ſo ingeniouſly deviſed to exhibit a planet's equated motion, produced but one half of the grand equation; and equally ſingular, perhaps, may it be conſidered, that no one before the writer of this article has detected the deficiency. When both theſe methods of conſtructing a planetary wheel are *united*, the full effect will be produced; or either of them may be united with any other contrivance that produces only one half the equation.

Mr. Roemer's Contrivance.—The next contrivance that we have met with, for repreſenting planetary motion, is that of Roemer, who was mathematician to the king of France in the time of Mr. Huygens; this contrivance is detailed in Mr. Nicholſon's Journal, vol. 4. of the 4to. ſeries, by a correſpondent, who tranſlated his account from the French of "Machines and Inventions approved by the Royal Academy of Sciences for 1699," and who, in our opinion, ſpeaks better of it than it deſerves. The plan propoſed might anſwer for one planet only, but is not applicable to a number of planets at the ſame time, for the planetary wheel propoſed is is intended to be fo thick as to conftitute the fruftum of a cone, on the furface of which a diagonal elliptical line is to be drawn round it, from the fmaller to the larger diameter and back again, in which line the teeth are to be formed, after they have been laid down by a pair of dividers from a diagram previoufly made ; fo that, fetting afide the tedioufnefs of making fuch a wheel by the mechanical manipulation defcribed ; there could not be a number of thefe wheels brought into action by any of the ufual arrangements of wheelwork, feeing the pinions that are to act with them muft neceffarily be conical alfo, and be the drivers in every cafe, which the requifite calculations of the trains in planetary machines will not always admit, where the extreme ratios of relative velocity are fo widely different from each other. This plan, therefore, of exhibiting unequable motion in a planetarium, or orrery, muft be confidered among thofe projects of ingenuity which are more plaufible in theory than ferviceable in practice, and no doubt was abandoned for the reafons that have been here ftated ; which are our reafons for paffing over it without further notice.

Dr. Defaguliers' Contrivance.—The next mechanifm in the order of time, as far as we know, was Dr. Defaguliers' elliptic pulleys, or oval wheels with grooves at the circumference, and an endlefs cat-gut furrounding them, as defcribed under our article COMETARIUM. This was certainly a fcientific contrivance, and admits of application where the excentricity of the orbit is great ; for the excentricity and fhape of the pulleys may be made exactly fimilar to the excentricity and fhape of the orbit to be reprefented. The principal objection to the adoption of this invention in a planetarium, is the liability of the catgut to contract and elongate with the variations of moifture in a room, and confequently to be fometimes too tight for the pulleys, and fometimes too loofe, fo as not to perform their office of giving motion to the elliptic plates. We have feen the elliptic plates with their edges cut into teeth, which is a great improvement in the contrivance ; and where the excentricity is not very great, a pair of excentric circular wheels will act together very well, to anfwer the fame purpofe, as we fhall have occafion to fhew prefently.

Mr. Adam Walker's Contrivance.—Another method of exhibiting planetary motion we have witneffed in the philofophical lectures of Mr. Walker, fenior, which, if we recollect perfectly, was effected thus : A wooden board was fhapen nearly into the form of an epicycloid, and had equal teeth cut on its circumference by hand, with an arm fixed faft to one of its extremities, that carried the ftem of a planet, or of a ball to reprefent a planet ; then a pinion was fixed on the furface of an inclined plane, down which the epicycloidal wheel was fuffered to flide by its own weight, in a detached ftate, till its teeth came in action with the teeth of the pinion ; and a motion given to the pinion by a handle, made the wheel, thus circumftanced, to revolve with unequal velocities, accordingly as its central point was near to, or removed from, the pinion, during its revolution in this fliding ftate ; thus were not only the accelerations and retardations of motion alternately exhibited, but alfo the variations of diftance, as they regarded the fun's ball fixed in the focus of an elliptical board, placed over this mechanifm, and divided into twelve triangular areas, fo that the planetary body was feen to move through the twelve fectors, coloured alternately white and black, in a manner correfponding to the fame number of revolutions of the pinion ; and to perform apparently equal areas in equal times. It is hardly neceffary to obferve on this contrivance, that, however convenient it might be to illuftrate in a general way the nature of planetary motion to an audience, it is obvious that detached wheels acting thus at liberty cannot be introduced into any machine that gives motion to a fyftem of bodies, where their apfides crofs one another in various directions, and would require as many inclined planes as there are planets to be reprefented ; likewife the planetary arms would require to be attached to *wheels* in every inftance, though the calculations of the ratios of velocity might, and, according to the general conftructions, would require in fome inftances *pinions* to be the laft movers ; all which difficulties in practice are infurmountable. The *fhape* of the planetary wheel, we have underftood, was not determined geometrically, nor yet by calculation, but by a repetition of manual rectifications of the figure till it was found to correfpond with the areas previoufly delineated.

Mr. Jofeph Prieftley's Contrivance.—When Dr. Birbeck was appointed profeffor to fucceed the late Dr. Garnet, at Anderfon's Univerfity in Glafgow, his friend, Mr. Jofeph Prieftley of Bradford, contrived an orrery, which was made for him by a watch-maker at Halifax, of the name of Thomas Lifter, which orrery the doctor has lately brought with him to London, on quitting the faid profefforfhip. It was finifhed in the year 1801, and will be defcribed in its proper place with the other planetary machines. The inequalities of motion in this machine are produced by two feparate methods ; the two fuperior planets Saturn and Jupiter have their equations effected by inequalities made in the teeth of the laft moving wheels ; but the others have their equations, with the exception of the earth, produced by a contrivance which is at the fame time novel, fimple, and accurate enough for mechanical reprefentation. The inventor has been kind enough to comply with our requeft of his giving us an account of his mode of producing unequable motion by mechanifm, which account we fhall prefent to our readers in his own words. The figure to which he refers, is *fig.* 2. of *Plate* III. of *Planetary Machines*.

Let A P B, fays Mr. Prieftley, be the orbit of the planet, O its centre, and S and F the two foci ; in the former of which the fun is fuppofed to be placed. On the other focus F, as a centre, defcribe a circle D E p.

Let P be any given place of the planet in its orbit ; draw Fp, cutting the circle D Ep in p. Now, agreeably to the hypothefis of Ward, it will be,

As the periodical time of the planet,
Is to the time of its paffing from A to P ;
So is 360 degrees,
To the angle E Fp.

Hence, if a point p be made to revolve equably in the circle D E p, defcribed on the lower focus F of the orbit, performing one revolution in the periodical time of the planet ; and if, at any given time, the point be found at p, then a line drawn from the focus F through p, will cut the orbit of the planet in P, its place at the fame time.

There are different ways of adopting this hypothefis in machinery. The firft I fhall mention, will immediately occur to any one viewing the figure. Let a wire, fomething longer than F B, be made to revolve equably round F, in the time reprefenting one revolution of the planet. On this wire let a ftud P be made to flide freely, and confined to move in the orbit A P B ; then the motion of the ftud will, very nearly, reprefent that of the planet.

In the conftruction of an orrery, where each planet will require a feparate arm Fp, moveable on its peculiar centre, with the flider P confined to its own orbit, it may not be eafy to contrive the whole fo as to prevent one part of the machinery from interfering with another ; nor can this method be conveniently ufed, where the wheels carrying the arms

arms are rims. The following construction has been found to answer the intention, and the motion to be very free and regular.

Let E p D be the toothed rim moving equably, the time of a revolution representing that of the planet. This rim may have any convenient diameter, not differing greatly from the orbit. Upon this rim, or on any projection attached to it, is fixed a pin C, round which one end of a bar C P moves; on the other end of the bar is fixed a perpendicular wire, or stem P, which carries the planet. This stem is confined to move in the orbit A P B; and, during its revolution, is made to rise and fall, so as to shew the inclination of the orbit to the ecliptic. The bar C P may be made of any convenient length; and the pin C should be so situated, that when P is at p, the bar becomes a tangent to the circle E p B. This is necessary, that the end P, in its vibrations on C, may be always found, as nearly as possible, in the line F p; and on this account, the length of the bar should be as great as circumstances will conveniently admit.

Contrivances by the Rev. William Pearson.—Some time previously to the year 1796, the Rev. William Pearson, who lived at that time in the city of Lincoln, had read the accounts of Mr. Benjamin Martin's and Mr. James Ferguson's planetary mechanism with such attention, as enabled him to discover many imperfections in them, which it appeared to him might be avoided, and among the rest that defect which arises from equable motion and unvarying distance. On entering into a correspondence with one of the instrument-makers in London, he found that the modern machines owed their origin chiefly to one or the other of the above-named authors, and that little or no improvement had been made in the accuracy of their representations since their time. In consequence of this information, and unacquainted with the contrivances we have just described, except that of Dr. Desaguliers, described by Mr. Ferguson, he turned his mind towards the subject with a view of devising some improvements in this kind of machinery, which required an union of mechanical skill, with a knowledge of the science of astronomy, to enable him to strike out original plans for the accomplishment of his purpose. His first object was to render the trains of wheel-work as nearly as possible such as would produce the true periods of the different planets in their orbits, in doing which he found no difficulty after he had adopted a direct and unerring system of calculation, which became easy and familiar by practice; but this part of his pursuit is not the object of our present article: the next object of his attention was to devise the mechanical means of exhibiting planetary motion, both with regard to variable velocity and variable distance; different methods presented themselves in succession at different times, some of which he afterwards found had been tried before by others, but the first project that promised to be really subservient to his purpose was that which was represented in *fig.* 3. of *Plate* III. of *Planetary Machines*, and which was made for the arm of Mercury, in an orrery constructed under his direction, by a clock-maker at Lincoln. The contrivance had three objects in view, the variable distances, the variable velocities, and the latitudes of the planets, or deviation from the ecliptic, two of which purposes it answered most completely, and the third in a certain degree, besides preserving, fourthly, the parallelism of the planet's axis in every part of its orbit. It occurred to the contriver of the mechanism in question, before he had ever seen Mr. Adams's "Geometrical and Graphical Essays," and before he had heard of "Suardi's Geometric Pen," that if a small arm were by any means made to revolve in a retrograde direction, when placed at the distant end of the long arm, or radius vector of any planet, during the time that the radius vector itself revolved just once by a direct motion round the sun in the centre, the curve traced by a pencil placed at the remote end of the small arm would be *an excentric circle;* and also that there would be an alternate acceleration and retardation of angular velocity in the pencil with respect to the sun, or central point round which the radius vector might be carried; which velocity would be the quickest when the pencil was in its nearest situation, and slowest when most remote; because in the former case, the compound motion would be the sum of two motions, both in the same direction, and in the latter the difference of two motions in contrary directions. This idea, having at the moment of its occurrence made a strong impression on the mind of the inventor, excited in him much impatience to have it brought to the practical test of an experiment; the small frame, shewn in *fig.* 3, was roughly put together, and the equal wheels A, B, and C, were included, so that A was fast to the arbor S, but B and C revolved on their arbors in the frame; the arbor of the latter, however, was left long enough for its pivot to protrude downwards, and to receive a crank-piece P, bearing a short pencil: the stem or arbor S, having its conical point at S fixed on a sheet of paper, was then held fast by a milled nut above it, to prevent its revolving, and the frame was carried round while the three small wheels, with equal numbers of teeth, were connected together; the consequence was, as had been expected, that the pencil traced a circle of a diameter equal to twice the distance of the arbors A and C from each other, but the centre of the circle was found to be at G instead of S, just the length of the short arm or crank-piece P, from the point S, from which the excentric circle was described. This fact determined at once that the frame and short arm ought to be to each other in length as the mean distance is to the excentricity of the orbit of any planet thus to be described, and, as orbits with but little excentricity are very nearly *excentric circles*, a circle thus described cannot be discriminated in a machine from an ellipse of the same excentricity.

Before we proceed to describe the mechanism resulting from the principle of a little arm revolving backwards on the end of the radius vector of any planet just once in each revolution of the planet, let us illustrate the principle itself more clearly. Suppose the line A C, in *fig.* 4. of *Plate* III. to represent the length of the frame or radius vector S C, and also the short arm C A, representing the excentricity or distance from the centre to the focus of the orbit, to be both directed into one right line S A, before any motion be communicated to the frame; then as the teeth of the three wheels A, B, and C, of equal numbers of teeth, are connected together, and the wheel A is at rest, the wheel B will have a motion in the same direction as the frame, and the wheel C will have its motion in a contrary direction, but of the same velocity; conceive the centre of the wheel C to be carried along the circumference of the concentric circle C O I E, the space of the quadrant C O, this wheel C by means of its connection with the wheel A, through the medium of wheel B, will in the same time have made a quarter of a revolution, and the remote end of the small arm attached to this wheel will be at N, at right angles to the radius vector, after having passed along the quadrant A N, of the excentric circle A N P E, of which the point G is the invisible centre, and during the whole continuance of these two equal but contrary motions of the radius vector and short arm, through these quadrants respectively, the latter will have preserved itself parallel to its original situation A C; again, while the radius vector is moving through the three remaining quadrants of the concentric circle

circle from O to I E and C, successively, the remote end of the small arm will describe the three corresponding quadrants of the excentric circle from N to P, M, and A, in equal portions of time, and its parallelism will still be preserved throughout the whole circle, as seen in the figure. Thus, while the centre of the wheel C describes the concentric circle C O I E round the point S with an equable motion, the remote end of the small arm, supposed to carry a planetary body, will describe the excentric circle A N P M, during the whole of which time the motion of the planet will be equable as it respects the point G or centre, but unequable as it respects the point S out of the centre, where the sun is supposed to be placed: for conceive lines like S N to be drawn from S to the planet in different parts of the circle A N P M, or orbit, and they will intersect the circle C O I E *behind* the remote end of the radius vector in one half of a revolution, and *before* it in the other, and the angle at S, subtended by the short arm in any situation, will express the *equation of the centre* in that point of the orbit, which equation, therefore, is *additive* to the mean motion of the radius vector in one six signs of anomaly, and *subtractive* from it in the other six. The nature of the alternate retardation and acceleration of motion produced by this mechanism round the point S, and also the variation of distance, may be easily apprehended by attending to the successive retrograde and direct motions of the arm in each revolution of the radius vector; from A to N these move in opposite directions, and the difference of their velocities, as viewed from S, is equal to the quantity of retardation in any particular point of this quadrant; at N the difference is nothing, in which situation of the arm the equations would be a *maximum* if the arm were perpendicular to the line S N, *i. e.* if S N were a tangent, to the circle of which the arm O N is radius; but this will not happen till the radius vector has advanced beyond the space of an exact quadrant, and the arm has come to *n*, where the angle subtended at S by the arm will be the greatest possible.

The distance of this point, where the equation is a maximum from 90° of mean anomaly, will evidently depend on the relative proportions in length of the radius vector and short arm, or which is the same thing, of the mean distance and excentricity of the planet to be represented. From *n* to P, through the remainder of the first semi-circle, the radius vector and arm will both move in the same direction, and will cause an acceleration which will be greatest at P, the perihelion point, where they will both be again in a right line, shortened by double the whole length of the short arm, as compared with the original situation at the aphelion point. From the perihelion to the point of greatest equation at the opposite side of the orbit, the motions of the radius vector and arm continue to be in the same direction, but through the last quadrant and a small portion of the third, the directions are again opposite till the planet arrives at the aphelion point A, where it has undergone all its changes of velocity and distance, and where it commences the same alternation of slow and quick motions that were before exhibited.

Thus, if S be considered as the sun, A the place of the aphelion of any planet, P its perihelion, *m* and *n*, in the small circle of the arm, the places of mean motion, the concentric circle C O I E the ecliptic, and the excentric one A N P M the planet's orbit, it is evident that both the excentricity, and also a *certain equation* of the centre of a planet's orbit, may be very conveniently represented by the same apparatus that has long been used for no other purpose but that of preserving the parallelism of its axis.

But still the main question is not disposed of; *viz.* what portion of the equation, considered as an arc of the orbit, will a line equal to the excentricity subtend? The analogy for resolving this query is as follows:

As the mean distance, or radius vector, of the planet,
Is to radius,
So is the excentricity, or short arm,
To the sine of the greatest angle at S subtended by the short arm.

This angle, taken in degrees and minutes, we find is invariably, as nearly as may be, *one-half of the greatest equation*, as has been already mentioned.

It will now have occurred to the reader, probably, that, if a line equal to the excentricity subtends one-half the equation of the centre of a planet, *double* the excentricity will be the measure of a short arm that will subtend the *whole* equation; this is nearly true as to the question of the equation alone, but then the distances and excentricity of the orbit, on which the geocentric appearances depend, would be greatly out of proportion; and what is gained in the heliocentric apparent places would be lost in the geocentric appearance in the system. To keep all the desiderata within their due bounds, and to make the elements of the orbit accord with both heliocentric and geocentric appearances in the mechanical representation, an additional contrivance was superadded, which supplied the defect of the revolving short arm without deranging materially the effect of its operation; the last wheel of the train, which carries the radius vector round in the due period, had its teeth so unequally cut as to represent the second half of the equation, by causing an alternate acceleration and retardation in the revolution of the radius vector itself, so that the total effect produced by these two contrivances acting together was very nearly agreeable to the real motion of the planet itself in its own orbit. But we have said, that the latitude of the planet was represented by the same contrivance that shews the distances and one-half of the equation. This was done by placing the stem of the planet in a square socket, at the remote end of the small arm, in so detached a way, that it was at liberty to rest on the plane of an inclined plate, carried by the radius vector, to represent the inclination of the orbit, and to receive the circular scale of latitudes pointed to by the end of the stem as it travelled up and down the said plane in its retrograde revolution.

The little frame we have had occasion to mention might do very well as a piece of mechanism for a radius vector, where the length is small, but where the planet is represented as moving at a considerable distance from the sun, the mechanism contained in *fig.* 3. of *Plate* IV. is better adapted, where A B is the radius vector proportional to the mean distance, and embracing fast the upper extremity of the tube of the wheel with unequal teeth; C is a contrate wheel of any number of teeth made fast to a surrounding tube that has no motion; the horizontal arbor D has two pinions of equal numbers, no matter what, one of which, E, is connected with the fixed wheel C, and the other, F, is connected with a second contrate wheel G, which is every way like the wheel C, except that its position is inverted for the sake of making its direction of motion retrograde; the lower pivot of wheel G rests in a cock H, attached to the end of the radius vector, and its upper pivot ascending above the same carries the short arm that supports the stem of the planet; lastly, I is the inclined plate with a scale of latitudes, on which the end of the stem rests, and by which it is made to ascend through one portion of its orbit, after which its own weight brings it gradually down again. The inclined plate is so placed that the nodes may fall at their

 respective

refpective diftances from the aphelion point; and all the changes of place arifing from the combined caufes of varying diftance, varying velocity, and inclination of the orbit, are duly reprefented.

A fimilar combination of mechanical contrivances was afterwards, in the year 1802, adopted by Mr. Pearfon, when he contrived and fuperintended the conftruction of the large planetarium at the houfe of the Royal Inftitution in Albemarle ftreet, London; though the means are fomewhat different. The plane of the inftrument was defired by Dr. Thomas Young, at that time the lecturer, to be vertical inftead of horizontal, which afforded the means of making the fhort arms, reprefenting the refpective excentricities revolve backwards by a weight fufpended to each, inftead of the wheel-work which we have defcribed: the inequalities among the teeth of the tubed wheels in this inftrument effect one half of the equation, and the retrograde revolutions of the little arms produce the other, and make all the planets revolve according to equated motion, while the ftems round which the faid fhort arms revolve are, agreeably to Dr. Young's fuggeftion, fo bent, as to reprefent alfo the inclination of the orbits, and confequent heliocentric latitudes, for eftimating which the ecliptic plate is put exactly in the plane paffing through the centre of the fun, or coincident with the plane of the earth's orbit, The fmall divided plates carried by the ends of the radii vectores indicate both the equations and heliocentric latitudes; which obfervations we make here, becaufe the conftruction of the inftrument has never yet been publicly explained, except perhaps partially in the lectures, and becaufe the ufes of the different parts, not being obvious by mere infpection, are as yet but little underftood. For a more particular defcription of this inftrument, fee our article PLANETARIUM.

But we are not to take for granted, becaufe one half of the greateft equation will be thus reprefented at the point of mean diftance by a radius vector and fhort arm, that are to each other as the mean diftance to the excentricity, that therefore half the equation will be equally well reprefented in every other part of the orbit of a planet. Let us examine this matter more particularly, and bring it to the teft of actual calculation. Let the line S H, *fig.* 5. of *Plate* III. be the radius vector of Mercury, and H A the fhort arm reprefenting the excentricity, which are to each other very nearly as 5 to 1; then when the planet is at A, its greateft diftance from S, the fun, it is obvious from what has been faid, that its angular velocity, as it refpects S, muft be flower than if it were at P, or any other part of the line S A; conceive now the point H, round which the little arm revolves, to move forwards fo far that the planet may fall back by means of the arm to the point a; then if a line were drawn from S to a, the equation or angle at S would be fubtended by $a\ b$, the fine of the angle A H a to radius A H, which line confequently is perpendicular to the radius vector at the point b; the diftance b H is the cofine of the fame angle, and we have S H + H b for the bafe of a right-angled triangle, and $b\ a$ for the perpendicular of the fame, to determine the angle at S or femi-equation, which is one of the fimple cafes in plane trigonometry, where the bafe is ufed as radius, and the perpendicular as tangent of the required angle. For example, the mean diftance of Mercury, as given by La Lande, is 38710, and its excentricity 7955.4, the mean diftance of the earth being 100000; then if, agreeably to this ratio, we take the fmall arm reprefenting the excentricity at unity, the radius vector muft be 4.86587; for as 7955.4 : 38710 :: 1 : 4.86587; let the point a now be taken equal to 30° from A, and from the tables of natural fines we have $a\ b = .5000000$ and S H + H b = 4.86587 + .8660254 = 5.7318954, hence

As log. 57319	Ar. co.	.2417014
Log. 5000		.6989700
Tang. of ½ equation 4° 59′ 7″		.9406714

In the fame manner one half of the equation, correfponding to any other point c in the quadrant A Q, may be found where H d is the cofine to be added to the radius vector, and $c\ d$ the fine which conftitutes the fubtenfe of the required angle at S. In the fecond quadrant from Q to P the radius vector minus the cofine becomes the bafe of the triangle at any point e or g, but the fines at thofe points are the perpendiculars $e\ f$ and $g\ h$, as in the laft quadrant, fo that the bafe of the triangles fucceffively taken is conftantly fhortening from the aphelion to the perihelion points of the orbit, whilft the perpendiculars are increafing in the firft quadrant, and then decreafing in an inverted order in the fecond, which circumftance makes the equation greater in a given quantity of mean motion near the perihelion than near the aphelion, as the Newtonian theory requires. That a due eftimate may be had of the effect produced by this mechanifm in every part of Mercury's orbit, we fhall fubjoin a fmall table containing the data and refult of correfponding calculations for every ten degrees of mean motion; and parallel to the femi-equations fo obtained, we fhall put a parallel column of half the equations taken from the beft tables as publifhed by La Lande, from which it will be feen that the errors, which at moft are a fmall portion of the whole equation, are in excefs from the aphelion or 0° to 102° of mean anomaly, and in defect from 102° to about 258°, then from 258° to 360° or 0° again in excefs, which deviations from the truth are agreeable to the deviations arifing from the approximation called the "elliptic hypothefis," which Buliald proved from four obferved places of the planet Mars, as obferved by Tycho Brahe, makes the computed places more *backward* than the true ones in the firft and third quadrants of mean motion, and more *forward* in the fecond and fourth.

TABLE.

Dift. from the A-phelion	Bafe Line.	Perpendicular.	Dift. from the A-phelion	Correfponding Semi-Equations by Mechanifm.	Semi-Equations by La Lande.
°			°	° ′ ″	° ′ ″
0	586587	00000	360	0 0 0	0 0 0
10	585068	17365	350	1 41 52	1 37 44
20	580556	34202	340	3 22 17	3 14 1
30	573190	50000	330	4 59 7	4 47 21
40	563191	64279	320	6 29 47	6 16 11
50	550866	76604	310	7 55 0	7 38 49
60	53687	86603	300	9 10 5	8 53 26
70	520789	93969	290	10 13 41	9 58 0
80	503952	98481	280	11 3 26	10 50 16
90	486587	100000	270	11 36 48	11 27 43
100	469222	98481	260	11 51 2	11 47 34
110	452385	93969	250	11 44 5	11 46 54
120	436587	86603	240	11 14 41	11 22 44
130	422308	76604	230	10 16 52	10 32 23
140	409983	64279	220	8 53 25	9 14 3
150	399984	50000	210	7 8 30	7 27 35
160	392618	34202	200	4 58 2	5 15 24
170	38816	17365	190	2 23 42	2 43 13
180	386587	00000	180	0 0 0	0 0 0

In examining the preceding table it may be feen that the place of mean motion, or point where the equation is a maximum, falls, according to the mechanifm, fomewhere between 100° and 110°, which, in La Lande's tables, is at 105°; let us try where it will fall exactly by the mechanical reprefentation.

The point B, where the line S B is a tangent to the fmall circle, is the place of the planet's greateft equation, and this point will be found beyond the firft quadrant, a quantity equal to the angle Q H B, or, which is the fame thing, H S B, or greateft femi-equation; for as S H Q and S B H are both right-angled, and have the angle at S common to both, the third angle, H Q S, is equal to the third angle B H S, and, confequently, the fupplemental angle Q H B is equal to the fupplemental angle H S Q, or greateft femi-equation. *Q. E. D.*

But the greateft femi-equation by the mechanifm when computed is $11° 51' 34''$, therefore the place of mean motion falls at $90° + 11° 51' 34''$, or at $101° 51' 34''$, which point is fhort of 105° by a quantity upwards of 3°. This want of exact coincidence is, however, of little or no moment in the mechanical reprefentation of the orbit, becaufe the quantity of the greateft equation is nearly ftationary for many degrees both before and after the exact point of mean motion. The reprefentation will be ftill more accurate where the orbits have lefs excentricity, than that of Mercury, which is the cafe with all the other planets, except two out of the four newly difcovered ones, *viz.* Pallas and Juno.

As we have had frequent occafion in this article to fpeak of a wheel with unequal teeth, made for the purpofe of effecting alternate accelerations and retardations of angular motion, and have alfo feen the theory explained by Mr. Huygens, it may be proper to fay a few words here about the practical method of cutting fuch a wheel. This operation may be done by three different methods; firft, the divided circle of the plate, to be ufed with the engine, may have the divifions laid down unequally by Huygens' mode of transferring equal divifions from an excentric circle to a concentric one, as already explained; and then the teeth may be cut in the ordinary way from thefe unequal fpaces, when punched or drilled into dividing holes; or, fecondly, an equally divided circle of the engine plate may be ufed, and the increments and decrements, previoufly calculated, may be given at each tooth by the micrometer fcrew of fuch an engine as either Hindley's or Rehé's; or, thirdly, which is the readieft method, the wheel to be cut may have a hole drilled in the excentric point, and be placed thereby on the arbor of the engine, till all the teeth are marked with flight notches by the cutter, adjufted for diftance at each cutting, and then the hole in the centre muft be ufed for completing the teeth in their proper direction; for when the cutter is put into the notches fucceffively, it will cut the teeth towards the centre without any guidance of the index or alidade; and this method is practicable with any common engine without a micrometer fcrew for taking and giving fmall portions, as deductions from or additions to a mean tooth. For the wheels with unequal teeth in the large planetarium of the Royal Inftitution, in Albemarle ftreet, London, the firft method was ufed by the maker, M'Culloch, under the direction of the contriver both of the machine itfelf, and of the method ufed of rendering the teeth of certain wheels gradually unequal round each feparate femicircle, agreeably to the planetary motions to be produced thereby in the planets themfelves; but in an accurate and elegant machine fince made (by Fidler) for himfelf, the laft method was ufed with fuccefs for the large wheel that produces the fun's, or rather earth's annual equation.

Another, and that a very recently contrived method of exhibiting the equations of all the planetary orbits at the fame time, together with their variable diftances, by very fimple mechanifm, has been adopted by Mr. Pearfon in the machine we have juft mentioned, as made by Fidler, under his own direction; this method has the advantage of fhewing alfo the mean motions, and is well calculated for illuftrating the irregularities of motion on which the various phenomena of the heavenly bodies depend, as well as for fhewing the exact times at which they occur, and the countries to which they will be vifible. For a defcription of the machine itfelf we refer the reader to the articles Planetarium and Orrery, and fatisfy ourfelves in this place with an account of the principle by means of which the equations of the centre are effected. *Fig.* 1. of *Plate* IV. of *Planetary Machines*, which is illuftrative of the principle in queftion, is derived from *fig.* 4. of *Plate* III. which has been explained, but has the addition of a third diminutive arm at the end of the longer arm placed at the extremity of the radius vector; we have feen that one arm, equal in length to the excentricity of the orbit to be reprefented, will, by its retrograde revolution, give the diftances and one half of the equation, very nearly, in every part of the orbit, and we have feen that if the faid arm were made equal to twice the excentricity it would give the whole equation near enough, but would not give the diftances truly; now the introduction of the additional arm is to make the apparent place of the planet fulfil both thefe conditions, which it does in a furprizing manner. Let S J, in *fig.* 2, be a radius vector, revolving equably round the point S, in *fig.* 1, in which cafe the extreme end J will defcribe the concentric circle J K O L Q R T V; let J *a* be a fhort arm equal in length to the excentricity once and a half taken, which arm is made to revolve in a backward direction by means of the faft grooved circle *d*, of the catgut *e f*, and of the pulley *g* of the fame diameter as *d*, which mechanifm anfwers as well as that in *fig.* 3, before defcribed, and is fimpler: over the pulley *g* is fixed faft to a ftem, borne by the radius vector, round which the pulley turns, another grooved circular piece J, round which the gut *h i* goes, and embraces alfo a diminutive pulley *a* of half the fize of J, fo that whilft the radius vector and arm J *a* go each once round in contrary directions, the third or little arm *a* A, which is equal in length to only one half the excentricity, goes twice round in the fame direction, in which the radius vector moves, and thus carries a planet at its extremity round the point S, in which the fun is placed, very nearly agreeably to the laws of planetary motion, with regard both to angular velocity and diftance in every part of the orbit. To render the effect thus produced more intelligible, conceive two pins made faft in the line J A, *fig.* 1, confidered as one line equal to twice the excentricity of the orbit to the radius S J, and let one of them be at C, the middle of the line, and the other at A, the extremity; then if this line preferves its parallelifm all round the orbit, by a retrograde motion given to it by the catgut *e f* and pulley *g*, *fig.* 2, the pin C being at the diftance of the excentricity S G from the end J of the radius vector, will defcribe the excentric orbit 1, 2, 3, I, 4, 5, 6, of the planet, while the pin at A will have the proper velocity as feen from S, but will move in the circle A B D E P F M H, which is too excentric to become the true orbit; but if the point A of the additional fmall arm be put to C when the motion begins, and has the planetary body placed on its extremity, then it will move in the fame excentric

2 circle

circle as the firft pin C, but with the apparent angular veloci ty of the fecond pin A as feen from the other focus W, and very nearly fo as feen from the fun at S: for conceive the radius S J to have moved to K, the pin A will be found at B, on account of the angle B K *b* being equal to the angle J S K, which is here 45°, but the planet has moved a quadrant to 1, and is found in the circle defcribed by the pin C, or middle circle; but, viewed from W, according to the elliptic hypothefis, is feen in the line W B, as though it had been actually at B in the outermoft circle; again, when the radius vector has completed a quadrant and is in the fituation S O, the firft pin is at N, the fecond at D, and the planet at 2, in the line W D as before, and the additional arm has now defcribed a femicircle: here the equation D S O is fubtended by double the excentricity very nearly: when J is advanced 135° to L, the additional arm has moved $\frac{3}{4}$ of a circle, and is found at 3, ftill in the middle circle, and alfo in the line W E, extended: and when S Q is the fituation of the radius vector the planet is at I, the perihelion point of the middle circle, and alfo in the line W P, extended as before. In like manner in the other femicircle of mean anomaly, when the extreme end of the radius vector is fucceffively at the points R, T, and V, the planet will be found at the points 4, 5, and 6, and alfo in the lines W F, W M, and W H, refpectively, ftill moving in the middle circle, till it arrives at the aphelion point C, from which it originally fet out. When the pulleys are made to produce this effect very nicely, the band or gut, that embraces two pulleys of different diameters, will affect the ratio of 1 : 2 in practice, and will require the fmaller pulley to be fomewhat lefs in diameter than what the exact proportion requires in theory. The radius vector has a flit in its remote end, with a thumb-fcrew under it, to fix the pulley at a greater or lefs diftance, as the tenfion of the gut may require, and the whole contrivance being fimple, fteady in its motion, and light in its conftruction, as well as having a tendency to prevent the radius vector from bending downwards, is far preferable, in every point of view, to any contrivance we have before feen for anfwering the fame purpofe. The mechanical reprefentation of the orbit bears the fame analogy to the elliptic hypothefis, that an excentric circle does to an ellipfe of the fame excentricity, and in the orbits of the planets thefe figures are fo nearly alike, that they may be fubftituted for each other, without fenfible error; and we may add, that the equation produced by only one arm, equal to twice the excentricity, is by no means fo accurate as the *equation doubled*, that is, produced from an arm equal to the exact excentricity, becaufe the tangents of different angles do not increafe by equal quantities.

Befides the preceding methods of producing the equation of a planet's orbit, our author has contrived to indicate the quantity thereof in any point of the orbit, as well as the latitude alfo, as feen from the fun; this is done by means of a hand fixed under the revolving pulley J, travelling over a divided and filvered plate, fixed faft in the fituation of the dotted circle, on the end of the radius vector, concentric with the pulley, which plate not only fhews the equation and latitude at any time, but is of ufe in placing the arms in their proper fituations by the latitudes taken from the Ephemeris or Nautical Almanac.

Thefe are all the methods that have fallen within our notice, of effecting the grand equation of a planet's orbit, as applied to an orrery, or planetarium; but there remain yet two pieces of mechanifm, contrived by our prefent inventor, that are well calculated to explain in a lecture-room the equation of an individual planet, as detached from the fyftem, which we fhall briefly defcribe, as being contrivances equally novel and competent to their purpofe. The firft is reprefented by *figs*. 4 and 5 of our laft plate, the former being a fection of the wheel-work, and the latter a fketch of a part of the vifible part of the inftrument. AB is a little frame, containing four wheels, *a*, *b*, *c*, and *d*; *a* and *b* are equal in diameter, and of fimilar numbers of teeth, *a* fixed on the arbor of the handle *e*, and *b* on a tubed arbor *f*, that carries the index *g*, feen in *fig*. 5 of the fhape of a T, with a point touching the circle *k*, which is an ecliptic circle; fo that whatever velocity is given by the handle to the wheel *a* in an equable manner, the fame is communicated, by the medium of the wheel *b*, to the index *g*, which therefore moves according to mean motion in the ecliptic circle K. The wheels *c* and *d* are excentric, and have alfo fimilar diameters and numbers of teeth, but are placed to act fo, that the longeft radius of one always acts with the fhorteft of the other, and thus produce the fame effect as Dr. Defaguliers' elliptic grooved plates with the endlefs catgut. The excentricity of the wheels bears the fame proportion to their common radius, that the excentricity of the planet's orbit does to its mean diftance: wheel *c* is fixed faft to the fame arbor of the handle as wheel *a* is, but wheel *d* has a feparate arbor, which goes with the tube of wheel *b*, and carries the hand *i*, and on its upper end a ball to reprefent the fun. The fectoral arc of the index *g* is graduated, for Mercury for inftance, into 24° each way from the middle, to which the hand *i* muft be put when the index points to that part of the ecliptic circle in which the aphelion point of the planet is; then as the handle is turned the index fhews the mean motion in the ecliptic, which may have a fecond circle divided into figns of mean anomaly, beginning at the aphelion point, and as the motion proceeds the hand *i* falls back, till at the end of three figns and a half of mean anomaly it is found near the extremity of the fectoral arc, at *g*; at the perihelion point the hand is again in the middle; and at eight and a half figns of mean anomaly it will be in its prefent fituation again, at its greateft equation, at the oppofite end of the fectoral piece; and laftly, at the aphelion point the hand will be again found in the middle, which is the zero of both the pofitive and negative equations, which are refpectively marked + and − on the oppofite ends of the graduated fectoral arc. Thus, the index *g* fhews the mean motion, the hand *i* the equated motion, and the graduated portion of the index has the quantity of the equation plus or minus, fhewn by the hand *i* in every part of the orbit, while a line drawn from S, the fun, over the point of the hand *i* to the ecliptic K, fhews the equated or true heliocentric place of the planet. The other inftrument for explaining the nature of the mean and equated anomaly of a detached planet, and of its equation, which is their difference, is fimply a mechanical conftruction of the elliptic hypothefis of bifhop Ward, and is reprefented by *fig*. 6. of the fame plate. S G W is an elliptic plate of wood or metal, defcribed from the foci S and W, the fmall circle at S is divided into an ecliptic circle with a flender ftem in the centre bearing a ball to reprefent the fun, and the other fimilar circle at W is divided into as many fpaces as there are days or weeks in the period of the planet; of which 88^d are proper for Mercury; the bar *a* G is concealed under the dotted line, and turns on the vertical ftem of the ftand that fupports the elliptical plate at G, by means of a piece of brafs tube fixed at its end; on the bar *a* a fliding piece *b* is inferted, that bears a fmall pulley *c*, and a planet in the angular point behind it, on a ftem as high as that of the fun; this fliding piece has two rollers, bearing againft the edge of the elliptical plate, to facilitate the motion of the bar round the plate, which is produced by

 hand;

hand; an endlefs gut or filk cord S W c draws the fliding piece clofe to the faid plate, and caufes the pulley and planet to defcribe the proper ellipfe for the orbit. According to the elliptic hypothefis, if the angle c W A be the meafure of the mean anomaly, the angle at the fun in the other focus, *viz.* c S A, will always be the equated anomaly, and the fmall angle S c W will, in every fituation, be the equation of the centre, as being the fupplement of the fum of the other two angles, that is, the external angle c W A, that reprefents the mean anomaly, is equal to the fum of both the internal angles of the triangle at S and c, as being refpectively the fupplement of the other internal angle at W; but the internal angle at S is the equated anomaly; therefore the angle c W A $- \angle c$ S W is the angle c, or equation during the firft fix figns of mean anomaly; in the other fix figns the angle reprefenting the mean anomaly at W will be fmaller than the angle at S, reprefenting equated anomaly, therefore the equation, or difference between them, which has been fubtractive, becomes now additive; and the hypothefis, thus mechanically conftructed, affords the ready means of explaining the particulars of planetary motion, for which purpofe equal fectoral arcs are laid down on the plate alternately black and white, which the thread S c moves over in equal arcs of the circle W, moved over by the thread W c; which are equal portions of time; and when the circle W is divided into days or weeks, and the circle S into figns of longitude, and alfo into figns of anomaly, the fame refults will follow as from the preceding mechanifm, as nearly as may be, while, at the fame time, all the variations of diftance, as well as of the equation, will be faithfully exhibited. Both thefe contrivances may be conftructed fo as to be ufed either horizontally or vertically, and on any fcale of magnitude that the audience of a lecture room may require.

Equation *of Time*. Having, under the article Day, explained the origin of the difference between folar and mean time, we have now only to explain the method by which this difference is calculated.

To effect this, it is neceffary to know precifely the motion of the fun, and the dimenfions of its orbit: we may then calculate the arc which it defcribes every day in the year parallel to the equator. If this real and variable motion be compared with its mean motion, the difference will be the equation of time.

If we imagine two meridians, drawn through the two extremities of the arc of the ecliptic, which the fun defcribes in one day, the arc of the equator, which they intercept, is the difference between the folar and a fidereal day; for when the rotation of the celeftial fphere is terminated, this fmall arc of the equator muft traverfe the meridian before the centre of the fun can arrive there. Now as this arc is not always of the fame length, the folar days are not all equal.

Nor would they be fo, even if the fun defcribed every day an equal arc of the ecliptic, for thefe arcs take fucceffively different inclinations relatively to the equator. At the moment of the equinoxes, they cut this plane at an angle equal to the obliquity of the ecliptic, and at the period of the folftices they are parallel to it. The meridians drawn through the extremities of thefe diurnal arcs are more feparated at the folftices than if they contained the fame arc at the time of the equinoxes; and, as it is this feparation of the two meridians which meafures the fucceffive retardations of the fun, thefe are unequal, and lefs at the equinoxes than at the folftices. The daily variation of the motion of the fun in its orbit is another fource of inequality, as it augments and diminifhes the diurnal arc of the ecliptic, and this produces a correfponding variation in the arcs of of the equator contained between the above-mentioned meridians.

Thus the inequality in the folar days arifes from two diftinct caufes, the obliquity of the ecliptic, and the unequal motion of the fun in its orbit. As thefe two caufes each produce their feparate effect, they muft be both deftroyed, to render the folar days equal, that is, the motion of the fun muft become uniform, and the ecliptic muft coincide with the equator.

To calculate the value of the equation of time, we muft calculate the arc which the fun defcribes each day on the ecliptic, and project it on the equator, and from this deduct the mean diurnal motion: the difference will give the equation of time for that day.

To reprefent thefe refults geometrically, we may fuppofe an artificial fun to move in the manner defcribed under the article Day, the mean day is the interval between two fucceffive returns of this fictitious fun, and the mean noon the inftant of its paffage over the meridian; and the mean equinox is the inftant of its paffage through the equinoctial point. It is obtained by a fimple proportion, when the longitude of the perigee is known, and the epoch when the true fun is in the apfides, the time which elapfes between two confecutive returns to the mean equinox, forms the mean tropical year, and which is equal to $365,^{d} 242250$.

To calculate the place of the mean fun on the equator for a given inftant, it is fufficient to calculate the mean longitude, and this, reduced to the equator, is the mean right afcenfion of the fun.

The projection of the true fun on the equator may either be determined from obfervation, or from calculating its right afcenfion. The difference between their right afcenfions, reduced into time, in the proportion of 24^{h} to 360°, indicates the interval between the paffage of the true and mean fun, and is the required equation of time: it is fometimes additive, and fometimes fubtractive, and has the remarkable property of becoming zero four times in a year.

To underftand the reafon of this phenomenon, let us imagine (*fig.* 108.) two funs, S^2 and S, to fet out at the fame time from the equinox, both moving with an uniform motion; the one, S^2, in the ecliptic, the other, S^3, in the equator, and let the motion of each be referred to the latter place. S^3 will at firft advance upon the meridian of S^2, but afterwards this latter will approach it, and they will arrive together at the folftice; after this the meridian of S^2 will advance upon that of S^3, till the fecond equinox, where they will arrive together. The fame circumftances will occur in the other half of the orbit, and thus the two funs will coincide together four times in the year, namely, at the equinoxes and folftices.

But, in reality, the mean fun does not fet out at the fame time as the true fun; they will not, therefore, meet at the fame points; the unequal motion of the fun changes this difference, but thefe two caufes united only change the epoch of the coincidences; their number remains the fame.

Let us confider the motion of the two funs, S^2, and S^3, fuppofed to fet out together from the autumnal equinox, and proceeding towards the perigee. The true fun, S^1, which defcribes the ecliptic, being referred by its meridian to the plane of the equator, will then be found behind the others, for it is preceded by S^2 till the perigee; let us now confider the motion of the other two. Till the moment of the folftice, S^3 precedes S, and S^2 precedes S^1, their order is therefore S^1, S^2, S^3. At the folftice S^2 joins S^3, and afterwards paffes it; their order is then S^2, S^3, S^1, but at the perigee S coincides with S^2, and afterwards precedes it: to do this S and S^3 muft meet in the interval. The order then becomes S^1, S^3,

S^2, S^1; thus between the winter folftice and the perigee the true fun S^1, referred to the equator, meets the mean fun S^3, and the equation becomes zero. From the perigee to the vernal equinox S^1 precedes S^2, and S^2 precedes S^3; they none of them meet therefore in this interval. At the equinox S^3 joins S^1, and their order becomes S^2, S^3, S^1; but S^3 cannot remain long between the two others, for at every quadrant the feparation of S^3 and S^2 increafes to $2^\circ\ 24'\ 24.''4$, as appears by calculation; but the diftance of S^1, S^2 never exceeds $1^\circ\ 55'\ 27''$, which is the greateft equation of the centre, and as, in the prefent fituation of the folar orbit, this takes place near the equinoxes, the arc which correfponds to it on the equator is ftill lefs than it. It is evident, therefore, after the vernal equinox, and before the fummer folftice, there muft be fome moment when the mean fun S^3 arrives upon the meridian of S^1, when the equation is again zero. From that point to the fummer folftice the order is as follows, S^2, S^1, S^3: at the folftice S^2 joins S^1, and afterwards paffes it. But S^1 precedes S^3 as far as the apogee, confequently the meridian of S^1 joins the mean fun S^3, before the folftice, and the equation becomes zero for the third time.

From the folftice to the apogee, the order of the three funs is as follows, S^3, S^2, S^1; at the apogee S^2 joins S^1, and afterwards precedes it till the perigee, the order thus becoming S^3, S^1, S^2; but at the autumnal equinox S^3 joins S^2, and confequently meets in this interval the meridian of S^1, and the equation becomes zero for the fourth time.

The order of the three funs then becomes S^1, S^2, S^3, and the fame appearances are re-produced in the fame order as before.

Hence it appears, that in confequence of the obliquity of the ecliptic, combined with the unequal motion of the fun, the equation of time becomes zero four times a year, *viz.* once between the winter folftice and the perigee, twice between the vernal equinox and the fummer folftice, and for the laft time between the apogee and the autumnal equinox. The epochs of thefe phenomena evidently vary with the pofition of the greater axis of the folar orbit; at prefent they happen about the 24th December, 15th April, 15th June, and the 31ft of Auguft. If the equator coincided with the ecliptic, that part of the equation of time depending on their inclination would difappear, and the mean motion would only differ from the true by the equation of the centre, and mean and true time would agree twice a year when the fun is in the apfides.

Dr. Mafkelyne has invented a rule for computing the equation of time, in which all the three caufes are confidered; it was inveftigated in the following manner.

Let A P L Q (*Plate* XII. *fig.* 109.) be the ecliptic, A L Q the equator, A the firft point of Aries, P the point where the fun's apparent motion is floweft, S any place of the fun; draw S v perpendicular to the equator, and take $An = AP$. When the fun begins to move from P, fuppofe a ftar to begin to move from n, with the fun's mean motion in right afcenfion or longitude, *viz.* at the rate of $59'\ 8''$ in a day; and when n paffes the meridian, let the clock be adjufted to 12; take $nm = Ps$, and when the ftar comes to m, if the fun moved uniformly with his mean motion he would be found at s, but at that time let S be the place of the fun. Let the fun S, and confequently v, be on the meridian; and then as m is the place of the imaginary ftar at that inftant, mv muft be the equation of time. The fun's mean place is at S, and as $An = AP$, and $nm = Ps$, we have $Am = APs$; confequently $mv = Av - Am = Av - APs$. Let A be the mean equinox, or the point where it would have been if it had moved with its mean velocity, and draw Az perpendicular to A Q: then $Am = Az + xm = Aa \times$ cofine $zAa + zm$: or becaufe the cofine of zAa, the obliquity of the ecliptic $23^\circ\ 28'' = \frac{11}{12}$ very nearly, $Am = \frac{11}{12}Aa + xm$: hence $mv = Av - zm - \frac{11}{12}Aa$. Here Av is the fun's true right afcenfion; zm the mean right afcenfion, or mean longitude; and $\frac{11}{12}Aa$ (*viz.* Ax) is the equation of the equinoxes in right afcenfion; therefore the equation of time is equal to "the difference of the fun's true right afcenfion, and his mean longitude corrected by the equation of the equinoxes in right afcenfion."

When Am is lefs than Av, mean or true time precedes apparent; when it is greater, apparent time precedes mean: that is, when the fun's true right afcenfion is greater than his mean longitude, corrected as above fhewn, we muft add the equation of time to the apparent to obtain the mean time; and when it is lefs we muft fubtract. To convert mean time into apparent, we muft fubtract in the former cafe, and add in the latter.

Tables of the equation of time are computed by this rule for the ufe of aftronomers; they are either calculated for the noon of each day, as given in the Nautical and fome other Almanacs, or for every degree of the fun's place in the ecliptic, as is done in the annexed tables.

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TABLE

Of Equation of Time to convert apparent into mean Time for 1810, with the fecular Variation.

Argument.—Sun's mean Longitude.

Deg.	Sig. O.	Diff.	Secular Variation. ±		Sig. I.	Diff.	Secular Variation. +		Sig. II.	Diff.	Secular Variation. +	
	′ ″	″	″		′ ″	″	″		′ ″	″	″	
0	+ 6 59.2	18.8	2.97	25	− 1 31.2	12.5	4.31	24	− 3 43.4	4.5	10.83	18
1	6 40.4	18.9	2.72	24	1 43.7	12.0	4.55	24	3 38.9	5.0	11.01	17
2	6 21.5	18.9	2.48	24	1 55.7	11.4	4.79	23	3 33.9	5.5	11.18	18
3	6 2.6	18.8	2.24	24	2 7.1	10.8	5.02	24	3 28.4	6.1	11.36	17
4	5 43.8	18.9	2.00	25	2 17 9	10.4	5.26	23	3 22.3	6.6	11.53	16
5	5 24.9	19.0	1.75	24	2 28.3	9.8	5.49	24	3 15.7	6.9	11.69	16
6	5 5.9	18.8	1.51	24	2 38.1	9.3	5.73	23	3 8.8	7.7	11.85	16
7	4 47.1	18.8	1.27	25	2 47.4	8.8	5.96	23	3 1.1	8.0	12.01	15
8	4 28.3	18.7	1.02	24	2 56.2	8.3	6.19	23	2 53.1	8.4	12.16	15
9	4 9.6	18.6	0.78	24	3 4.5	7.6	6.42	23	2 44.7	8.8	12.31	14
10	3 51.0	18.4	0.54	25	3 12.1	7.1	6.65	23	2 35 9	9.2	12.45	14
11	3 32.6	18.5	0.29	24	3 19.2	6.6	6.88	23	2 26.7	9.8	12.59	14
12	3 14.1	18.3	0.05	25	3 25.8	5.9	7.11	22	2 16.9	10.0	12.73	13
13	2 55.8	18.0	0.20	24	3 31.7	5.4	7.33	23	2 6.9	10.3	12.86	13
14	2 37.8	17.9	0.44	24	3 37.1	4.9	7.56	22	1 56.6	10.8	12.99	12
15	2 19.9	17.6	0.68	25	3 42.0	4.2	7.78	22	1 45.8	11.2	13.11	12
16	2 2.3	17.3	0 93	24	3 46.2	3.4	8.00	22	1 34.6	11.4	13.23	11
17	1 45.0	17.1	1.17	24	3 49.6	3.0	8.22	21	1 23.2	11.6	13.34	11
18	1 27.9	16.9	1.41	25	3 52.6	2.5	8.43	22	1 11.6	11.9	13.45	10
19	1 11.0	16.7	1.66	24	3 55.1	1.9	8.65	20	0 59.7	12.1	13.55	9
20	0 54.3	16.4	1.90	24	3 57.0	1.3	8.85	21	0 47.6	12.3	13.64	9
21	0 37.9	16.0	2.14	25	3 58.3	0.6	9.06	21	0 35.3	12.5	13.73	9
22	0 21.9	15.5	2.39	24	3 58.9	0.1	9.27	21	0 22.8	12.7	13.82	8
23	+ 0 6.4	15.1	2.63	24	3 59.0	0.5	9.48	20	− 0 10.1	12.8	13.90	8
24	− 0 8.7	14.7	2.87	24	3 58.5	1.1	9.68	20	+ 0 2.7	12.9	13.98	7
25	0 23.4	14.3	3.11	24	3 57.4	1.7	9.88	19	0 15.6	13.1	14.05	6
26	0 37.7	13.9	3.35	24	3 55.7	2.2	10.07	20	0 28.7	13.1	14.11	6
27	0 51.6	13.5	3.59	24	3 53.5	2.8	10.27	20	0 41.8	13.2	14.17	5
28	1 5.1	13.2	3.83	24	3 50.7	3.4	10.47	18	0 55.0	13.1	14.22	5
29	1 18.3	12.9	4.07	24	3 47.3	3.9	10.65	18	1 8.1	13.0	14.27	4
30	− 1 31.2		4.31		3 43.4		10.83		1 21.1		13.31	

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TABLE

Of Equation of Time to convert apparent into mean Time for 1810.

Argument.—Sun's mean Longitude.

Deg.	Sig. III.	Diff.	Secular Variation. +		Sig. IV.	Diff.	Secular Variation. +		Sig. V.	Diff.	Secular Variation. +	
	′ ″	″	″		′ ″	″	″		′ ″	″	″	
0	+ 1 21.1	13.0	14.31	4	+ 5 59.3	2.1	13.14	11	+ 2 46.2	15.0	8.78	17
1	1 34.1	13.1	14.35	3	6 1.4	1.6	13.03	12	2 31.2	15.5	8.61	17
2	1 47.2	13.1	14.38	2	6 3.0	1.2	12.91	12	2 15.7	15.9	8.44	17
3	2 0.3	13.0	14.40	2	6 4.2	0.6	12.79	12	1 59.8	16.4	8.27	17
4	2 13.3	12.8	14.42	2	6 4.8	0.1	12.67	12	1 43.4	16.8	8.10	17
5	2 26.1		14.44		6 4.7		12.55		1 26.6		7.93	
		12.6		1		0.7		13		17.2		17
6	2 38.7	12.4	14.45	0	6 4.0	1.4	12.42	13	1 9.4	17.6	7.76	17
7	2 51.1	12.2	14.45	0	6 2.6	2.0	12.29	13	0 51.8	18.0	7.59	17
8	3 3.3	12.0	14.45	1	6 0.6	2.5	12.16	13	0 33.8	18.4	7.42	17
9	3 15.3	11.7	14.44	1	5 58.1	3.3	12.03	14	+ 0 15.4	18.6	7.25	17
10	3 27.0		14.43		5 54.8		11.89		− 0 3.2		7.08	
		11.4		2		3.8		14		18.9		17
11	3 38.4	11.1	14.41	2	5 51.0	4.4	11.75	14	0 22.1	19.2	6.91	17
12	3 49.5	10.8	14.39	3	5 46.6	5.0	11.61	14	0 41.3	19.5	6.74	18
13	4 0.3	10.5	14.36	4	5 41.6	5.7	11.47	15	1 0.8	19.8	7.56	17
14	4 10.8	10.1	14.32	4	5 35.9	6.4	11.32	15	1 20.6	20.0	7.39	18
15	4 20.9		14.28		5 29.5		11.17		1 40.6		7.21	
		9.7		4		6.9		15		20.2		17
16	4 30.6	9.4	14.24	5	5 22.6	7.5	11.02	15	2 0.8	20.5	6.04	17
17	4 40.0	9.0	14.19	6	5 15.1	8.1	10.87	15	2 21.3	20.6	5.87	18
18	4 49.0	8.5	14.13	6	5 7.0	8.7	10.72	15	2 41.9	20.8	5.69	17
19	4 57.5	8.1	14.07	6	4 58.3	9.3	10.57	16	3 2.7	20.9	5.52	18
20	5 5.6		14.01		4 49.0		10.41		3 23.6		5.34	
		7.6		7		9.8		16		21.1		18
21	5 13.2	7.4	13.97	7	4 39.2	10.4	10.25	16	3 44.7	21.1	5.16	18
22	5 20.6	6.9	13.87	8	4 28.8	10.9	10.09	16	4 5.8	21.2	4.98	17
23	5 27.5	6.2	13.79	8	4 17.9	11.5	9.93	16	4 27.0	21.3	4.81	18
24	5 33.7	5.7	13.71	9	4 6.4	12.1	9.77	17	4 48.3	21.4	4.63	18
25	5 39.4		13.62		3 54.3		9.60		5 9.7		4.45	
		5.1		9		12.7		16		21.3		18
26	5 44.5	4.5	13.53	9	3 41.6	13.0	9.44	16	5 31.0	21.3	4.27	18
27	5 49.0	3.9	13.44	10	3 28.6	13.6	9.28	16	5 52.3	21.4	4.09	18
28	5 52.9	3.4	13.34	10	3 15.0	14.2	9.12	17	6 13.7	21.3	3.91	18
29	5 56.3	3.0	13.24	10	3 0.8	14.6	8.95	17	6 35.0	21.3	3.73	19
30	5 59.3		13.14		2 46.2		8.78		− 6 36.3		3.54	

TABLE

Of Equation of Time to convert apparent into mean Time for 1810, with the secular Variation.

Argument.—Sun's mean Longitude.

Deg.	Sig. VI.	Diff.	Secular Variation. ±		Sig. VII.	Diff.	Secular Variation. −		Sig. VIII.	Diff.	Secular Variation. −	
	′ ″	″	″		′ ″	″	″		′ ″	″	″	
0	− 6 56.3		3.54		− 15 17.8		2.56		− 13 54.9		9.64	
1	7 17.5	21.2	3.35	18	15 26.6	8.8	2.79	23	13 38.9	16.0	9.88	24
2	7 38.5	21.0	3.17	19	15 34.7	8.1	3.02	23	13 22.1	16.8	10.11	23
3	7 59.3	20.8	2.99	18	15 42.1	7.4	3.25	23	13 4.6	17.5	10.33	22
4	8 20.0	20.7	2.80	19	15 48.8	6.7	3.48	23	12 46.4	18.2	10.55	22
5	8 40.0	20.6	2.61	19	15 54.8	6.0	3.71	23	12 27.3	19.1	10.77	22
		20.4		19		5.2		23		19.9		21
6	9 1.0		2.42		16 0.0		3.94		12 7.4		10.98	
7	9 21.1	20.1	2.23	19	16 4.4	4.4	4.18	24	12 46.8	20.6	11.19	21
8	9 41.0	19.9	2.04	19	16 8.1	3.7	4.41	23	11 25.5	21.3	11.40	21
9	10 0.7	19.7	1.85	19	16 11.0	2.9	4.64	24	11 3.5	22.0	11.61	21
10	10 20.1	19.4	1.66	19	16 13.0	2.0	4.89	24	10 40.8	22.7	11.81	20
		19.2		20		1.2		24		23.4		20
11	10 39.3		1.46		16 14.2		5.13		10 17.4		12.01	
12	10 58.1	18.8	1.26	20	16 14.7	0.5	5.37	24	9 53.4	24.0	12.20	19
13	11 16.5	18.4	1.06	20	16 14.2	0.5	5.61	24	9 28.9	24.5	12.39	19
14	11 34.5	18.0	0.86	20	16 12.9	1.3	5.81	24	9 3.7	25.2	12.58	19
15	11 52.2	17.7	0.66	20	16 10.8	2.1	6.09	24	8 37.9	25.8	12.77	19
		17.3		20		3.0		24		26.4		18
16	12 9.5		0.46		16 7.8		6.33		8 11.5		12.95	
17	12 26.3	16.8	0.25	21	16 4.0	3.8	6.57	24	7 44.6	26.9	13.12	17
18	12 42.7	16.4	0.04	21	15 59.3	4.7	6.81	24	7 17.5	27.3	13.29	17
19	12 58.7	16.0	0.16	20	15 53.7	5.6	7.05	24	6 49.7	27.6	13.45	16
20	13 14.2	15.5	0.37	21	15 47.3	6.4	7.29	24	6 21.6	28.1	13.61	16
		14.9		21		7.3		24		28.5		15
21	13 29.1		0.58		15 40.0		7.53		5 53.1		13.76	
22	13 43.5	14.4	0.80	22	15 31.7	8.3	7.77	24	5 24.3	28.8	13.91	15
23	13 57.4	13.9	1.00	21	15 22.6	9.1	8.01	24	4 55.1	29.2	14.04	14
24	14 10.8	13.4	1.23	22	15 12.6	10.0	8.25	24	4 25.6	29.5	14.19	14
25	14 23.6	12.8	1.45	22	15 1.7	10.9	8.49	24	3 55.9	29.7	14.31	13
		12.1		22		11.7		23		30.0		12
26	14 35.7		1.67		14 50.2		8.72		3 25.9		14.44	
27	14 47.2	11.5	1.89	22	14 37.5	12.5	8.96	24	2 55.8	30.1	14.56	12
28	14 58.0	10.8	2.11	22	14 24.1	13.4	9.19	23	2 25.5	30.3	14.67	11
29	15 8.2	10.2	2.33	22	14 9.9	14.2	9.42	23	1 55.0	30.5	14.78	11
30	− 15 17.8	9.6	2.56	23	− 13 54.9	15.0	9.64	22	− 1 24.7	30.3	14.88	10

TABLE

Of Equation of Time to convert apparent into mean Time for 1810, with the fecular Variation.

Argument.—Sun's mean Longitude.

Deg.	Sig. IX.	Diff.	Secular Variation. —		Sig. X.	Diff.	Secular Variation. —		Sig. XI.	Diff.	Secular Variation. —	
	′ ″	″	″		′ ″	″	″		′ ″	″	″	
0	— 1 24.7	30.5	14.88	10	+ 11 36.3	17.0	14.89	10	+ 14 6.9	7.0	9.96	22
1	0 54.2	30.5	14.98	9	11 53.3	16.2	14.79	11	13 59.9	7.8	9.74	22
2	— 0 23.7	30.5	15.07	8	12 9.5	15.3	14.68	11	13 52.1	8.5	9.52	22
3	+ 0 6.8	30.4	15.15	8	12 24.8	14.5	14.57	11	13 43.6	9.1	9.30	22
4	0 37.2	30.3	15.23	7	12 39.3	13.8	14.46	12	13 34.5	9.6	9.‥8	22
5	1 7.5		15.30		12 53.1		14.34		13 24.9		8.86	
		30.1		6		13.0		13		10.2		23
6	1 37.6	29.9	15.36	5	13 6.1	12.1	14.21	13	13 14.7	10.7	8.63	22
7	2 7.5	29.7	15.41	5	13 18.2	11.2	14.08	14	13 4.0	11.6	8.41	23
8	2 37.2	29.5	15.46	5	13 29.4	10.4	13.94	14	12 52.4	12.0	8.18	22
9	3 6.5	29.3	15.51	4	13 39.8	9.5	13.80	15	12 40.4	12.5	7.96	23
10	3 36.0		15.55		13 49.3		13.65		12 27.9		7.73	
		28.9		3		8.7		15		13.0		24
11	4 4.9	28.6	15.58	2	13 58.0	7.9	13.50	15	12 14.9	13.4	7.49	23
12	4 33 5	28.3	15.60	1	14 5.9	7 0	13.35	16	12 1.5	14.0	7.26	23
13	5 1.8	27.8	15.61	1	14 12.9	6.1	13.19	16	11 47.5	14.4	7.03	24
14	5 29.6	27.3	15.62	0	14 19.0	5.2	13.03	17	11 33.1	14.8	6.79	24
15	5 56.9		15.62		14 24.2		12.86		11 18.3		6.55	
		26.8		0		4.4		17		15.1		23
16	6 23.7	26.3	15.62	1	14 28.6	3.7	12.69	17	11 3.2	15.6	6.32	23
17	6 50.0	25.9	15.61	2	14 32.3	2.8	12.52	18	10 47.6	16.0	6.09	24
18	7 15.9	25.3	15.59	2	14 35.1	2.0	12.34	18	10 31.6	16.3	5.85	24
19	7 41.0	24.6	15.57	3	14 37.1	1.1	12.16	19	10 15.3	16.7	5.61	24
20	8 5.8		15.54		14 38.2		11.97		9 58.6		5.37	
		24.1		4		.0.3		19		17.0		24
21	8 29.9	23.4	15.50	5	14 38.5	0.6	11.78	19	9 41.6	17.2	5.13	23
22	8 53.3	22.8	15.45	4	14 37.9	1.3	11.59	19	9 24.4	17.4	4.90	24
23	9 16.1	22.1	15.41	6	14 36.6	2.0	11.40	20	9 7.0	17.7	4.66	24
24	9 38.2	21.5	15.35	6	14 34.6	2.7	11.20	20	8 49.3	17.9	4.42	24
25	9 59.7		15.29		14 37.9		11.00		8 31.4		4.18	
		20.9		7		3.6		21		18.1		24
26	10 20.6	20.2	15.22	8	14 28.3	4.4	10.79	20	8 13.3	18.3	3.94	24
27	10 40.8	19.3	15.14	8	14 23.9	5.0	10.59	21	7 55.0	18.5	3.74	25
28	11 0.1	18.5	15.06	8	14 18.9	5.6	10.38	21	7 36.5	18.6	3.45	24
29	11 18.6	17.7	14.98	9	14 13.3	6.4	10.17	21	7 17.9	18.7	3.21	24
30	+ 11 36.3		14.89		+ 14 6.9		9.96		+ 6 59.2		2.97	

Equation, *lunar* and *folar*, in *Chronology*. See Metempsosis.

EQUATOR, or Æquator, in *Aftronomy* and *Geography*, a great circle of the fphere, equally diftant from the two poles of the world, or having the fame poles with thofe of the world.

Such is the circle D A (*Plate* XII. *Aftron. fig.* 109.) its poles being P and Q. It is called the equator, becaufe when the fun is in it the days and nights are equal; whence alfo it is called the *equinoctial*; and when drawn on maps and planifpheres, the *equinoctial line*, or fimply the *line*. Every point of the equator is a quadrant's diftance from the poles of the world; whence it follows, that the equator divides the fphere into two hemifpheres, in one of which is the northern, and in the other the fouthern pole.

By the paffages or tranfits of arcs of the equator over the meridian, equal or mean time is eftimated; hence we have frequent occafion for the converfion of degrees of the equator into time; and again, for the re-converfion of parts of time into degrees or parts of the equator.

For the performance whereof, we fubjoin the following table; wherein are exhibited the arcs of the equator, which pafs the meridian in the feveral hours, minutes, &c. of equated or mean time.

Converfion of the Parts of the Equator into Time, and *vice verfâ*.

Deg. of Equat.	Hours.	Min.	Hours.	Deg. of Equat.	Hour. Min.	Deg. of Equat.	′
Min.	Min.	Sec.	Min. ′	Min. ′	Sec.	Min. ′	″
Sec.	Sec.	Third	Sec. ″	Sec. ″	Third.	Sec. ″	‴
Third.	Third.	Fourth.	Th. ‴	Th. ‴	Fourth.	Th. ‴	⁗
1	0	4	1	15	1	0	15
2	0	8	2	30	2	0	30
3	0	12	3	45	3	0	45
4	0	16	4	60	4	1	0
5	0	20	5	75	5	1	15
10	0	40	6	90	6	1	30
15	1	0	9	135	10	2	30
30	2	0	12	180	20	5	0
60	4	0	15	225	30	7	30
90	6	0	18	270	40	10	0
180	12	0	21	315	50	12	30
360	24	0	24	360	60	15	0

The conftruction of this table is very eafy; for the equator being divided into 360 degrees, and revolving always in 24 hours, any point of it moves through 15° in one hour, and in one minute through the 60th part of 15°, or 15′ of a degree, and in one fecond through 15″ of a degree, &c. and therefore nothing more is neceffary befides fimple addition, in order to have the number of degrees, minutes, and feconds, which it defcribes in any given time.

The ufe of the table is obvious; fuppofe, *e.gr.* it were required to turn 19° 13′ 7″ of the equator into time: againft 15 deg. in the firft column we have 1ʰ 0′ 00″; againft 4 deg. we have 16′ 0″; againft 10 minutes, 40″; againft 3 minutes, 12″ 0‴; againft 5 feconds, we have 0′ 20‴; and againft 2 feconds, 8‴; which, added together, give 1ʰ 16′ 52″ 28‴.

Again, fuppofe it were required to find how many degrees, minutes, &c. of the equator anfwer to 23 hours 25 min. 17 fec. and 9 thirds. Againft 21ʰ in the fourth column of the table, you have 315; and againft 2 hours, 30; againft 20′, 5°; againft 5′, 1° 15′; againft 10 fec. 2′ 30″; againft 5 fec. 1′ 15″ 0‴; againft 2 fec. 30″ 0‴; againft 6 thirds, 1″ 30‴; and againft 3 thirds, 45‴; which, added together, give 351° 19′ 17″ 15‴. See Equinoctial.

Equator, *elevation* or *altitude of the*. See Elevation *of the equator*.

Equator *of the Sun*, or *Solar Equator*. The fun revolves from eaft to weft on an axis inclined to the ecliptic, and the plane, paffing through the centre of the fun perpendicular to this axis, is called the plane of the fun's equator. It cuts the plane of the ecliptic in a ftraight line, called the line of the nodes of this equator; and the nodes themfelves are the points where this line, produced each way, meets the celeftial fphere.

To determine the pofition of the axis of rotation in fpace, it is neceffary to determine the inclination of the folar equator to the ecliptic, and the angle which the line of nodes makes with fome fixed line in the plane of the ecliptic, for example, with the line of the equinoxes. This angle is called the longitude of the nodes of the folar equator, and is thus determined: when the pofition of a fpot on the difc of the fun has been obferved, and its latitude and longitude determined, the direction of the vifual rays drawn to the fpot at the moment of obfervation is known. The longitude of the fun at the fame inftant is likewife known, its diftance from the earth, and its apparent diameter.

The interfection, therefore, of its furface with this ray, is found by a fimple geometrical procefs. Three fimilar obfervations of the fame fpot determine three points upon the furface of the fun, and thefe three fpots are fituated on the fame circumference of fome circle parallel to the folar equator, and the pofition of a plane is known when it paffes through three given points. The plane of this circle defcribed by the fpot will, therefore, be known by thefe obfervations, by which the pofition of the folar equator may be determined.

To determine the fucceffive pofitions of the fpots on the furface of the fun, fuppofed fpherical, we may imagine the three rectangular co-ordinates or axes paffing through the centre of the fun, and continuing parallel to each other during the whole annual revolution. The firft of thefe axes is perpendicular to the ecliptic, the two others are fituated in this plane, one parallel to the line of the equinoxes, the other perpendicular to it. Latitudes and longitudes, reckoned relative to thefe axes from the centre of the fun, are called heliocentric, and they may evidently be found by trigonometric methods, if we can determine their analogous longitudes and latitudes meafured in the fame manner from the centre of the earth, and which are called geocentric.

By methods of this kind it has been found that the folar equator is inclined to the ecliptic about 7°. It continues conftantly parallel to itfelf, the points of this equator, as they are raifed by the rotatory motion of the fun above the plane of the ecliptic, traverfe this plane in a point which, feen from the centre of the fun, was, in 1750, 85°. This was then the heliocentric longitude of the folar equator. Since that time it has undergone no variation except what arifes from the motion of the equinoctial points.

EQUATORIAL Instrument, is an inftrument made ufe of in *Practical Aftronomy*. When a fimple telefcope, mounted on a ftand, is elevated to view any heavenly body at the moment of its meridian paffage, the obferved body appears to pafs horizontally acrofs the field of view, but in any

any other ſituation to the eaſt or weſt of the meridian, the apparent paſſage of any heavenly body through the field of view, is in an oblique direction, and the more ſo, the greater the declination towards the viſible pole, and alſo the greater the diſtance from the meridian line. Hence the motion of the ſimple teleſcope, which moves in a parallel of altitude, or circle parallel to the horizon, when turned round in a ſtate of elevation on its vertical axis, will never coincide with the motion of a heavenly body, that moves either in the equator, or in a circle parallel to it; unleſs indeed the obſerver could ſtand at one of the poles, in which caſe the equator would become the horizon, and circles of altitude would be alſo circles of declination. But no obſerver can be ſo circumſtanced. He may, however, incline the axis of motion of his teleſcope, ſo as to be placed in the meridian, and exactly parallel to the earth's axis, and then, when the field of view is directed to take in any heavenly body, the motion of ſuch inclined axis, or the motion of the teleſcope round ſuch axis, ſuppoſing the axis to be fixed, will attend the ſaid body during the remainder of its path above the horizon. Accordingly we find Chriſtopher Scheiner uſing a teleſcope mounted on a polar axis in the year 1620, which time was ſoon after Galileo had invented the ſimple dioptric teleſcope, and though John Muller, or Regiomontanus, had contrived and deſcribed his torquet, a kind of portable equatorial, in the year 1544, and alſo Tycho Brahe had given the name of *equatoriæ* to ſome of his inſtruments about thirty years afterwards, yet the idea of Scheiner's polar axis no doubt ſuggeſted to the modern inſtrument-makers the beſt principle on which an equatorial inſtrument, as well as equatorial ſector, and equatorial ſtands, ought to be conſtructed. Scheiner's contrivance was competent to the following of a ſtar or other heavenly body through its diurnal arc, but had no appendages by which to aſcertain the place of the obſerved body, as to right aſcenſion, declination, diſtance from the meridian, &c. neither would the teleſcope be directed to a body inviſible to the naked eye for want of ſuch appendages.

Mr. Henry Hindley, an eminent clock-maker at York, was probably the firſt man who contrived and attached the different adjuſtable circles as companions to the teleſcope. Mr. Smeaton, in his paper on the "Graduation of Aſtronomical Inſtruments," read before the Royal Society of London, on November 17, 1785, has informed us, that Hindley contrived an inſtrument of the equatorial kind ſo early as the year 1741, which was ſent up to London to be ſold in the year 1748. This inſtrument had the equatorial plate, quadrant of latitude, and declination ſemi-circle indented at the circumference, and moved by worm-ſcrews, containing fifteen threads each, all in action together, which ſcrews at the ſame time meaſured as micrometer ſcrews, the angular motions, and, as it ſeems, without other graduations. The teleſcope was of the refracting kind, and inverted the object viewed. "It ſtaid with me," ſays Mr. Smeaton, "two years, in which time I ſhewed it to all my mechanical and philoſophical friends, amongſt whom was Mr. Short, who afterwards publiſhed, in the Philoſophical Tranſactions, an account of a portable obſervatory, but without claiming any particular merit from the contrivance. However, the model of it differs from Hindley's equatorial only in the following articles: he added an azimuth circle and compaſs at the bottom; he omitted the endleſs ſcrews, placing verniers in their ſtead, and at the top a reflecting teleſcope inſtead of a refractor. This inſtrument of Hindley's being afterwards returned to him unſold, I pointed out the principal deficiencies that I found therein; *viz.* that in putting the inſtrument into different poſitions, the ſpringing of the materials was ſuch, as in ſome poſitions to amount to conſiderable errors. This remained with him in the ſame ſtate till the year of the firſt tranſit of Venus in 1761, when it was ſold to —— Conſtable, eſq. of Burton Conſtable in Holderneſs. Mr. Hindley, to remedy the evil above-mentioned, applied balances to the different movements. He ſoon after completed one, *de novo*, upon this improved plan, for his Grace the late duke of Norfolk." The next, in point of time, to Mr. Hindley, was Mr. Short, who placed his reflecting teleſcope over a ſyſtem of graduated circles, and who has generally been conſidered as the firſt contriver of the equatorial inſtrument, though it appears evident from Mr. Smeaton's account, that Hindley's inſtrument was prior to his. Mr. Short publiſhed his account in the Tranſactions of the Royal Society, not in the year 1789, as ſtated by a typographical error under our article CIRCLE, but in 1749, in vol. xlvi. N° 493. About the year 1770 a rage for making equatorial inſtruments generally prevailed, and numberleſs were the modifications that makers of every deſcription produced, but the chief improvers of the inſtrument at that period were Nairne, Ramſden, and Dollond, who married Ramſden's ſiſter, all of whom, ſoon after the year juſt ſpecified, improved on the original portable inſtrument, chiefly by introducing the improved dioptric in place of the heavy catoptric teleſcopes, and by uſing the beſt divided circles, together with the moſt accurate adjuſtments, balancing of the parts, and nicely divided verniers. Mr. Ramſden, to ſecure the advantages of his ſhare of the improvements, took out a patent for his inſtrument, including the refraction apparatus, and hanging level in the year 1775.

Still, however, the equatorial inſtrument had its ſcale of magnitude adapted only for portability, and its circles conſequently were not capable of meaſuring with that degree of accuracy that celeſtial obſervations demand, to be of real uſe in the preſent improved ſtate of aſtronomy; and it remained for Mr. Edward Troughton to conſtruct an equatorial inſtrument ſufficiently large to be placed in an obſervatory, for the purpoſe of making uſeful obſervations. This ingenious artiſt contrived many commodious modifications of the inſtrument under our preſent conſideration, but we mean to confine our notice to two of the principal of them, both worthy of future imitation; one as a moveable, though not very portable inſtrument, and the other as a fixed one. The firſt was made to go to Coimbra, in Portugal, where it has had the ill fate to be ſhut up in the dark, though it was finiſhed ſo long ago as the year 1788; the latter is now in uſe under the direction of Dr. Hamilton, at Armagh, in Ireland, and is that with which the Armagh obſervations were made; of theſe Mr. Pond, the lecturer on aſtronomy at the Royal Inſtitution, availed himſelf when he compoſed his famous catalogue of declinations of ſome of the principal ſtars, which we noticed under our article CIRCLE, and which is inſerted in the article DECLINATION. This inſtrument was made in the year 1796; about three years after ſir George Shuckburgh's large equatorial inſtrument was deſcribed in the Philoſophical Tranſactions of London, as an inſtrument on a large ſcale, carefully made under Mr. Ramſden's direction by Mr. Berge, who has ſince become his ſucceſſor. The principal modern authors who have deſcribed the different equatorial inſtruments, are Mr. Short, Mr. Benjamin Martin, Mr. Nairne, Mr. Dollond, the Hon. Stuart M'Kenzie, profeſſor Vince, and ſir George Shuckburgh; at one time it was our intention to deſcribe one or two only of the different conſtructions of this inſtrument, and to have noticed the differences of the others; but to do juſtice to the ſubject, and to ſhow more clearly the progreſſive progreffive improvements in the art of conftructing aftronomical inftruments of this defcription, we have determined to give drawings and correfponding defcriptions, in fucceffion, of each inftrument that appears to poffefs any claim to originality. Of courfe we muft avail ourfelves of the refpective defcriptions that have been publifhed of the various inftruments that have been before defcribed, but our detail will be a condenfed one, and interfperfed with original remarks, tending to affift the reader in forming his opinion of their refpective merits; and where no defcription has been previoufly given, as is the cafe with Mr. Troughton's inftruments, and a neat portable one by his nephew, Mr. Farer, we fhall fupply the accounts from original and authentic fources, preferving, as we proceed, that order of time in which the feveral inftruments were conftructed, except in the inftance of Mr. Farer's, which being portable, we have thought it better to place immediately after the portable ones of older date, by way of contraft, than to give it a place after the larger and more complete inftruments.

Portable Equatorial Inftrument by Mr. James Short.—We have already faid that Mr. Short's equatorial inftrument, called by him the equatorial telefcope, or portable obfervatory, was the firft inftrument probably made in England that could be confidered as a well arranged affemblage of graduated circles for afcertaining the various data of a heavenly body's place, out of the meridian, by a fingle obfervation. Mr. Ben. Martin has given a brief defcription of this inftrument, together with its ufes, in appendix II. of his Philofophia Brittannica, the fubftance of which, not being in every one's hands, we think may be acceptable to our readers, particularly as its perufal will afford the beft means of contrafting the more improved inftruments with the original model, and, confequently, of tracing the progrefs that the art of making inftruments of this kind has made within the period of our own recollection. *Fig.* 1. of *Plate* XI. of *Aftronomical Inftruments*, exhibits a perfpective view of all the effential parts of Mr. Short's inftrument, which is compofed of four graduated circles, two of them entire, and two of them about three-fourths of a circle, together with a four-footed ftand, a variety of fupporting pillars, levels, wheels, and endlefs fcrews, axes of motion, and a reflecting telefcope furmounted over the whole. A, A, are two horizontal plates one over the other, and reprefenting the horizon of the place of obfervation; thefe plates reft on four pillars of the pedeftal, that contains a magnetic box and needle, and that is fupported by the four adjuftment fcrews B, B, B, B, the lower plate being faft to the pillars, and the upper one, that carries two fpirit levels on its plane at right angles to each other, being moveable by a rod or handle C, the fcrew on which takes into the teeth cut on the edge of this upper horizontal plate. This moveable plate is divided into 360°, and a vernier borne by the under plate reads to the accuracy of every *three minutes*. Another fet of four pillars, inferted into the moveable horizontal plate, fupports the vertical circle D D, or rather portion of a circle, which is divided into twice 90°, and fomewhat more at each fide, and is called the meridian circle; its vernier, placed on the upper horizontal circle, reads alfo every three minutes of fpace. The handle or rod E moves this circle in like manner as the rod C moves the horizontal circle defcribed. On the upper or mutilated part of the meridian circle D D, are placed two other plates, the upper one moveable on the under one, like the horizontal plates, and the vernier carried by the under one. It does not appear from the drawing or account whether the axis of motion rotates or is fixed. The upper or moveable plate, marked F F, is divided into hours and ten-minute fpaces, and thefe again are fubdivided by the vernier into fingle minutes of time. This plate, which is called the equatorial plate, has a third fet of pillars inferted into it, and is moveable by the rod G, like the other moveable plates; the pillars fupport a fourth circle, or rather mutilated circle H H, on the upper part of which the telefcope L L is mounted, as feen in the drawing. This uppermoft circle is called the circle of declination or horary circle, and is divided into twice 90°; it is alfo moveable by the rod or handle K, like the reft of the moveable circles; and has every three minutes of fpace, by its vernier, placed on the plane of the equatorial circle. The telefcope is of the Gregorian conftruction, with a great fpeculum of 18 inches focal length. In making the adjuftments of this inftrument for obfervation, the horizontal plates A, A, are firft levelled by the joint aid of the two levels and fcrews of adjuftment that bear the whole fabrick; this adjuftment is not perfect till the bubbles of the levels will remain ftationary, in the middle of their tube, while the upper plate is carried quite round the fubjacent one. In the next place the meridian circle D D is turned by its handle E, till the equatorial plates are parallel to the equator; that is, till they are raifed equal to the complement of the latitude of the place of obfervation, and the inftrument is faid to be fit for making obfervations; of courfe the placing of the circles relatively to each other, in regard to perpendicularity, and of the line of collimation of the telefcope in regard to the points zero in the declination circle, are fuppofed to be immoveably adjufted by the maker, fo as to require no future rectification. As it will be of fome importance to the developement of the progreffive improvements of the different equatorial inftruments, to confine ourfelves to the ufes that this inftrument by Mr. Short was applied to, we cannot do better than confine ourfelves to the words of one of the early defcriptions of its practical application.

"*To find the Hour of the Day, and Meridian of the Place.*—Firft, find, from aftronomical tables, the fun's declination for the day, and for that particular time of the day; then fet the declination-femicircle to the declination of the fun, taking particular notice whether it is north or fouth, and fet the declination-femicircle accordingly.

"You then turn about the horizontal handle, and the equatorial handle, both at the fame time, till you find the fun precifely concentrical with the field of the telefcope. If you have a clock or watch at hand, mark the inftant of time; and by looking upon the equatorial plate and vernier, you will find the hour and minute of the day, which comparing with the time fhewn by the clock or watch, fhews how much either of them differs from the fun. In this manner you find the hour of the day.

"Now, in order to find the meridian of the place, and, confequently, to have a mark by which you may always know your meridian again, you firft move the equatorial plate, by means of the equatorial handle, till the meridian of the plate or hour-line of 12 is in the middle of the vernier; and then, by turning about the declination-handle till the telefcope comes down to the horizon, you obferve the place or point which is then in the middle of the field of the telefcope; and a fuppofed line, drawn from the centre of this field to that point in the horizon, is your meridian line. The beft time of the day for making this obfervation for finding your meridian is about three hours before noon, or as much after noon. The meridian of the place may be found by this method fo exact, that it will not differ at any time from the true meridian above 10″ of time, and if a proper allowance be made for the refraction at the time of obfervation, it may be found much more exact. This line

line thus found will be of ufe to fave trouble afterwards; and is, indeed, the foundation of all aftronomical obfervations.

"*To find a Star or Planet in the Day-Time, even at Noon-Day.*—The inftrument remaining as rectified in the laft experiment, you fet the declination-femicircle to the declination of the ftar or planet you want to fee; and then you fet the equatorial plate to the right afcenfion of the ftar or planet at that time, and, looking through the telefcope, you will fee the ftar or planet; and after you have once got it into the field, you cannot lofe it: for, as the diurnal motion of a ftar is parallel to the equator, by your moving the equatorial handle fo as to follow it, you will at any time, while it is above the horizon, recover it, if it be gone out of the field.

"The eafieft method for feeing a ftar or planet in the day-time is this: your inftrument being adjufted as before directed, you bring the telefcope down fo as to look directly at your meridian mark; and then you fet it to the declination, and right afcenfion, as before-mentioned.

"By this inftrument moft of the ftars of the firft and fecond magnitude have been feen even at mid-day, and the fun fhining bright; as alfo Mercury, Venus, and Jupiter: Saturn, and Mars are not fo eafy to be feen, upon account of the faintnefs of their light, except indeed when the fun is but a few hours above the horizon.

"And in the fame manner in the night-time, when you can fee a ftar, planet, or any new phenomenon, fuch as a comet, you may find its declination and right afcenfion immediately, by turning about the equatorial handle, and declination handle, till you fee the ftar, planet, or phenomenon; and then looking upon the equatorial plate, you find its right afcenfion in time; and you find upon the declination-femicircle its declination in degrees and minutes.

"In order to have the other ufes of this inftrument, you muft make the equatorial plates become parallel to the horizontal plates; and then this inftrument becomes an equal altitude inftrument, a tranfit inftrument, a theodolite, a quadrant, an azimuth inftrument, and a level. The manner of applying it to thefe different purpofes is too obvious to need any explanation.

"As there is alfo a box with a magnetic needle faftened in the lower plate of this inftrument, by it you may adjuft the inftrument nearly in the meridian; and by it likewife you may find the variation of the needle; if you fet the horizontal meridian, and the equatorial meridian, in the middle of their verniers, and direct your telefcope to your meridian mark, you obferve how many degrees from the meridian of the box the needle points at: and this diftance or difference is the variation of the needle."

Thefe are the ufes to which Mr. Short's inftrument, before us, was principally applied, and had the circles been divided with verniers fubdividing the divifions more minutely, it would have been fomething more than an aftronomical play-thing, to which it cannot be confidered as any thing fuperior, when it comes to be contrafted with one of the moft improved kind, even of thofe that are equally portable. We cannot difmifs our notice, however, of the prefent inftrument, without remarking further, that the manner in which the two pairs of plates A A, and F F, move over each other refpectively, is by no means calculated to preferve a fteady undeviating motion, for want of a fufficient length in the axis of motion. This is the principal objection we expreffed to Dr. Wollafton's circle made by Mr. Cary, and if the doctor borrowed his notion of fuch a pofition of his circles from Mr. Short, he copied one of the worft properties that this artift's inftrument poffeffes.

This equatorial inftrument has obtained the name of univerfal, from the circumftance of its being applicable to ufe in any latitude; which name is equally due to its fucceffors.

Portable Equatorial Inftrument by Mr. Ed. Nairne.—The imperfections of the preceding inftrument were attempted to be removed by Mr. Nairne, whofe conftruction introduced a long axis of motion for the horizontal circle, thereby effecting a fteadinefs in its performance, and placed the telefcope on the axis of the declination-femicircle to obtain a lefs encumbered elevation of the telefcope; but ftill the circles were not graduated fo minutely as to render them of real ufe in practical aftronomy. A brief account of this inftrument is contained in vol. lxi. part i. of the Philofophical Tranfactions of London, and was read before the Society on Feb. 7, 1771. Its fubftance is this:—

The inftrument confifts of the following parts, *Plate* XII. *fig.* 1. of *Aftronomical Inftruments*, a mahogany triangular ftand A A A, and three adjufting fcrews B, B, B, a moveable azimuth circle C, which is divided into degrees, and by a vernier index into every fix minutes; above this azimuth circle is the horizontal plate D, to the under part of which is faftened the vertical conical axis E; on the middle of the upper furface of the horizontal plate is placed a ground glafs level F, by which the plate D is fet parallel, and the pillar E perpendicular to the horizon; from this plate rife perpendicularly two quadrants G, G, one of which is divided for the latitude into half degrees, and has a vernier index to three minutes; the equatorial plate H, with its hour circle, is fupported by the two quadrants G, G, its axis of motion, which is placed near the hours XII, XII, paffes through the centres of the quadrants, and carries the index I, pointing to the divided quadrant; the equatorial plate is divided into half degrees, and has a vernier index fhewing every three minutes of right afcenfion, or 12 feconds of time: it is figured to fhew both degrees and time. To prevent mifapprehenfion it may be right to remark that the hours XII, XII, ought properly to have been placed according to the meridian line; but they are here placed otherwife for the convenience of better feeing the meridian diftance fhewn by the vernier. On the upper part of the equatorial plate is the plate K; upon this plate K are fixed the two fupporters M, M, which fupport the axis N, *under* which is faftened the femicircle of declination O, divided into half degrees with a vernier fubdividing it into every three minutes. On the *upper* part of this axis is fixed an achromatic telefcope P, which magnifies about 50 times; to the eye-end of this telefcope is applied a fmall reflecting fpeculum, making an angle of 45° with the axis of the telefcope, whereby objects that are in the zenith or in any other altitude may be obferved without putting the body in an inconvenient pofition. To the under part of the axis N is faftened a brafs arm carrying the weight Q, which counterbalances the telefcope, and brafs-work annexed to it; whilft the weights R, R, counterbalance in like manner the whole of the inftrument that is moveable on the equatorial axis, fo that whatever pofition the inftrument is put in it will there remain, being perfectly balanced. The four motions of this inftrument may, when required, be moved extremely flowly, by means of the indented edges of the circles and femicircles, and the fcrews or worms of the handles S, T, V, and W, for the horizontal circle, the motion for latitude, the equatorial and declination motions refpectively. The adjuftments and ufes of this inftrument are fo fimilar to thofe of its predeceffor, both in kind and extent, that it would be fuperfluous to particularize them again. In this account it is not ftated whether the axis of motion of the equatorial circle is prolonged,

longed, but as the height to which it is elevated above the horizon circle feems to admit of it, and as the axis of this is elongated, we are difpofed to believe that a fimilar advantage belonged to the former; otherwife it would not have that ftability that is neceffary in this part of the inftrument for making the moft effential motion fteady enough to be depended on. How far the mahogany legs were firm and fteady enough for the purpofe of affording a motionlefs pedeftal is not faid; but the want of accuracy, or rather the want of minutenefs in the divifions and fubdivifions of the graduated circles, quadrant, and femicircle, made this confideration of lefs importance than it would have been in an inftrument poffeffing greater powers. We have been informed, from credible authority, that Mr. W. Ludlam, of St. John's college, Cambridge, was the principal contriver of Mr. Nairne's conftruction.

Ramfden's portable equatorial inftrument.—The principal parts of this inftrument, fays profeffor Vince, (Treatife on Prac. Aftr.) are, the azimuth circle G H, the equatorial, or hour circle E F, and the declination circle C D; (fee *Plate* XI. *fig.* 2. of *Aftronomical Inftruments*,) to this latter there is fixed a telefcope A B, having under it a rod *m n*, paffing through two pieces π, ρ, in one of which, as π, are two fcrews acting on the rod againft each other, in order to adjuft the rod perpendicular to the axis on which the declination circle turns. The azimuth circle G H lies on a brafs plate *t u*, fupported by three feet, refting on the fcrews X, Y, Z, and on this plate it turns about an axis T, by means of a fcrew S; upon this circle are placed two fpirit levels *c d*, *a b*, at right angles to each other, fupported at each end by a fcrew, by which they may be adjufted; the circle is divided into twice 180°, and has a vernier V fixed on the plate *t u*, by which the degrees are fubdivided into minutes or half minutes, according to the fize of the inftrument; and by means of the fcrew I the circle may be fixed to the plate *t u*. K K is a polar axis moveable about a centre L, fuftained by two fupporters *q*, *i*, refting on two pieces W, V, firmly connected to the plane of the circle G H; the lower end of this axis has an arc fixed to it, which runs againft an arc *z y*, attached to G H, and to which it may be fixed by a key at *e*; and in this fituation, if you apply the key to Q, it gives a motion to the axis, by which you may very accurately adjuft the telefcope to an object. To the centre L, and perpendicular to the polar axis, are fixed two ftrong pieces of brafs, one of which is here reprefented by *x*, and the other is on the other fide of the axis; thefe fupport a circle $\alpha\ \beta\ \gamma\ \delta$; on the top of the polar axis, and perpendicular to it, is placed a brafs plate, moveable about a pivot on the top of the axis; to this are fixed four pieces, two of which are reprefented by *f*, *g*; thefe are connected to the hour circle E F, lying on $\alpha\ \beta\ \gamma\ \delta$, and carry it about; upon $\alpha\ \beta\ \gamma\ \delta$, at W, is fixed a vernier to the circle E F, which circle is divided into twice twelve hours. The declination circle C D is fupported by its centre, on an axis refting on two fupporters *h*, *k*, on one fide, and two others of the like kind on the other; thefe reft upon the brafs piece on the top of the polar axis, and may be adjufted by two pair of fcrews at the feet of the two fupporters, to fet the plane of the declination circle perpendicular to the hour circle, which, by the maker, is placed perpendicular to the polar axis. This circle is divided from zero both ways to a little more than 90°, and a vernier is placed at R to fubdivide, as at V. A fmall quadrant is fixed to the eye-piece of the telefcope, which turns round upon the piece, carrying two wires perpendicular to each other, for the parallel of declination and hour circle. The eye-piece carries two crofs wires to reprefent the circle of altitude and a parallel to the horizon. The quadrant has two radii *l*, *o*, perpendicular to each other, and move together; the former has a round or circular fpirit level upon it, fo that by turning about the eye-glafs and the quadrant till the bubble refts in the middle, the plane of the quadrant becomes perpendicular to the horizon; and the vernier on the latter fhews the altitude to which the telefcope is directed, and the correfponding refraction; and in this pofition the circle of altitude is perpendicular to the horizon. At P is a fmall micrometer circle, called the refraction circle, (with a fixed index,) moveable by a finger fcrew; this circle is divided into half minutes, and one revolution is equal to 3′ 18″; when moved it raifes or depreffes the centre of the crofs wires in a circle of altitude.

After this general defcription of the parts of the inftrument, let us confider what motions it is capable of, and what the circles may be made to reprefent, before we proceed to its adjuftments. And firft, the azimuth circle G H, being fet parallel to the horizon, will reprefent the horizon; fecondly, if the polar axis K K be inclined to the horizon at an angle equal to the latitude of the place, the equatorial circle E H will be inclined to the horizon in an angle equal to the inclination of the equator to the horizon; therefore, if we turn about the azimuth circle, and confequently the equatorial circle, the latter may be made to coincide with the equator; thirdly, if the declination circle be fet perpendicular to the equatorial, then the confequences muft be, that if the line of collimation be adjufted parallel to the plane of the declination circle, or perpendicular to its axis, and alfo parallel to the equatorial circle E F, when zero on the declination circle coincides with zero on the vernier R, then the telefcope is directed to the equator in the heavens, and by turning about the declination circle the line of collimation will defcribe a fecondary to the equator; and by fetting the declination circle to the declination of any body in the heavens, if we turn about the circle E F, and confequently the circle C D with the telefcope, on the brafs plate, on the top of the polar axis (which is kept fixed,) the equatorial circle, moving in its own plane perpendicular to the polar axis, muft continue to coincide with the equator, and, confequently, the telefcope will defcribe a parallel to the equator, and therefore muft bring the body into the field of view. Thefe being the motions of the parts of the inftrument, we may now proceed to defcribe the neceffary adjuftments for them.

Adjuftments.—1. *To adjuft the azimuth circle parallel to the horizon.*—Turn it till one of its levels becomes parallel to a line joining two of the fcrews at the feet, as X, Z, and then adjuft that level with one of them; turn the circle half round, and if the bubble be not in the middle, adjuft it half way, by one of the above-mentioned fcrews, and half way by the fcrew at one end of the level; repeat this operation till the bubble ftands right in both thefe pofitions; then turn the circle at right angles to thefe pofitions, and, if neceffary, fet the bubble right by the other fcrew Y at the foot, and the adjuftment is made. If you previoufly adjuft the other level by one of the fcrews at the end, then the circle may be adjufted horizontal by them, without turning it.

2. *To adjuft the level* r s *parallel to the rod* m n.—Set the polar axis, as near as you can, perpendicular to the horizon, and turn about the declination circle C D by a pinion for that purpofe, until the bubble of the level *r f* ftands in the middle; reverfe the level, and if the bubble do not ftand in the middle, adjuft it half way by the fcrew at S, under one

one end of the level, and half way by turning the declination circle; and repeat the operation till the bubble ſtands in the middle in both poſitions.

3. *To adjuſt the rod* m n *perpendicular to the axis on which the declination circle turns.*—Set the polar axis as near as you can parallel, and conſequently the equatorial circle perpendicular to the horizon; ſet the declination circle to zero, and turn the hour circle till the bubble ſtands right; then ſet the declination circle to 90°, and adjuſt the bubble by the polar axis: then turn the declination circle to the oppoſite 90°, and if the level be not right, correct half the error by the polar axis, and the other half by the two ſcrews in the piece π, releaſing one and ſcrewing up the other; repeat this operation till the bubble ſtands right in both poſitions, and the adjuſtment is made. For theſe two adjuſtments tend, the former to ſet the axis of the declination circle, on the axis about which the rod revolves, perpendicular to the horizon: and the other to ſet the rod *m n* parallel to the horizon, and conſequently perpendicular to that axis; when, therefore, the bubble thus continues right, both circumſtances muſt have taken place.

4. *To ſet the axis of the declination circle perpendicular to the polar axis.*—The inſtrument remaining as in the laſt adjuſtment, that is, the declination circle at 90° and the bubble right, turn the equatorial circle half round, and if the bubble be not right, correct half the error by the polar axis, and the other half by the two pair of ſcrews at the feet of the two ſupporters *h, k;* and repeat this operation till the bubble is right in both poſitions, and the adjuſtment is completed. For the former adjuſtment tends to ſet the axis of the declination circle perpendicular to the horizon, and the latter to ſet it parallel to the equatorial circle, or perpendicular to the polar axis; conſequently, when the bubble is right in both the above poſitions both circumſtances muſt take place, that is, the polar axis muſt be parallel to the horizon, and the axis of the declination circle perpendicular to it. And as this adjuſtment is made by the level, which is horizontal when the axis of the declination circle is thus adjuſted perpendicular to the horizon, and which is previouſly adjuſted parallel to the rod, they muſt both be perpendicular to the axis, about which they turn; and, conſequently, they move in a plane paſſing through the polar axis, or perpendicular to the equatorial circle. Hence, alſo, the declination circle, being perpendicular to its own axis, becomes perpendicular to the equatorial circle.

5. *To make the centre of the croſs wires cut the ſame object whilſt you turn round the eye-glaſs by the pinion of the refraction apparatus.*—Set the index on the refraction circle to the beginning of the diviſions, and turn round the eye-glaſs, and if the centre of the wires do not continue to cut the ſame object, correct it by four ſmall ſcrews (which you will find by unſcrewing the neareſt end of the eye-tube which contains the firſt eye-glaſs), the two oppoſite at a time, and repeat the correction till the centre continues to cut the ſame object.

6. *To make the line of collimation deſcribe a great circle perpendicular to the equatorial circle.*—Set the declination circle to 90°, and the equatorial circle to VI, and bring the bubble to the middle by the polar axis. Then note ſome object covered by the centre of the croſs wires, repreſenting the parallel of declination and hour circle, and turn the equatorial circle half round, and if the ſame object be not now covered by the centre of the wires, move, if neceſſary, the declination circle in its own plane, until it is in the ſame vertical circle with the object, and then bring the centre half way to it by the upper and lower of the four ſmall ſcrews which move theſe wires, and turn the declination circle back through half the ſpace it was moved, and you get a new object now covered by the centre of the wires; repeat this operation till the ſame object be covered in both theſe poſitions; then ſet the hour circle to XII, and bring the bubble to the middle by the declination circle, and if the centre do not now cover the ſame object, bring it to the object by the other two ſcrews, and the line of collimation is adjuſted parallel to the level, or to the rod *m n*, and, conſequently, it muſt be perpendicular to the axis of the declination circle. Hence as that circle is turned about in its own place, the line of collimation muſt deſcribe a ſecondary to the equator. The line of collimation for the centre of the croſs wires being thus adjuſted, it is, at the ſame time, in the centre of motion, on which the wires parallel and perpendicular to the horizon turn; hence, when the index of the refraction circle is ſet to the beginning of the diviſions, the interſections of the two ſets of wires coincide. The adjuſtment of the wire parallel to the equatorial circle may be examined by the paſſage of a ſtar through the teleſcope, (all the other adjuſtments being previouſly made, and the equatorial circle adjuſted to coincide with the equator in the heavens, and the declination circle ſet to the ſtar's declination;) for if the ſtar do not run upon the wire, it muſt be adjuſted till it does: or it may be done thus. Set the equatorial circle to XII, and having directed the line of collimation to ſome ſmall well defined object, turn the declination circle in its own plane, and obſerve whether the perpendicular wire continue to cut the ſame object as it paſſes through the field of view; if not, adjuſt till it does.

7. *To adjuſt the verniers of the equatorial and declination circles.*—Elevate the equatorial circle to an angle of about 45°, as moſt proper for this purpoſe, and ſet the declination circle to zero, and turn the equatorial circle in its own plane till the bubble ſtands right; then turn the equatorial circle half round, and if the bubble do not ſtand right, adjuſt half by moving the equatorial, and half by moving the declination circle; and repeat this operation till the bubble ſtands right in both poſitions, then, by moving the verniers, ſet zero on the vernier belonging to the equatorial circle to VI, and zero on the vernier belonging to the declination circle to zero, and the verniers are adjuſted. Thus the inſtrument is ready for obſervation, except that the azimuth circle is not adjuſted to ſhew azimuths, which will be done when we come to ſhew the methods of making obſervations.

The method here uſed ariſes out of the two diſtinguiſhing features of the inſtrument under our conſideration; namely, the poſition of the level near the teleſcope, and the want of graduations on the latitude arch, or arch for giving the polar axis its due inclination.

But the Hon. Mr. M'Kenzie's method appears to us more ſimple, as well as more intelligible, for elevating the equatorial circle to the co-latitude of the place, thus; "lower the teleſcope as many degrees, minutes, and ſeconds below zero, on the declination-ſemicircle, as the complement of your latitude is; then elevate the polar axis till the bubble be horizontal, and the equatorial circle will be elevated to the co-latitude of the place, as required; after which the level may be made to ſtand true in oppoſite poſitions, and the verniers be placed to zero, as above directed.

Mr. Atwood, in his Syllabus, has given another method of making this adjuſtment, which profeſſor Vince acknowledges to have the advantage over his in point of both eaſe and accuracy, the ſubſtance of which is as follows:

 Having

Having ſet the declination circle to 90° in either quadrant, direct the point of interſection of the croſs-wires to coincide with ſome diſtant object as a mark; turn the equatorial circle in its own plane 180°, and if the interſection does not now coincide with the diſtant mark, correct half the error in declination by moving the declination circle in its own plane, and half the error in right aſcenſion by the feet ſcrews of the ſupporters that adjuſt the axis of the declination circle; now if theſe adjuſtments be accurately made, the interſection will coincide with any diſtant mark, choſen anew, when the equatorial circle has been turned 180°; but if the coincidence is not perfect, the ſame adjuſtments muſt be repeated till the condition is fulfilled. The line of collimation being now directed to coincide with the diſtant mark, ſet the vernier of the declination circle to 90°, and turn this circle 180° in its own plane, turn alſo the azimuth circle, ſo that the line of collimation may be again directed to the ſaid diſtant mark, then turn the equatorial circle about in its own plane 180°, and if the diſtant mark be not now covered by the interſection, the quantity of deviation ſhews double the total error of dividing the two ſemi-circles of the declination circle, and alſo its excentricity, which errors cannot be allowed for by adjuſtment. The error in right aſcenſion, now diſcovered, muſt ariſe from the plane of the declination circle not being quite perpendicular to the equatorial, and alſo from the line of collimation not being exactly parallel to the plane of the declination circle; therefore correct $\frac{1}{4}$th of the error by the ſcrews of the declination axis, and $\frac{1}{4}$th by moving the line of collimation perpendicular to the plane of the declination circle: if the firſt trial of theſe adjuſtments be not attended with complete ſucceſs, when the diſtant mark is again examined in reverſed poſitions they muſt be repeated till they are correct. Hence it is manifeſt, when the above adjuſtments are properly made, 1ſt, that the line of collimation is parallel to the plane of the declination circle; 2dly, that the plane of the declination circle is perpendicular to the plane of the equatorial; 3dly, that the errors of diviſion are at the oppoſite points 90°, if any are diſcovered in the declination circle, and, 4thly, that when the declination circle is ſet to 90°, the line of collimation is perpendicular to the plane of the equatorial circle, or, when it is ſet to zero, it is parallel to it.

The azimuth circle being adjuſted horizontal, and the declination circle put to 90°, make the vertical wire parallel to it, turning the equatorial and azimuth circles in their reſpective planes; direct the point of interſection to a diſtant mark near the horizon, and move the azimuth and declination circles each in their own planes to 180°, ſo that the ſaid mark may appear ſomewhere in the vertical wire, and if there is an error in altitude, let the line of collimation biſect it, by moving the polar axis, and it will then be horizontal. Let this new biſected point or mark in the horizon be noted; then the declination circle being put to zero, turn the azimuth circle 90°, ſo as to bring the new mark upon the croſs wire, and direct the interſection to it by turning the equatorial circle in its own plane, and the declination is in that ſituation parallel to the horizon. The inſtrument remaining as before, turn the equatorial and azimuth circles in their reſpective planes 180°, and if each circle be accurately divided, the teleſcope muſt evidently be brought into a poſition exactly parallel to its former one, and therefore the interſection of the wires will again coincide with the new mark in the horizon. Otherwiſe the quantity each of thoſe circles muſt be moved further or back, will ſhew their reſpective errors of excentricity and alſo of diviſion. Laſtly, the declination circle being at zero, and the line of collimation or interſection made to coincide with the horizontal mark, by moving the equatorial and azimuth circles, ſet the equatorial vernier to VI, and the adjuſtment is finiſhed; for the line of collimation being parallel to the horizon and to the plane of the declination circle when the vernier ſtands at VI, that plane, by revolving about the polar axis, muſt be perpendicular to the horizon when the vernier ſtands at XII, which is the thing required.

Methods of making Obſervations.

1. *To take the altitude of a body above the horizon.*—Set XII on the equatorial circle to zero on its vernier, and the plane of the declination circle is then perpendicular to the horizon; make, therefore, the line of collimation horizontal, by bringing the bubble to the middle of the level in the teleſcope, and obſerve what point of the declination circle ſtands againſt zero in its vernier, and then by moving the declination and azimuth circles in their own planes, bring the body to the centre of the croſs wires, and obſerve again what point of the declination circle ſtands againſt zero, and the arc intercepted between theſe two points gives the apparent altitude. If the declination circle had been ſet to zero, and the line of collimation been adjuſted horizontal by moving the polar axis, then, when the body had been brought to the centre of the croſs wires, the declination circle would have ſhewn its altitude at once. For Mr. Atwood's indirect methods of taking an altitude, ſee pages 163, 164, and 165 of Vince's "Treatiſe on Practical Aſtronomy."

2. *To meaſure very ſmall vertical angles.*—Let the elevation of the equatorial circle be a, the polar diſtance of the teleſcope (either more or leſs than 90°) be b, and ſet XII (correſponding to noon) on the equatorial circle to zero; then if that circle deſcribes an angle whoſe verſed ſine is v, and the line of collimation be brought (by moving the azimuth circle) back to the ſame vertical, it will have been depreſſed through a vertical arc equal to $\frac{v \times si.a \times si.b}{si.b - a}$, radius being unity. Or, if $b = 90°$, the depreſſion $= v \times \tan. a$. Hence if, for example, it ſhould be required to find the angle which the horizontal wire of the teleſcope ſubtends, ſelect ſome well defined diſtant object, ſet the declination circle to zero, and XII on the equatorial to zero, and elevate the equatorial ſo as to bring the object into the field of view, and make the upper edge of the wire coincide with it, then move the equatorial and azimuth circles in their own planes till the lower edge coincide with it, and read off the equatorial arc. *Ex.* If the elevation of the equatorial be 41° 3′, and the arc denoted by the equatorial vernier be 57′, the angle required = vec. ſin. $57' \times \tan. 41° 3' = 24'' 6'''$. Hence alſo the diameter of a planet may be meaſured. When the planet comes to the meridian (the two circles being fixed as before) alter the elevation of the equatorial circle, and bring the upper edge of the horizontal wire to be a tangent to the upper limb of the planet (or the apparent lower limb), and then by turning the azimuth and equatorial circles in their own planes, bring the lower edge of the wire to be a tangent to the lower limb of the planet (or the apparent upper limb), and the rule gives the ſum of the diameters of the planet and wire, from which ſubtract the diameter of the wire, and you get the diameter of the planet.

3. *To find the latitude of a place.*—Take the altitude of the ſun's upper or lower limb a little before noon, and continue your obſervation till he riſes no longer, and you get

 his

his apparent meridian altitude; with which and his declination you may find the latitude by the common rule.

4. *To incline the equatorial circle so as to make any angle with the horizon.*—Set the declination-circle (in the southern quadrant) to the given angle, and XII on the equatorial circle to zero on its vernier; then bring the line of collimation horizontal by moving the polar axis till the bubble in the level on the telescope stands in the middle, and the equatorial circle stands at the proper angle.

5. *To determine the position of the meridian.*—Elevate by the last article the equatorial circle, to make an angle with the horizon equal to the co-latitude of the place, and set the declination-circle to the declination of any known star, then turn the equatorial and azimuth-circles in their own planes till the star is brought to the centre of the cross wires, and correct the position of these circles on account of refraction, by the small quadrant and apparatus at the eye-piece of the telescope, and the equatorial circle will then coincide with the equator in the heavens, and the vernier will shew how far, in time, the star is from the meridian; and hence, if we turn the equatorial circle till XII stands at zero on the vernier, the plane of the declination-circle will coincide with the meridian. Hence, if we direct the telescope to the horizon, the point which the centre of the wires will cut is the south point of the horizon, and may serve for a meridian mark. If the point of the arc of the azimuth-circle lying against zero on its vernier be noted, the error in its position will be known; and if this be very small, so that by moving the vernier till zero on it may be brought to zero on the arc, it may be adjusted to shew azimuths. The position of the vernier of the azimuth-circle may also be verified thus. The equatorial-circle being set parallel to the horizon, and XII set to zero on its vernier, turn the azimuth-circle, and by moving the declination-circle, bring a star on the east side of the meridian to the centre of the cross wires, and note the azimuth, then turn the azimuth-circle (the telescope remaining fixed) and do the same when the body comes to the west side; and if the azimuths at both observations be the same, the vernier is adjusted right; if not, half their difference is the error. The instrument being set upon a moveable plane, if the points on which the three screws at the feet rest be marked, it will then always be easy to set the azimuth-circle very nearly in its proper position.

6. *To determine the apparent time of the day.*—Proceed as in the last article, only take the sun instead of a star, and bring its centre to the centre of the cross wires, and correct for refraction, and the arc intercepted between XII and zero on the vernier shews the distance of the sun, in time, from the meridian, or from apparent noon.

7. *To find a star or planet in the day-time.*—Elevate the equatorial-circle to make an angle equal to the co-latitude, and adjust it to coincide with the equator in the heavens, and set the declination-circle to the declination of the body. Find by the usual way the distance of the star from the meridian at the time required, and reduce it to siderial time; then turn the equatorial-circle in its own plane, east or west, as the star lies, till the arc between XII and zero on the vernier be equal to that time, and the star will be in the field of view. By this means Jupiter, Venus, and fixed stars of the first magnitude, may be observed in the day-time.

8. *To find the right ascension and declination of a star.*—Elevate the equatorial-circle to the co-latitude of the place, and previously set it to coincide with the equator in the heavens, and set XII on the equatorial-circle to zero on its vernier. After this set the declination-circle to the sun's declination, and take the time of its transit; then set the declination-circle to the star's declination and take the time of its transit, and the difference of the times will give the difference of their right ascensions; and the star's transit being taken at the intersection of the wires, the declination-circle (corrected for refraction) will give its declination. Thus also you may compare two stars, or the moon and a star. Or it may be done at any time, if you move the declination and equatorial-circles in their own planes till the star is brought to the centre of the cross wires, and correct the position of these circles on account of refraction, and the declination-circle will give you the declination required; and the vernier of the equatorial-circle will give you the star's distance, in time, from the meridian, or your clock will give you the sun's distance, the difference of which times gives the difference of their right ascensions, and, therefore, knowing the sun's right ascension, you have the right ascension of the star.

9. *To find the longitude.*—The equatorial-circle being set to coincide with the equator in the heavens, and XII to zero on its vernier, take the time of the transit of the moon's limb, and also of a proper star as near as possible to the moon's parallel, and the longitude may be determined therefrom by the lunar method, in the usual way.

10. *To measure horizontal angles.*—Adjust the equatorial-circle parallel to the azimuth-circle; and having directed the line of collimation to one of the objects, move the equatorial-circle in its own plane, and also the declination-circle, if necessary, and bring the line of collimation to the other, and the arc through which the equatorial-circle has moved gives the angle required.

As an appendage to this account, by professor Vince, of Ramsden's portable equatorial instrument, we think it may be acceptable to our readers to have the Hon. S. M'Kenzie's account of Mr. Ramsden's new refraction apparatus much improved, which was published in his anonymous pamphlet, (dated in the year 1791, a year after the professor's treatise was published), together with the explication of the principles on which the apparatus was constructed.—"Refraction or parallax," says our author, "by changing the apparent altitude of a planet, may also change its apparent right ascension and declination; see *fig.* 2. of *Plate* XII. (of *Astron. Inst.*) where H O represents the horizon; E Q, part of the equator; P, the pole of the equator; Z, the zenith; P E H, the meridian; Z V, an arc of a vertical drawn through I, the *apparent* place, and F, the *true* place of the planet; P A, a circle of declination, or hour-circle, drawn through the true place F; and P B, a circle of declination or hour-circle drawn through the apparent place I. The error in altitude from F to I alters the right ascension of the planet as much as the arc of the equator A B, or its parallel F C, amounts to. It also alters its declination from A F to B L, that is, from C to I. If a planet be in the meridian at L, the error, in declination from L to K, will be the same as the error in altitude; but there will be no error in right ascension, because the same circle of declination P E H, (perpendicular to the horizon,) passes through the apparent place K, and the true place L. In like manner, if by the construction of an instrument you have a vertical circle Z V, perpendicular to the horizon, it will pass through the apparent place I and the true place F, and there will be no error in right ascension; and if by the same instrument the error in altitude from F to I be determined, the true place F is found, and consequently there will be no error in declination. With Mr. Ramsden's new refraction apparatus you have just such a vertical circle as will appear from what follows.

In the focus of the telescope of the equatorial two *fixed* wires

wires are placed at right angles to each other; one, E Q, (ſee *fig.* 4.) repreſents part of a parallel of the equator; the other, P A, part of a meridian, or hour-circle. There are alſo two moveable croſs wires at right angles to each other; one, H O, repreſents a portion of a parallel to the horizon; the other, Z V, a portion of a vertical circle. Theſe moveable wires have a motion round the axis of the teleſcope, by turning a pinion.

A ſmall quadrant (ſee *Plate* XI. *fig.* 2. and alſo *Plate* XII. *fig.* 2.) is fixed on the part that carries the moveable wires, with diviſions on each ſide; one expreſſing the degree of altitude of the object viewed, the other expreſſing the minutes and ſeconds of error occaſioned by refraction, correſponding to that degree of altitude. To the index of this quadrant is fixed a ſmall circular level, which being adjuſted by its own pinion, gives the altitude; while by another pinion it aſcertains the perpendicularity of one of the moveable wires, which gives the vertical circle above-mentioned, whereby the true right aſcenſion may be determined, free from all error ariſing from refraction or parallax. Hence, in taking the moon's right aſcenſion with an equatorial inſtrument, fitted with this refraction apparatus, in order to determine longitudes at land, there is no occaſion to attend to her parallax, as the difference of her right aſcenſion, cauſed by parallax or refraction, will only depreſs or elevate her on the ſame vertical circle, but will not change her right aſcenſion from one hour-circle to another. In this refraction apparatus the centre of the fixed wires always remains in the line of collimation; whereas by the former conſtruction, on raiſing or depreſſing that centre, it was moved out of that line; and as it was very difficult to replace it exactly, an error in the obſervation was liable thereby to be produced. In all obſervations made with this refraction apparatus, firſt adjuſt the circular-level, then ſet the centre of the moveable wires, by the micrometer ſcrew, to the refraction correſponding to the altitude of the object viewed, as given by the ſmall quadrant; and let one of the moveable wires be ſet always perpendicular. Since copying the preceding extract from Mr. M'Kenzie's pamphlet, we have been aſſured that it was publiſhed previouſly to profeſſor Vince's treatiſe, and that the date 1791 is a typographical error for 1771; accordingly, we learn from Mr. Dollond, that Ramſden's inſtrument preceded his, but our inquiries to obtain the *preciſe time* of its origin have not been ſucceſsful. The two different ſizes of Ramſden's portable inſtrument were according to the following table of dimenſions.

	Rad. in In.	Limb divided to	Vernier of 30 gives	Divided to parts	By vernier into
Azim. or horizontal circle,	5.1	15′	0° 30″	45th of in.	1350th
	2.7	30	1′ 0″	42d ditto	1262
Equatorial or hour-circle,	5.1	15 or 1m	30″ or 2s	45th ditto	1350
	2.7	30 or 2	1′ or 4s	42d ditto	1260
Vertical ſemicircle for declination or latitude,	5.5	15	30″	42d ditto	1260
	2.75	30	1′	41st ditto	1230

Portable Equatorial Inſtrument by Meſſrs. P. and J. Dollond.—Mr. Dollond informs us that his father contrived the inſtrument, which now comes under our notice, in or about the year 1775, and the readineſs with which he communicated all the particulars we wiſhed for reſpecting it deſerves our grateful acknowledgment. This inſtrument, ſays the author, (in his quarto pamphlet,) which of all others is the moſt amuſing to lovers of aſtronomy, is now rendered, by the following improvements, greatly ſuperior to any hitherto produced. As the whole weight does not exceed thirty pounds, it may be ſaid to be truly portable, yet, by the ſteadineſs of all the parts, and the perfection of the achromatic teleſcope, the obſervations may be made to a very great exactneſs. The focal length of the achromatic object-glaſs is about 17 inches; it is compoſed of three glaſſes, and admits of an aperture of two inches. The tube being made as thin as poſſible, is eaſily balanced by the weight A, which is fixed in the ſemi-circle B B; (ſee *fig.* 3. of *Plate* XI.) then again all the parts above the horizontal axis (the end of which is ſeen as C) are balanced by the ſquare weight D. By means of theſe balances the centre of gravity is preſerved over the centre of the inſtrument in every poſition, and the different parts prevented from being ſtrained when the inſtrument is put into any oblique poſition, which may be required in its various uſes. This alſo tends to keep the teleſcope ſteady, which is of the greateſt advantage in making an obſervation. Beſides theſe very eſſential improvements, every part has been reduced to the moſt ſimple ſtate; and ſeveral, which in other inſtruments of this kind, were found ſuperfluous, have been entirely rejected.

The inſtrument is ſupported by three feet E, E, E; the ſcrews *a*, *a*, *a*, are to raiſe or depreſs the feet, in order to bring the plate G G into an horizontal poſition, which is determined by two ſpirit-levels *b*, *b*, that are fixed on it at right angles to one another. If theſe levels are well adjuſted, the plate will be horizontal when the air-bubbles come into the middle of the glaſs tubes. As this plate repreſents the horizon of the place, it is called the horizontal plate: it is divided into half-degrees, and by a vernier *c* of thirty diviſions is ſubdivided to every minute. This index is made to move round the centre of the horizontal plate in order to ſet it to zero, or point o, when that point is found to be in the plane of the meridian. The plate is moved round by turning the handle *d*. The worm-ſcrew, which works in the part *e*, may be eaſily diſengaged from the plate, when any conſiderable quantity is required to be moved at once. Preſs the handle *d* outwards, and the worm will be diſengaged. The plate F F is called the equatorial plate, as it repreſents the plane of the equator; it turns on the horizontal axis C, ſo that it may be inclined according to the latitude of the place, which is ſhewn on the latitude arch *f f*, that paſſes through the ſquare weight D: this arch is divided into 90°, and by the vernier is ſubdivided into every minute. The tube *g* is fixed to the horizontal axis, cloſe under the centre of the equatorial plate. An axis is fixed to the middle of the plate, which paſſes through the tube *g*, into a centre fixed in the ſquare weight; this axis tends greatly to ſecure the equatorial plate from ſwinging, when put into different inclinations, or when the teleſcope is turned into any oblique poſition.

The horizontal axis is made parallel to the horizontal plate by turning the ſcrew *h*, which will raiſe or depreſs that end of it. When the equatorial plate is inclined nearly to the latitude of the place, the clamp *i* may be tightened by the ſcrew at the ſide; then, by turning the finger-ſcrew *k*, it may be adjuſted to the greateſt exactneſs: the vernier *l* may be adjuſted, (in caſe any error ſhould be found,) by the ſmall ſcrews at *m*.

The equatorial plate is divided into twice XII hours; theſe

these are fubdivided into every two minutes of time, and by the vernier n again fubdivided to every four feconds. This plate is moved round by turning the handle O. The worm-fcrew which works in the edge may be difengaged from the plate, by preffing the handle O outwards.

Above this plate is the femi-circle B B, which is called the declination femi-circle; this is divided into twice 90°, and fubdivided as the other circles are; it is fixed to the axis H, which may be made parallel to the horizontal axis by the fcrew p, in the fame manner as the horizontal axis is made parallel to the horizontal plate. On this declination femi-circle the telefcope I I is fupported, and being balanced by the weight A, is moved with the greateft eafe, by means of the pinion fixed at q, which is turned with the fingers at r.

To fet the line of collimation of the telefcope at right angles to the axis H, the wires in the eye-tube s may be moved in an horizontal direction by the fcrews, which will be difcovered when the part of the eye-tube t is taken off; this piece carries the eye-glafs, and is made to flide on the part that contains the wires, that diftinct vifion may be obtained by eyes of different convexities. There are four eye-tubes, intended for different purpofes, producing magnifying powers from 40 to 60, and an eye-piece with a diagonal fpeculum is fometimes added for gaining a convenient view of ftars near the zenith. There is a combination of lenfes to the number of four in one of thefe eye-tubes, and the enlargement of the field of view thereby affords a pleafing view of the heavens. Befides thefe, there is a fliding piece containing fmoaked glaffes to guard the eyes of the obferver from the fun's rays, which glaffes are fmoaked but faintly at one end, and have the fhade of darknefs gradually increafed towards the other to fuit all ftates of illumination. There is alfo a femi-ring fitted by friction to the tube of the telefcope, near the object end, which bears an arm holding a fmall diagonal reflector to direct the light of a lamp or candle into the tube fo as to enlighten the crofs wires contained in one of the eye-tubes.

The compafs box, placed on one fide of the horizontal plate, is ufeful in afcertaining nearly the meridian line, and alfo in detecting the variation of the magnetic needle at any time. Thefe were the original parts compofing the inftrument before us; and the inftrument viewed as a whole piece of mechanifm prefents a fightly compact figure, but the circumftance of the declination-femicircle, not allowing the telefcope to reach as high as the pole, is an objection in the conftruction of this inftrument, which, we are obliged to confefs, renders it of lefs value in our eftimation than it otherwife would have been. When the inftrument is to be adjufted for obfervation, the horizontal plate is levelled by the levels in the firft place, and then the equatorial plate is made parallel to the equator itfelf, by moving the fquare weight along the arc $f f$ till the vernier l marks the latitude of the place. The directions given for the ufes of Mr. Short's inftrument will equally apply here as far as they go, but as this inftrument profeffes greater accuracy in the readings than that and Nairne's, it ufes are more extenfive; for it will ferve occafionally for an equal altitude inftrument, a tranfit inftrument, a quadrant or fextant, an azimuth circle, a theodolite, and a level.

When this inftrument is to be ufed for obferving equal altitudes, bring zero on the equatorial plate to zero on the vernier z, by the handle O, and zero on the vernier l to 90° on the latitude arch, taking care that the clamp i is made faft by the fcrew at the fide; adjuft the horizontal plate very nicely by the two levels and feet fcrews, then by turning the handles d and r bring the telefcope to the fun for the morning obfervations: in the afternoon fet again the horizontal plate level, and the declination-femicircle to the degree and minute fhewn at the correfponding morning obfervation; then bring the telefcope to the fun by turning the handle d only. In this manner feveral correfponding altitudes may be obferved on the fame day, and the inftrument ufed in the mean time for other purpofes. For the methods of making equal altitudes ferviceable in the practice of nautical aftronomy, fee problems X, XI, XII, and XIII, in our article CHRONOMETER.

To convert this equatorial into a tranfit inftrument, bring zero on the vernier l to 90° on the latitude arch, and fix the clamp i; level the horizontal plate, and bring the telefcope to the meridian mark, fuppofed to be afcertained, by turning the handles d and r: turn now the handle r alone, and it will raife the telefcope in the plane of the meridian, fo that when the fun or ftars are feen to pafs the vertical wire, they will then be upon the meridian, and the time may be noted accordingly. This application fuppofes of courfe the axes of the declination-circle perfectly parallel to the horizon plate, and alfo the line of collimation perfectly parallel to the fame plate, but at right angles to the former, when the vernier is at zero. Thefe verifications, however, we think, demand the levels to be applied nearer to the telefcope than on the horizon plate only.

When the inftrument is in the pofition juft defcribed, let the moveable vernier c be put to zero on the horizontal plate and be made faft, then turn the handles d and r to bring any celeftial object into the field of view of the telefcope, and its azimuth will be fhewn on the horizontal plate, while at the fame time its altitude will be indicated on the declination femi-circle.

When ufed as a theodolite, let this inftrument have its horizontal plate levelled as before; then bring zero on the equatorial plate to zero on the vernier z, and alfo zero on the vernier l to 90° on the arc of latitude, and fix the clamp i. Turn the horizontal plate and declination-femicircle, fo as to gain a view of the object whence the angle is to be meafured; then bring the telefcope to the fecond object, by moving the equatorial plate and declination-femicircle without the horizontal plate, and this laft plate will then fhew the meafure of the faid angle; and if there is any elevation or depreffion of the latter object compared with the firft, the declination-femicircle will point it out. The bearings, alfo, will be fhewn by the compafs, as in the common theodolite.

When zero on the femicircle is brought to zero on the vernier y, the inftrument then becomes a level; fo that by turning the equatorial plate round, an obferver may fee what objects are level with the telefcope. For this purpofe alfo, our opinion is, that the level would be much better applied parallel to the telefcope, on the declination-femicircle itfelf.

The late Mr. John Dollond had invented his object-glafs micrometer previoufly to his arrangement of the circles and other parts of his equatorial inftrument, feeing Dr. Mafkelyne gave a paper on it to the Royal Society, which was read Dec. 12, 1771, which micrometer was fometimes made an appendage to his equatorial; but as this addition is not peculiar to the inftrument in queftion, but may be applied to any other aftronomical inftrument, or even a common telefcope, we will defcribe it hereafter, under our article EQUATORIAL *Micrometer*. We muft not, however, omit a notice of the refraction apparatus belonging to the equatorial inftrument, as made by the Dollonds, an account of which was read before the Royal Society on March 4, 1779, as drawn up by Mr. Peter Dollond, and prefented by the

the aftronomer royal. *Fig.* 3. of *Plate* XII. of *Aftronomical Inftruments*, is a reprefentation of this apparatus, detached from the object end of a telefcope. The account itfelf, being fhort, will admit of being tranfcribed.

"The refraction of the atmofphere," fays the author, "occafions the ftars or planets to appear higher above the horizon than they really are; therefore a correction for this refraction fhould be made in a vertical direction to the horizon. The equatorial inftrument is fo conftructed, that the correction cannot be made by the arches or circles which compofe it, when the ftar, &c. is in any other vertical arch, except that of the meridian; becaufe the declination arch is never in a vertical pofition but when the telefcope is in the plane of the meridian.

"To correct this error, a method of moving the eye tube, which contains the wires of the telefcope in a vertical direction to the horizon, has been practifed: but as the eye-tube is obliged to be turned round, in order to move it in that direction in the different oblique pofitions of the inftrument, the wires are thereby put out of their proper fituation in every other pofition of the inftrument, except when it is in the plane of the meridian; for the equatorial wire fhould always be parallel to the equator, that the ftar in paffing over the field of the telefcope may move along with it, otherwife we cannot judge whether the telefcope be fet to the proper declination, except at the inftant the ftar is brought to the interfection of the wires, which is only a momentary obfervation.

"The method I have now put in practice for correcting the refraction of the atmofphere, is, by applying two lenfes before the object-glafs of the telefcope; one of them convex, and the other concave; both ground on fpheres of the fame radius, which in thofe I have made is thirty feet. The convex lens is round, of the fame diameter as the object glafs of the telefcope, and fixed into a brafs frame, or apparatus, which fits on to the end of the telefcope. The concave lens is of the fame width, but nearly two inches longer than it is wide, and is fixed in an oblong frame, which is made to flide on the frame that the other lens is fixed into, and clofe to it. Thefe two lenfes being wrought on fpheres of the fame radius, the refraction of the one will be exactly deftroyed by that of the other, and the focal length of the object-glafs will not be altered by their being applied before it: and if the centres of thefe two lenfes coincide with each other, and alfo with that of the object-glafs, the image of any object formed in the telefcope will not be moved or fuffer any change in its pofition. But if one of the lenfes be moved on the other, in the direction of a vertical arch, fo as to feparate its centre from that of the other lens, it will occafion a refraction, and the image will change its altitude in the telefcope. The quantity of the refraction will be always in proportion to the motion of the lens, fo that by a fcale of equal parts applied to the brafs frame, the lens may be fet to occafion a refraction equal to the refraction of the atmofphere in any altitude. If the concave lens be moved downwards, that is, towards the horizon, its refraction will then be in a contrary direction to that of the atmofphere, and the ftar will appear in the telefcope as if no refraction had taken place.

"There is a fmall circular fpirit level fixed on one fide of the apparatus, which ferves to fet it in fuch a pofition, that the centres of the two lenfes may be in the plane of a vertical arch. This level is alfo ufed for adjufting a fmall quadrant, which is fixed to it, and divided into degrees, to fhew the elevation of the telefcope when directed to the ftar; then the quantity of refraction anfwering to that altitude may be found by the common tables, and the concave lens fet accordingly, by means of the fcale at the fide, which is divided into half minutes, and, if required, by ufing a vernier, may be divided into feconds.

"It muft be obferved, that when a ftar or planet is but a few degrees above the horizon, the refraction of the atmofphere occafions it to be confiderably coloured. The refraction of the lens acting in a contrary direction would exactly correct that colour, if the diffipation of the rays of light were the fame in glafs as in air; but as it is greater in glafs than in air, the colours occafioned by the refraction of the atmofphere will be rather more than corrected by thofe occafioned by the refraction of the lens. We may conclude this defcription with the fubjoined references to *fig.* 3. of *Plate* XII. which is a view of this apparatus:

"A A, the circular brafs tube which fits on to the end of the telefcope.

"B B, the oblong concave lens, in its frame, which flides over the fixed convex lens.

"C, the circular fpirit level, which fhews when the oblong lens is in a vertical arch.

"D, the quadrant to which the fpirit level is fixed, for fhewing the angular elevation of the telefcope.

"E, the milled head fixed to a pinion, by which the whole apparatus is turned round on the end of the telefcope, in order to fet the oblong lens in a vertical arch.

"F, another pinion for fetting the quadrant to the angular elevation of the telefcope. By means of thefe two pinions the air bubble muft be brought to the middle of the level.

"*a a*, is the fcale, with divifions anfwering to minutes and half minutes of the refraction occafioned by the concave lens."

The beft portable equatorial inftrument of the Dollonds, with a 17 inches achromatic telefcope, is marked in their catalogue at 84*l.*; and their achromatic object-glafs micrometer of the new conftruction, at 21*l.*

Were we to be guided by a fimple comparifon of this inftrument and its refraction apparatus with Ramfden's, and to infer from thence which of the two was prior in point of time, we fhould be induced to place this before the other for obvious reafons, deduced from their comparative conftructions, particularly the fituation of the levels and refraction apparatus, and total elevation of the telefcope, but, on minute inquiry, we found that Ramfden's was the firft, and we can only account for the preference we are difpofed to give it, from the circumftance of his having a patent, that precluded the latter, though his brother-in-law, from adopting his conftruction. If there is any real comparative advantage in Dollond's, now that his achromatic telefcopes are generally made, it is that which arifes from the graduation of the latitude quadrant, and the lightnefs of the whole inftrument; Ramfden's weighing 59 pounds, and Dollond's only 30.

Portable equatorial inftrument by Fayrer.—We have already faid that Mr. Fayrer of White Lion ftreet, Pentonville, has the poffeffion of a large engine for cutting clock wheels, &c. the property of his uncle Troughton, which we have defcribed under our article CUTTING-*engine* as originally made by Rehe: this artift, during fome of his hours not occupied by his engine, makes mathematical and philofophical inftruments, and among others he has lately conftructed a portable equatorial inftrument for Mr. Lowe of Iflington, which, we think, merits a place in our collection, as being not only an original one, but as poffeffing advantages likely to recommend it to public attention. This portable inftrument differs from its predeceffors chiefly in thefe refpects; it has no azimuth circle fixed in a permanently horizontal pofition; it has its equatorial circle divided into degrees and

and alfo into time, with two verniers reading at oppofite points, one vernier reads to the accuracy of 30″ of fpace, and the other to 2″ of time; this circle has a long axis paffing through a tube, like Troughton's large Coimbra inftrument hereafter defcribed, from which probably this part of the conftruction was taken; it may, therefore, be placed in a horizontal direction by its axis being placed firmly vertical, in which fituation it becomes an azimuth circle; the telefcope is fixed on the end of the axis of the declination circle, which idea correfponds with, and may have been borrowed from, Nairne's conftruction; this pofition allows any elevation of the telefcope that may be required, and keeps the obferver's eye at a diftance from the other parts of the inftrument, but injures the uniformity of the appearance of the inftrument as a whole; the levels are applied, one on the common axis of the telefcope and declination circle, and the other at right angles thereto, as a chord to the declination circle; and laftly, the declination circle is complete, with oppofite verniers reading, like the other oppofite verniers, to an accuracy of twenty or thirty feconds, according to the dimenfions of the graduated circles, when nicely divided on Troughton's dividing engine. From fuch conftruction it is eafy to perceive, that this little inftrument poffeffes the advantage of having its telefcope reverfed as well as its circles with refpect to the oppofite verniers, which property greatly enfures the accuracy of the adjuftments. After thefe previous remarks it will fuffice to give a brief detail of the parts of this inftrument as reprefented in *fig.* 4. of *Plate* XI. *of Aftronomical Inftruments.*

A, A, A, are three adjuftment fcrews for levelling the circular ftand to which the feet are faftened; B, B, are a pair of triangular frames fixed firmly to the faid circular ftand, and fupporting the pivots of the horizontal axis, round which the tube C, attached to the axis, moves; at the fummit of the more vifible triangular frame B is an adjuftable or fliding part Y, like that of a tranfit inftrument, by which the telefcope may be adjufted into the meridian, when previoufly placed nearly fo by the feet. The graduated circle D, which may be either an equatorial or azimuth circle, accordingly as its axis is inclined or vertical, has a fteel axis nicely fitted to revolve in the tube C, in any pofition of this tube with refpect to the horizon; but the double vernier bar is faft to the inferior end of the tube, as may be feen in the figure: the pofterior pivot of the horizontal axis, borne by the triangular bars B, B, projects, and has firmly attached to it the quadrantal piece E, partly hidden from fight in our view of the inftrument; this quadrantal piece is graduated, and reads by a vernier as minutely as the other circles; it ferves to fet the equatorial axis parallel to the earth's axis, in which fituation it may be clamped faft, as well as in a vertical, or indeed any other pofition, by a clamping fcrew out of fight in the prefent pofition applying to the quadrantal arch; F F is the declination circle, with its horizontal axis refting on a pair of vertical fupports, carried by the upper end of the polar axis, that paffes through the tube C, fo that, when the telefcope, attached to the axis of the declination circle, has any horizontal or rather oblique motion the circle D moves with it, and indicates the diftance moved along the equator, or in a circle parallel to it, when the polar axis is properly adjufted and clamped faft. The double vernier bar is on the pofterior plane of the declination circle, and may therefore be viewed after an obfervation without danger of altering the pofition of the telefcope. The level on the declination axis may be conveniently adjufted by turning the circle D half round, and by making the bubble keep the middle of the tube in both fituations, which may be done, partly by the fcrews A, A, A, and partly by the fcrews of rectification of the level itfelf; and zero of the declination circle may be put to zero on the verniers when the circle D is truly placed in an horizontal pofition, in which fituation alfo zero of the quadrant E muft coincide with zero on its vernier. Under thefe circumftances the levels will be competent to effect all that is required, and in the beft way; and the inftrument will poffefs all the various powers afcribed to a portable equatorial inftrument when converted into the other inftruments.

Univerfal equatorial inftrument by Mr. Ed. Troughton.— The equatorial inftruments we have hitherto defcribed are all, properly fpeaking, portable, and confequently of a fize not profeffing great accuracy in their readings. We now come to an inftrument of larger dimenfions, and one having its parts fo arranged and adjufted, as to entitle it to rank among the firft clafs of inftruments employed in modern obfervatories. It is of the univerfal kind, and may be called moveable (in oppofition to fixed) rather than portable, as it ftands feven feet high, and is therefore too bulky to be carried by one man. It was finifhed in the year 1788 for the late Mr. J. H. Magellan, and fent by him to the univerfity of Coimbra in Portugal, where we have faid it has been unfortunately fhut up in the dark. *Plate* XIV. of *Aftronomical Inftruments*, exhibits a perfpective drawing, fhewing all the principal parts of this excellent inftrument in its equatorial pofition, which we propofe to defcribe in the order of their afcent from the ground.

It will not be neceffary to give any letters of reference to this inftrument, as it is prefumed the reader, who has made himfelf acquainted with the component parts of the preceding inftruments, cannot be at a lofs to accompany us in our defcription of the prefent inftrument without the aid of alphabetical references. The bafis is of mahogany, confifting at the inferior part of a ftrong tripod, and at the fuperior of a circular table; thefe are connected by three pieces diverging from the table downwards, and connected by diagonal croffing bars: this frame work is ftill further united by three vertical pillars near the centre, one of which is omitted in the drawing, in order to expofe to view a more effential part. Immediately above the table, and parallel to it, is a very ftrong azimuth circle of brafs, 24 inches in diameter; this circle, however, is not in contact with the table, but refts on its conical axis, that paffes through a collar of brafs, attached to the centre of the table, and is fupported on its conical point on a ftud faft to the centre of the tripod. This length of bearing, like that of Mr. Nairne's defcending axis, keeps the azimuth circle fteady in the horizontal line both in motion and at reft, which is a circumftance of the utmoft importance. The tripod is furnifhed with three ftrong feet fcrews for the adjuftment of the azimuth circle into a true horizontal pofition; and three handles, with each a Hook's joint, are attached refpectively to thofe fcrews, that the adjuftments may be made with the body in an upright pofition. or nearly fo. The apparatus for quick or flow motion is fcrewed faft to the table, and clamps to the azimuth or horizontal circle. Two oppofite verniers, reading to the accuracy of 10″, are attached to the edge of the table, but in fuch a way that they are of ready adjuftment to an exact bifection of the circle, in cafe the wood work of the table and frame fhould alter its figure by warping in the leaft degree; otherwife the wooden frame, as a pedeftal, would have been objectionable. Upon the plane of the faid azimuth plate are erected two vertical fupporters of frame work, fomewhat refembling the appearance of two chair backs; which fupporters confequently have a motion in azimuth whenever the circle is turned round; they are 19 inches apart from each other, and an horizontal axis of this length binds them together at their upper extremities; the

the poſterior ſupporter has an adjuſtment apparatus for bringing the axis perfectly horizontal, which apparatus is hidden in the drawing behind the ſaid ſupporter. At the middle of the horizontal axis called alſo the axis of latitude, is a cubical part ſimilar to that in the axis of a tranſit inſtrument; to this the long braſs ſocket or tube, that embraces the polar ſteel axis, is made faſt, and is ſet exactly at right angles thereto by conſtruction. The polar axis, that paſſes down through this ſocket, has the equatorial or hour circle attached firmly to it, at right angles alſo by conſtruction, at its inferior end; and to its ſuperior end above the axis of latitude, is fixed a ſmall platform, of the ſhape of a parallelogram, to ſupport the ſuperſtructure not yet deſcribed. Any additional weight may be fixed to the lower end of the polar axis, that the ſuperincumbent materials may require to form an exact equipoiſe in any poſition; the ſiderial time, depending on the horary angles, is read by oppoſite verniers, fixed to the inferior end of the long polar ſocket; one of which only can be ſeen in the figure of the inſtrument, as it ſtands in the drawing: the equatorial circle is divided, ſo that a ſingle ſecond of time is diſtinctly read by the verniers; and if the application of three verniers had been thought of when this inſtrument was conſtructed, the inequality of the diviſions would have been corrected thereby ſtill more perfectly, as well as the excentricity of the circle, if any exiſts; which obſervation will equally apply to the azimuth and declination circles. Two quadrants are made faſt to the pivots of the axis of latitude, or horizontal axis already deſcribed, having their poſition juſt within the vertical ſupporters of the ſaid axis, and conſequently move with it, when it has any motion: theſe quadrants are divided, one of them agreeably to the uſual diviſions of the circle, and the other by particular deſire into 96 equal parts with its ſubdiviſions, and the two verniers are reſpectively placed on the contiguous ſupporters of the axis; the uſe of the quadrants is to fix the elevation or inclination of the polar axis agreeably to the latitude of the place of obſervation; that is, parallel to the axis of the earth; which poſition requires to be well verified when the inſtrument is uſed. Between the feet of the ſupporters, and at right angles to each other, are placed, on the plane of the azimuth circle, two nicely ground ſpirit levels, one of which is about half viſible, and the other ſtill leſs, which ſerve to place this circle perfectly horizontal in every direction, by the aid of the feet ſcrews: and near the centre of the ſame circle may be ſeen an apparatus for adjuſting and fixing the polar axis in any given degree of inclination from a horizontal to a vertical poſition, which it does with equal convenience, accuracy, and ſteadineſs: the lower end of this apparatus may be ſcrewed to any pair of the parallel holes made in the plate, farther from, or nearer to, the centre, as the quantity of inclination may require; while the upper end is attached to a broad ring embracing the ſocket of the polar axis; and about the middle is an adjuſtment ſcrew, juſt above a Hook's joint, that allows the ſcrew to act freely in any poſition of this apparatus. The ring that embraces the long ſocket of the polar axis will ſlide along it till the ſtem of the ſaid apparatus, into which the ſcrew acts, ſtands at right angles to the polar axis, in which ſituation its poſition will be firm and ſteady, as the axis can have no lateral or vibratory motion, by reaſon of its union with the axis of latitude. From this deſcription of the apparatus in queſtion it is eaſy to perceive that the nearer the polar axis approaches to a vertical ſituation, the farther from the centre of the azimuth plate muſt the fixing ſcrews be inſerted, and *vice verſâ;* alſo the lower towards the equatorial circle muſt the ſliding ring be, that embraces the ſocket; as well as the ſteadier the axis ſo fixed. Again, upon the platform on the ſuperior end of the polar axis, already noticed, are erected a ſecond pair of ſupporters, at the diſtance of 15 inches from each other at the bottom, and bound together at the ſame diſtance at top by the axis of the declination, which conſequently is 15 inches long; theſe ſupporters, which partake of any motion given to the equatorial circle, bear the declination or meridian circle, and teleſcope ſurmounted over all. At the upper end of one of theſe laſt named ſupporters is an adjuſtment for ſetting the declination axis at right angles to the polar axis, which is a very eſſential adjuſtment; the apparatus for producing quick or ſlow motion is faſt to the platform, the milled nuts of which apparatus may be ſeen under the declination circle; alſo the oppoſite verniers for reading off the angles of declination are attached to the ſaid platform, and both faces of the circle are divided, like the quadrants, one according to common uſage, and the other into 384 diviſions with their ſubdiviſions, which, at the time of the conſtruction, were conſidered by Mr. Magellan as the beſt check on the accuracy of the verniers that read off to 10″. The elevated ſituation of the teleſcope, which is $3\frac{1}{2}$ feet long, is ſufficiently explained by the drawing, where ſome of the ſupporters are ſeen attached to the declination axis, and ſome to the circle itſelf; this elevation was given, that the eye-tube might keep clear of the ſupporters and other parts of the mechaniſm, when a ſtar or planet is followed along the equator, or other circle parallel thereto; and as the declination circle is complete, the teleſcope will riſe to any degree of elevation that may be required, while the circle will meaſure that elevation. As a tangent to the upper edge of the circle, and parallel to the line of collimation of the teleſcope, is a very ſenſible ſpirit level with proper adjuſtment ſcrews: and on the upper ſide of the tube of the teleſcope are mounted two microſcopes, the uſe of which is to obſerve the coincidence of a fine plumb-line with points made on the tube, when placed in a vertical poſition for the purpoſe of levelling the declination axis; and indeed many of the adjuſtments of this inſtrument may be verified both by the plumb-line and levels. There are various eye-pieces to anſwer different purpoſes, both with and without diagonal reflectors for high altitudes, which it is not neceſſary to deſcribe here minutely, as they form no diſtinguiſhing feature of the inſtrument. Laſtly, the refraction apparatus placed at the eye end of the teleſcope, as made by Ramſden, was an appendage of this inſtrument, and by moving the adjuſtable croſs wire in the focus of the eye glaſs a quantity equal to the refraction or refraction and parallax taken together, rendered the calculations from the tables unneceſſary, by converting mechanically the apparent into the true altitude of any obſerved body. The reading of the ſubdiviſions of a circle by means of a microſcopic micrometer had not been adopted at the period this beautiful and uſeful inſtrument was conſtructed, otherwiſe its powers would have been made more extenſive than they now are by the verniers alone.

It is hardly neceſſary to add, that the powers of this univerſal inſtrument, as far as they go, may be readily and conveniently applied to almoſt all the purpoſes of practical aſtronomy, as well as of land-ſurveying and levelling; ſeeing it has all the properties aſcribed to the preceding inſtruments, but in a degree approaching nearer to perfection. This is the only inſtrument of the conſtruction here deſcribed that ever was made on ſo large a ſcale, but three or four others of an inferior ſize have ſince been made on the ſame.

fame plan, that, as portable inftruments, can hardly be furpaffed unlefs by the adoption of triple verniers, which are of recent origin.

Adjuftments.—1. In the firft place, the *telefcope* muft have its wire-plate turned round into fuch a pofition, that the middle vertical wire will coincide with a diftant mark throughout the whole field of view, as the telefcope is elevated or depreffed, and then the object-glafs muft be flided in or out, till a ftar of the fecond magnitude is feen as diftinctly as poffible, to prevent parallax at the wires.

2. In the next place, make the *azimuth circle horizontal* by means of two levels, adjufting one half of the error, produced by turning the circle half round, by means of the feet-fcrews, and the other half by the levels, as with the preceding inftruments.

3. Make the *polar axis perpendicular;* clamp it nearly fo, and turn the declination circle round till the bubble ftands in the middle of its level, now turn the upper part half round on the polar axis, and, if there is an error, correct one-half of it by the apparatus acting on the polar axis, at the azimuth plate, and the other half by turning round the declination axis by the flow motion. When the error has difappeared by a repetition of this procefs, turn the declination circle round the polar axis juft fix hours, and bring the bubble to the middle by the adjuftment at the top of one of the fupporters of the latitude axis: when this is done the azimuth and equatorial circles will be parallel to each other, and their axes perpendicular to the horizon; and, of courfe, the level near the telefcope will keep its bubble at the middle, as well as the other levels, while either or both of thefe circles revolve. Here the verniers of the latitude-quadrants may be fet to their refpective zeros.

4. The declination axis muft be fet *level*, or at right angles to the polar axis. In order to do this, fet the telefcope perpendicular by fixing the declination circle with its vernier at 90°, and put on the plumb-line; by the motion of one of the points, which is *adjuftable*, and alfo by the proper motion of the plumb-line; make the latter bifect both the points under the microfcopes; reverfe now the telefcope by turning the declination circle to the oppofite 90°, fufpend the plumb-line from the contrary end of the telefcope, and by the proper motion of the line make it bifect the *fixed* point; then half the error that appears at the adjuftable point muft be corrected by that adjuftment, and the other half by that at the top of the fupporter of the declination axis.

5. The line of collimation of the telefcope muft next be adjufted, both as it regards the right afcenfion and declination. In order to do this, let the upper end of the polar axis, and the object-end of the telefcope, be pointed to fome fixed object a little above the horizon, the declination circle being firft put with 90° to the zero of its vernier, the hour index placed at XII, and the telefcope above the polar axis; bring now the centre of the crofs-wires to the object fixed on, by raifing or lowering the polar axis in conjunction with a motion in azimuth, and read off the degrees, minutes, and feconds fhewn by the verniers of the azimuth circle and quadrants refpectively; in the next place, fet the polar axis nearly vertical, and place the hour circle at the oppofite XII, and point the polar axis, as before, to the faid fixed object, the telefcope being now below it; move the inftrument as before, by a compound motion of the polar axis and azimuth circle till the interfection of the middle wires coincides with the object before fixed on and ufed, and read off, as before, the degrees, minutes, and feconds both on the azimuth circle and quadrants: in this fituation of things, fet the azimuth circle to the *mean* of the two obferved azimuths by taking half their fum, and alfo the polar axis to the *mean* of the two obferved altitudes or inclinations of the polar axis; in this pofition of the inftrument, let the telefcope be carefully moved by altering the fcrews that faften it to the circle, until the vertical central wire coincides with the original object, and the adjuftment for right afcenfion is finifhed. Again, move the telefcope, by altering it in declination, till the horizontal wire cuts the fame object, and adjuft the verniers of the declination-circle to the points 90° and 96 parts refpectively on its oppofite planes. If, however, the object is not a very diftant one, the above directed adjuftment in declination will not be quite correct, becaufe the telefcope ftands *higher*, when *above* the pole than it is *below;* confequently, when this adjuftment is made by means of a near object, two marks fhould be ufed on that object, the diftance between which muft be double the meafure from the centre of the declination axis, to the line of collimation of the telefcope; otherwife a fmall angle will be formed at the object, by the two lines of fight, which angle will be fubtended by the double diftance in queftion; but when the object is at an infinite diftance this fmall fubtenfe is reduced in effect to nothing, and the fame mark therefore will do in both the pofitions of the telefcope.

6. To adjuft the hour index let the point 90° of the azimuth circle be turned to an object of fmall altitude; let the polar axis be made horizontal; and the telefcope be fet to 0° of declination: in this pofition the hour circle becomes vertical, and the altitude of the object may be taken by it, which muft be read off in time from VI hours: turn now the inftrument half round in azimuth, and make the telefcope look towards the object by turning round the polar axis; take another altitude in this pofition, and read off what is indicated from the oppofite VI hours, and the mean of thefe two altitudes is the exact place where the adjuftable index muft have its zero placed to be in its true pofition.

The apparatus for correcting the horary angle on account of refraction confifts of a fmall quadrant and level for taking altitudes, which are moveable round the axis of vifion, and therefore determine very readily the elevation of the telefcope in any given pofition; alfo the eye-piece and wires of the telefcope being moveable by means of a nice micrometer fcrew, may be fet with great accuracy to the refraction correfponding to the altitude of the obferved body as determined by the fmall quadrant and level.

The chief advantages refulting from the conftruction of the equatorial inftrument juft defcribed, are, firft, that it affords a firm fupport to a very long, and, therefore, powerful telefcope; and, fecondly, that the great range of polar diftance beyond 90° of declination renders an obfervation with the telefcope below the polar axis unneceffary.

As the rules we gave for ufing Ramfden's portable inftrument, as extracted from profeffor Vince's treatife, are not exemplified by actual obfervations, and as rules, however plain, are not always underftood without the illuftration of appropriate examples, we cannot finifh our account of the prefent inftrument better than by fubjoining to the rules given by the Hon. Mr. M'Kenzie his examples given at full length, when adapted to our purpofe, by which the reader will be led to have an idea of the practical application of the obfervations to the various purpofes of aftronomy. The rules were originally written as directions for the ufe of Ramfden's inftrument, but after our account of the adjuftments,

ments, they are equally applicable to the inſtrument under our immediate conſideration.

Obſervation 1. *To find the latitude of the place by the ſun, or any known fixed ſtar.*—The inſtrument being perfectly adjuſted in all its parts according to the directions given,—

Make the polar axis perpendicular to the horizon, and when the ſun approaches his meridian altitude, elevate the teleſcope to that altitude, and adjuſt the refraction apparatus as above directed: then follow the ſun by moving both the equatorial and declination circles (if neceſſary), and keeping the refraction piece always adjuſted till he is at his greateſt altitude; the vernier of the declination circle will then give you his meridian altitude; from which ſubtract his declination, if it be north, or add it if it be ſouth, the remainder if north, and the ſum if ſouth, is the height of the equator, that is, the complement of your latitude, which being ſubtracted from 90°, gives your latitude.

Example.

Sun's declination ſuppoſed - -	6°	57′	37″	North.
Meridian altitude of his centre obſerved	45	6	29	
Subtract his declination -	6	57	37	
Height of the equator or co-latitude	38	8	52	
Which ſubtracted from -	90	0	0	
Gives your latitude -	51	51	8	

If inſtead of obſerving the altitude of the centre, you obſerve that of the upper or lower limb of the ſun, you muſt allow for the ſemi-diameter of the ſun, which allowance you find in the Nautical Almanac. Alſo, if the refraction apparatus were not uſed, the tables for refraction and parallax in altitude muſt be uſed to reduce the apparent to the true altitude.

Obſervation 2. *To find the meridian by one obſervation only.*—Elevate the equatorial (or hour) circle to the co-latitude of the place, ſet the declination circle to the ſun's declination for the day and hour required; and adjuſt the refraction apparatus, then move the azimuth and hour circles both at the ſame time (either in the ſame or a contrary direction) till you bring the centre of the moveable wires (the vertical being truly perpendicular) exactly to cover the apparent centre of the ſun; that done, the centre of the fixed wires will be in the true centre of the ſun, the index of the hour circle will then give the apparent or ſolar time at the inſtant of obſervation. Thus you get the time though the ſun be at a diſtance from the meridian. Then turn the hour circle till the index points preciſely at 12 o'clock, and lower the teleſcope to the horizon to obſerve ſome mark in the centre of the teleſcope, and that is your meridian found by one obſervation only.

The beſt time for finding the meridian is, when the ſun is three hours diſtant from the meridian on either ſide of it.

Obſerve, that when you have once a true meridian fixed, you need make no uſe of the refraction apparatus in any obſervation, except to ſet one of the moveable wires perpendicular.

The meridian and ſolar time may be found in like manner by a fixed ſtar, whoſe declination and right aſcenſion are known.

Obſervation 3. *To obſerve a ſtar or planet in broad daylight, at any time when it is above the horizon.*—The table of right aſcenſions, declinations, &c. of Dr. Maſkelyne's 36 principal fixed ſtars, under the articles Chronometer and Declination, gives you the times of their tranſits over the meridian in ſiderial time.

Elevate the equatorial circle to the co-latitude of the place, and ſet the vernier of the declination-circle to the ſtar's declination, then adjuſt the refraction piece; look into the table for the time of its meridian tranſit or right aſcenſion; then take the time of the ſaid tranſit from the time of your obſervation as given by the ſiderial clock, borrowing 24 hours if neceſſary; this difference is the hour to which you muſt ſet the hour index of the equatorial circle, and the ſtar will then appear in the teleſcope.

Example 1.—Let it be required to place the teleſcope of the equatorial inſtrument to obſerve Capella on Sept. 30th 1809, exactly at 9h 0m 0 by a ſiderial clock well regulated?

Declin. of Capella from Tab. III. under Chronometer, 1806 -	45°	47′	5.″88	North.
3¾ years of annual variation add from ditto - - -	0	0	17.14	
True declination -	45	47	23.02	North.
Right aſcenſion or ſiderial time of tranſit from ditto, 1806 -	5h	2m	22.s62	
3¾ years annual variation add -	0	0	16.55	
True time of tranſit -	5	2	39.17	
Which ſubtract from ſiderial time of obſervation - - -	9	0	00.00	
And there remains the interval ſince the tranſit for the index to be put to	3	57	20.83	

Note, if the clock ſhews ſolar time, it muſt be converted into ſiderial time by problem VI. under our article Chronometer, and then the work may be done as here directed.

Example 2.—Let it be required to find Arcturus on April 1ſt, 1810, when the ſiderial time is 10h 30m?

Declin. of Arcturus 1806 -	20°	11′	59.″41	North.
4¼ years annual variation ſubtract	0	1	19.85	
True declination -	20	10	39.56	North.
Right aſcenſion or ſiderial time of tranſit - - -	14h	6m	48.s83	
4¼ years annual variation add -	0	0	11.59	
True time of tranſit -	14	7	0.42	
Which take from the time of obſervation, borrowing 24h - -	34	30	0.00	
The remainder is the place of the index	20	22	59.58	

In this obſervation Mr. M'Kenzie uſed a table of meridian paſſages given in ſolar time, which required the acceleration of ſiderial or ſolar time to be uſed; but as the principal catalogues give the paſſages in ſiderial time, we have adapted his rule thereto.

Obſervation 4. *To find the right aſcenſion and declination of a planet, comet, or fixed ſtar.*—The equatorial circle being elevated, as before, to the complement of the latitude of the place, move the declination and equatorial circles till the planet or comet is in, or near the centre of the field of the teleſcope, then adjuſt the refraction piece, and bring the centre of the moveable wires to cover the planet, the vernier of the declination circle will then give you the declination of the planet, and the vernier of the equatorial circle will give you the hour of the planet, &c.; then your regulator or clock will give you the sun's time or hour of the day. Take the difference between the sun's time and the planet's time; and if the planet's time be less than the sun's time, add that difference to the sun's right ascension at the time of observation, (which you find in the Nautical Almanac,) the sum (rejecting 24 hours, if it exceeds that number) is the right ascension of the planet, &c. Again, if the planet's time exceeds the sun's time, subtract the difference from the sun's right ascension; the remainder (adding 24 hours to the sun's right ascension, if necessary,) is the right ascension of the planet, &c.

Example 1.

Observed a star whose time by the equatorial circle is	2^h	18^m	3^s	P.M.
Sun's time as given by the regulator, *viz.*	9	44	40	P.M.
Difference between the two	7	26	37	
As the star's time is less than the sun's, add that difference to the sun's right ascension	20	57	9	
Reject 24 hours from	28	23	46	
Right ascension of the star is	4	23	46	

Its declination (by the vernier of the declination circle) is 16° 2′ 50″ north.

Example 2.

Observed a star whose time by the equatorial circle is 10^h A.M. (that is, astronomically)	22^h	0^m	0^s
Sun's time as given by the regulator, *viz.* 5° 55′ 4″ A.M. (that is, astronomically)	17	55	4
Difference between the two	4	4	56
As the star's time exceeds the sun's, subtract that difference from the sun's right ascension	10	38	58
Remains the right ascension of the star	6	34	2

Its declination (by the vernier of the declination circle) is 16° 25′ 1″ south.

Observation 4. *To find the longitude at land by the right ascension of the moon.*

Observed the centre of the moon on the moveable wire set vertical, either in or out of the meridian; time given by the equatorial or hour circle, suppose	2^h	28′	2″
Sun's apparent time by the regulator	6	0	0
Difference between those times	3	31	58
Add that difference to the sun's right ascension at 6 hours (because the moon's time is less than the sun's time, for had it been greater, the difference must have been subtracted)	8	25	27
And you have the moon's right ascension at the place of observation at 6 hours	11	57	25

Another method of making the above observation.—The centre of the moon being observed in the same manner at six hours P.M. as before directed, let the instrument remain in the same position it was in (only altering the declination) till a known star comes to the vertical wire, which will happen (suppose) in one hour after, *viz.* at 7 hours, then subtract that one hour of difference in time of transits, with the addition of 9″ 86dec for the acceleration corresponding to one hour, that is, subtract 1^h 0′ 9″ 86dec from the AR of the star, supposed to be 12^h 57′ 35″, the remainder is the moon's AR at six hours P.M. at the place of observation.

Star's right ascension	12^h	57′	35″
Difference in siderial time, (see CHRONOMETER, Tab. I.)	1	0	9.86
Moon's right ascension at 6 hours P. M. at the place of observation.	11	57	25.14

Then find, by the Nautical Almanac, at what time at Greenwich the moon has the same right ascension as that now observed.

Moon's right ascension at Greenwich at noon is	11^h	43′	20″
Ditto at midnight	12	10	36
Difference in those 12 hours	0	27	16
Moon's right ascension at Greenwich at noon	11^h	43′	20″
Moon's right ascension at 6 hours, at the place of observation	11	57	25
Difference between them	0	14	5

Proportion for finding the time at Greenwich.

As 27^m 16^s : 14^m 5^s : : 12^h : 6^h 12^m 0^s

So that the time at Greenwich, when the moon has 11^h 57′ 25″ of right ascension, is 6^h 12^m 0,′ that is, 12^m later than at the place of observation, which is therefore 12^m of longitude west from Greenwich.

Sir George Shuckburgh's fixed equatorial instrument.—A B, C D, E F, G H, (*Plate.* XV. *of Astronomical Instruments,*) are four columns, says sir George Shuckburgh, composed of hollow brass tubes 3½ inches in diameter, and five feet ten inches long; these, with two others, one of which appears in part at I K, and the other partially hidden behind E F, are firmly fixed, at their upper ends, to a circle of bell metal B D F H, and, at their lower end, to an inverted truncated hollow cone, L L L, of brass, in height two feet, and in diameter, at the base A G, one foot nine inches. The cross pieces, or tubes P, P, as likewise O, O, and O, O, serve to connect the columns more strongly together, and prevent their bending. These several parts constitute the principal axis of the instrument, the lower end of which terminates in a steel point or cone, resting in a hollow conoid of bell metal, in such manner that the apex of the former does not reach to the bottom of the latter, but the place of bearing, or of friction, is (it may be) about two tenths of an inch from the extremity of the cone; the other end of this axis finishes in a cylindrical pivot N, of about 1¼ inch long, and one inch in diameter, turning in a Y of bell metal. The entire length of this axis is eight feet four inches, the lower end being supported by an iron frame 3, 4, 5, 6, 7, 8, which is firmly fixed below the floor, into brick-work, and by means of two iron bars, one of which is seen at 28, and the other on the opposite side, not visible in the drawing, is kept

kept fecure from any motion, eaftward or weftward; the lower part of this frame, to about one foot high, is inclofed by a mahogany box or cafe 9, 10, the top of which is entirely covered up, and ferves as a die or bafe to this end of the inftrument. The other extremity of this long axis, *viz.* the pivot N, refts upon the ftrong iron fupport 29, 30, 31, ftanding 10 feet above the floor, made of maffive pieces of caft iron, $2\frac{1}{2}$ inches wide, and $\frac{1}{2}$ an inch thick, and held firmly by bolts and nuts as in the figure: 32, and 33, are the places where two iron bars, nearly at right angles to each other, and at $\frac{1}{2}$ right angles to the meridian, are fcrewed, to connect this upright fupport with the walls of the building, and going through the bricks, are held faft by iron collars and nuts on the outfide of the wall; thefe bars, or braces, not in the figure, refift any tendency from the weight or preffure of the inftrument, to pufh the fupporter 29, 30, and 31, out of its upright pofition; and being at right angles to each other, ferve to keep it fteady with refpect to any lateral force that may accidentally be applied. The lower part is continued below the floor, and firmly fixed with mortar and lead into the brick work of an arch. The bottom is fhut up in a box or plinth of mahogany, 34, 35, as has been mentioned in the defcription of the frame fupporting the other end of the axis at 9, 10. Near the lower end of the principal axis L N, are inferted 10 concentric brafs cones, or radii, *a a*, *b b*, *c c*, *d d*, *e e*, carrying on their extremities a graduated brafs circle, of $49\frac{1}{2}$ inches dimeter, at right angles to the principal axis already defcribed; this circle has two fets of divifions, one of points, and one of lines, each into degrees, and every ten minutes, and the intermediate minutes and feconds are read off by the microfcopes W and X, with a moveable wire, and micrometer fcrew, fuch as has been defcribed in general Roy's account of his inftrument for meafuring horizontal angles. (See Philofophical Tranfactions, vol. lxxx. p. 145.) The circle juft mentioned, is inclofed by a circular frame, or rail of mahogany, 14, 15, which is fupported by ten baluftérs, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, (17 and 24 being concealed) and ferves to protect the brafs circle from any accidental injury in paffing by it, without depriving it of expofure to the general temperature of the room. It at the fame time affords means of fupport to a fmall lamp, 13, which, by reflection from the perforated fpeculum at the bottom of the microfcopes, to be feen in that marked X, throws light upon the divifions by night: 26, 26, and 27, are iron rods that, by being attached to the wooden cafe, 9, 10, give fteadinefs to the upright baluftérs, and the circular frame that they fupport: 1 and 2 are large ftout brafs cones firmly fixed into the frame, 3, 4, 5, 6, 7, 8, before mentioned, and whofe ufe is to carry the microfcopes W, X. Any degree of pliancy or flexure in thefe cones would be readily difcernible in the microfcopes, and extremely detrimental to the obfervations; they are therefore made as ftiff as poffible: δ is a plane forming the upper fide of the frame, 3, 4, 5, 6, &c. and confifting of three plates, two moveable in grooves; and one fixed, furnifhed with fuitable fcrews, one giving the extremity of the axis a motion upward or downward, and the other a motion to the right or left. This latter is procured by a rod paffing through the cone, 2, one end fcrewing into the plate below L, near the centre, and the other turned by an occafional handle fixed on, near X, the former motion, *viz.* of elevating or depreffing the axis, is procured by a handle fixed on to a fcrew near ε: Q R is another circle of the fame dimenfions with the former, graduated in the fame manner, and held together by eight conical radii, *f f*, *g g*, *h h*, *i i*, firmly fcrewed to a circular centre-piece, which ferves as a bafe to a large conical axis, two feet three inches long, one fide of which is feen at U, and its exterior extremity near V, with its fliding plate and fcrews for adjuftment. Clofe behind the graduated circle, and at right angles to this axis paffing through it, lies the telefcope T S, $5\frac{1}{2}$ feet long. This circle is likewife furnifhed with two microfcopes and micrometers, as in the equatorial circle, one of which is feen at full length at Y, and Z, the eye-tube being at Y, and the object-glafs, with the perforated fpeculum, to throw light at Z; the other microfcope, on the oppofite fide of the circle, is not fo prominent in the drawing, being fomewhat fore-fhortened at Z. Near T, α, α, α, α, α, is an hexagonal lozenge, compofed of fix brafs rulers, firmly fixed to the columns A, B, and E, F, and fupporting the lower end of the microfcopes, as the pieces $\beta\,\beta$, $\beta\,\beta$, in like manner fuftain the upper end. By thefe means, the wire in the field of the microfcopes becomes a fixed immoveable index, and after proper adjuftment, an exact diameter of the circle, whilft the telefcope, together with the circle, turns round the conical axis beforementioned. At P is a fpirit level, paffing through the centre plate of the conical axis at right angles to the telefcope, fupported by a cock at each end, one of which appears at *k*; this cock is placed on the cone U, and by means of a fmall-toothed wheel and pinion, the level is made to revolve round its own axis, fo that the fame fide of the level may readily be brought uppermoft, whatever pofition the circle be put into; it is alfo furnifhed with all neceffary adjufting fcrews. It will readily be feen, that a telefcope thus fitted up, will have all the properties of a tranfit inftrument, while the graduated circle will poffefs thofe of a meridian quadrant. For this purpofe *l m* is a ftout brafs tube, inclofing a ftiff iron rod, turning upon two fine fteel points, adjufted by proper fcrews, parallel to the line of fight of the telefcope: this rod is attached to a fpirit level of great fenfibility, lying below it, which, with the rod, turns round upon the fteel points juft mentioned, and is in fact a hanging level of the beft conftruction. At the eye-end of the telefcope S is a peculiar apparatus, to correct the effects of refraction and parallax, when an obfervation is made out of the meridian: it is compofed of two levels, a fmall quadrant of altitude *n o*, and a femicircle divided with its vernier to every 5′ on the breech plate of the telefcope, the exterior eye-tube having a circular motion by a wheel and pinion at *o*, independent of the tube that carries the crofs wires; by this means the angle of the horary and vertical circles may at any time be found, together with the altitude of the object, and then by the refolution of two right-angled triangles the refraction and parallax in right afcenfion and declination will be obtained: *t*, *u*, are two handles to a Hook's joint at *x x*, which turning an endlefs fcrew at *w w*, give a gradual motion to the telefcope in right afcenfion or declination; and this motion can at any time be reftrained by a clamp at *q*: 11, 12, (the latter not feen,) are two fupporters to the clamp and endlefs fcrew. The handles *t*, *u*, are hung on to any part of the inftrument by means of the line and wire *v*, *v*, and are thus kept within the obferver's reach. Near *r* and *s* are two microfcopes, placed on oppofite fides of the circle Q R, and at right angles to the line of fight of the telefcope, but are hidden by the columns in our figure; they are of ufe only when the plumb-line, fufpended from the roof of the obfervatory, is ufed in preference to the level *l m* above defcribed, either for adjufting the inftrument, or obferving a meridian altitude, in which cafe the line muft bifect the centres of both microfcopes: *y*, and *z*, are thin perforated brafs plates, attached to the cover that goes on the object-glafs, and by occafionally turning them over it, change the aperture to $\frac{1}{2}$ or $\frac{1}{4}$. The crofs wires, of which there are

three

three vertical and one horizontal, within the eye-tube S, have all the requifite adjuftments by fcrews, &c. as in a common tranfit inftrument, and are enlightened at night by a lamp fixed near to one end of the declination axis U, *viz.* that oppofite the end V; but this part of the apparatus is hidden behind the axis and the telefcope, except the weight *i*, which is a counterpoife. This lamp throws a light through the conical axis, which is perforated at that end on purpofe, on a fpeculum in the centre of the telefcope, placed at $\frac{1}{2}$ right angles to the axis of the object-glafs, and from thence reflected to the crofs wires. This fpeculum, which is an elliptical diaphragm, is perforated to permit all the rays from the object-glafs to pafs unobftructed to the eye. The contrivance has been mentioned by Mr. Vince (Practical Aftronomy, p. 80.) From what has been already defcribed, it muft now be evident that if the principal, or polar axis, as it has been called, L N, be elevated to the latitude, and adjufted to the meridian of the place, if the line of fight of the telefcope be at right angles to the axis V U, and this latter at right angles to the polar axis L N, the brafs circle 14 and 15 will correfpond with the equator in the heavens, and the circle Q R will become an horary circle; that is, if the centre of the wires in the field of the telefcope be directed to any celeftial object, on Q R will be had its declination, and on 14 and 15 its diftance from the meridian, from whence, by knowing the hour, the right afcenfion will be obtained, and confequently its true place in the heavens.

Befides the preceding parts of this expenfive inftrument, there are fome neceffary appendages, as a ftool marked 36, and fome others defcribed in the original account, with references to the accompanying plates, a minute detail of all which would lengthen this article too much; we will therefore briefly enumerate them, and refer the more curious reader to the Tranfactions themfelves for the particulars. The appendages are, 1ft, a lamp to illuminate the crofs-wires; 2dly, the refraction-piece hereafter defcribed; 3dly, the plumb-line; 4thly, the moveable roof of the obfervatory; 5thly, a regulator or fiderial clock which indicates degrees, minutes, and feconds of fpace on the equator; and, 6thly, the meridian mark, confifting of a fmall adjuftable light-houfe, placed on a brick pier at the diftance of 2970 feet, which can be feen as well by night as day.

After a very rigorous examination of the two divided circles of this inftrument, it feems that the greateft error, including both the inequalities of the divifions and the excentricity, never amounts to more than 2″ in either of them, and the author calculates that an obfervation of right afcenfion, taken *out of* the meridian, may be depended on to the accuracy of 5″, allowing an error of 2″ for counting the beat of the clock, 1″ for the deviation of the meridian mark, and $\frac{1}{2}$″ for the error in reading the microfcope; but that the error in polar diftance may amount to 7″, including all the errors of the inftrument, of the adjuftments, and of the readings. This inftrument, it will have been obferved, has no azimuth circle, like moft of the portable inftruments, but if its axis were fixed perfectly vertical, its equatorial circle would then become an azimuth circle, and the inftrument altogether would greatly refemble Piazzi's great circular inftrument made by Ramfden. From what we apprehend alfo from fir George Shuckburgh's account of the variablenefs of the errors of adjuftment, in different degrees of temperature, we are difpofed to attribute much of the imperfection of this inftrument, in this refpect, to the metallic fupport of the upper pivot of the polar axis, which fupport muft naturally elongate and contract its dimenfions alternately, by changes of temperature; and as it is compofed of various parts differently placed, it affords no data for afcertaining by calculation either the quantity or direction of deviation from the truth. Before we proceed to the adjuftments of this inftrument, it may be proper to defcribe the refraction apparatus which is attached to it, and which is neceffary to be underftood in ufing the appended tables. *Fig.* 2. of *Plate* XI. exhibits a perfpective view of this apparatus on a larger fcale than is exhibited in *fig.* 1. where "A B is a portion of the telefcope; C the eye-tube; *a b c* a divided femicircle, *d* its vernier fixed to A B, fhewing the angle of the horary and vertical circles; *e* a fmall fpirit-level, attached to the plate on which this femicircle is engraved, and moving with it by means of the fcrew *f*, which turns a pinion, that works in a toothed wheel, that turns the whole plate, together with the exterior eye-tube round its centre, but without moving the tube that carries the crofs-wires. From hence it may be underftood, that by turning the fcrew *f* till the level *e* ftands true, the index *d*, which reprefents a point in the horary circle, will mark how much the divifion zero, which reprefents the vertical, is inclined thereto: *l k* is a fmall quadrant of altitude, that, by means of the level *g*, and fcrew and pinion *h*, turning on a centre at *m*, gives the elevation above the horizon of any object in the field of the telefcope: *i* is a fmall aperture through which a key is fixed on, to give a lateral motion to the wires to adjuft them; and near *f* is another fcrew, to adjuft them parallel to the equator and declination-circle."

This apparatus, it will be feen, has not the refraction-circle, or micrometer and divided nut, to elevate or deprefs the horizontal wire, a quantity correfponding to the data thereby determined, in order to convert the apparent to the true place of a heavenly body; it therefore indifpenfably requires the aid of fuch tables as we have fubjoined to our prefent article; but Ramfden's portable inftrument defcribed by the Hon. S. M'Kenzie, and by profeffor Vince, whofe accounts we have adopted, has the addition of the micrometer feen in miniature at P, in the figure of that inftrument. To that inftrument, therefore, as well as to Dollond's, the tables are otherwife unneceffary, than as they ferve as a check on the accuracy of the mechanical contrivances in queftion.

Adjuftments.— The three principal adjuftments, according to fir George Shuckburgh's account, are, 1ft, to adjuft the level P *k* parallel to the declination axis U V; 2dly, to adjuft this axis at right angles to the line of collimation of the telefcope; and, 3dly, to make this axis at right angles to the polar axis. The polar axis is placed nearly in the meridian, by means of a meridian mark previoufly verified, and elevated pretty nearly to the latitude of the place. This is to be done more accurately afterwards, by the fliding plates and fcrews at the bottom of the polar axis. The axis of the declination-circle is then brought nearly horizontal, by its proper level, *viz.* is turned round about the polar axis, till the bubble of the level ftands true between the indexes; the inftrument is then turned half round about the polar axis, = 180°, fhewn by the microfcope W. If the bubble then ftand true it requires no correction, but if it do not, correct half the error, by moving the equatorial circle by its handle *t*, and the other half by the (invifible) capftan fcrew, which we will call *a*, or end-fcrew; then turn the inftrument back again to its firft pofition, and fee if the level ftands true; if not, repeat this operation till it does, correcting one half of the error by the equatorial handle, and the other half by the fcrew *a*. The declination-axis will then be parallel to the level, and both of them to the horizon. It muft be remarked that in this operation it will be neceffary to move the declination-circle round its own axis a little, in order to bring the fame fide of the level uppermoft;

permoft; but this in no degree affects the refult, for the imaginary line, round which this axis revolves, is what is meant all along by the axis, and is the line to which the parallelifm of the level is referred.

The declination axis remaining in an horizontal pofition, with the level above the axis, as in the *fig.* turn the declination-circle 180°, *viz.* till the level become below the axis; then, by means of the pinion for this purpofe, reftore the tube of the level to an upright pofition, and fee if the bubble ftand true; if not, correct ½ the error by the fide fcrew, and the other ½ by *a*, the end fcrew. Now turn the declination-circle 90° each way from its laft fituation, and repeat the examination of the bubble, and correct as before, ½ by the fide fcrew, at the oppofite end of the tube, at right angles to the other fide fcrew; and ½ by the end fcrew, near the fide fcrew in queftion; and if after all thefe corrections in every part of an entire revolution of the declination-circle round its axis, and of the level round its axis, the bubble ftand true, it follows that the axis of the declination-circle, and of the level, are in every direction parallel to each other, both of them to the tangent of curvature, in the middle of the level, and all three to the horizon. This adjuftment is therefore complete.

It remains to be feen whether the line of fight of the telefcope be at right angles to the declination-axis, and the latter to the polar axis.

Take the error of the collimation of the telefcope in right afcenfion, by a ftar in the equator, *viz.* let the tranfit of a ftar on the equator over the affumed meridian be obferved with the declination-circle turned towards the eaft, and alfo towards the weft. If there be any difference in thefe obfervations, it will denote double the error of collimation in right afcenfion, and half of it will be the deviation of the line of fight from a line at right angles, to the axis of the declination-circle, and is correfpondent to a fimilar adjuftment of a tranfit inftrument. The amount of this error being thus afcertained, let it be corrected by the fcrews, at the eye-end of the telefcope, that move the wires to the eaft and weft. The declination-axis, by means of its level being reftored to an horizontal pofition, let the centre wire of the telefcope, (by which is always underftood the line of collimation,) be brought to bifect the meridian mark, by means of the fliding plate, and adjufting fcrew, below the polar axis; the telefcope will then become a complete tranfit inftrument; for, by the firft operation, the declination axis is made parallel to the level and its axis, and both to the horizon; by the fecond, the line of fight is put at right angles to this axis; and, thirdly, it is adjufted to the meridian.

Now, let the error of collimation in right afcenfion in the fame manner be obferved with any ftar out of the equator, by a circumpolar ftar, (the nearer the pole the better,) fuppofe the pole ftar. If any difference in minutes and feconds of a great circle, as afcertained by the micrometer, fhould be noticed in its paffage with the circle eaft or weft, halve that difference, and it will be equal to the angle that the plane of the declination circle makes with the polar axis, if the obferved ftar were actually in the pole; if not, divide it by the fine of its declination, and the true angle of the plane of this circle, (or of the line of collimation,) with the polar axis will be had. Again, if this operation be repeated with any other ftars, and the error fo found be divided by the fine of their declination, the error of the plane of the declination circle at the pole, *viz.* its greateft error, or angle with the polar axis, will be had. And note, if thefe obfervations are made with ftars on each fide of the equator, thefe quantities will be had in oppofite directions. Finally, the fame may be done by two land objects, one to the north, and the other to the fouth, the north and fouth meridian marks, for inftance, proper confideration being had to their declination; by this means the error will be thrown in contrary fenfes or doubled, and from a variety of fuch refults a very correct mean quantity may ultimately be deduced; and when found muft be corrected by the fcrews at one end of the declination axis.

It has now been feen, that, 1ft, the level and its axis are parallel to the axis of the declination circle: 2dly, the line of fight is at right angles to this axis, and parallel to the polar axis; and, confequently, the declination axis is at right angles to the polar axis: 3dly, the polar axis parallel to that of the earth. Thefe are the chief requifites in the adjuftment of this inftrument. Thofe that remain are fecondary, and we fhall take them in the following order: 1ft, the adjuftment of the crofs wires to the focus of the telefcope: 2dly, the hanging level: 3dly, the line of collimation north and fouth, as well as eaftward and weftward; 4thly, the index wires in the microfcopes: 5thly, the refraction apparatus; and, 6thly, the power and fcale of the microfcopes.

Firft, *the crofs wires.* Let the eye-tube be adjufted to diftinct vifion for parallel rays by fome diftant object, fuch as Jupiter, Saturn, or Venus, by day-light; that done, obferve, while one limb of either of thefe planets appears running along the equatorial wire, whether any motion of the eye, upwards or downwards before the eye-glafs, alters the relative place of the image and the wire; if a motion of the eye upwards moves the planet in the *fame* direction, the wires are too near the eye-glafs, and muft be pufhed in; and *vice verfâ*, till the image becomes fixed upon the wire, whatever be the motion of the eye. When this point is obtained, the eye ftop, with its wires, muft then be fixed, for that is their true place, *viz.* the correct focal point of the object-glafs; and whatever indiftinctnefs may be found from the diverfity of eyes of different obfervers, muft be corrected by the motion of the eye-glafs only. Another point to be fecured is the permanency, as far as may be, in the pofition of the object-glafs; for if this be not correctly centered, which is very rarely the cafe, and, indeed, never to be expected, that is, if its axis be not concentric with the axis of the cell, in which it is fixed, any motion of this latter, by fcrewing or unfcrewing it, may not only change the place of the focus to which the wires are adjufted, but will neceffarily move the line of collimation both in right afcenfion and declination. To obviate this, therefore, two correfponding marks fhould be made with a graver, both upon the cell into which the glafs is burnifhed, and alfo upon the tube of the telefcope into which the cell is fcrewed, or otherwife inferted, that in cafe the object-glafs fhould ever be taken out to clean it, &c. it may be reftored very nearly, if not exactly, to its former pofition.

The eye-glafs, object-glafs, and wires being thus fettled in their refpective places to each other, it will not be an improper time to meafure the interval between the wires, which cannot be too accurately done, being of fuch conftant ufe; this may be either, 1ft, by obferving the paffage of a ftar in the equator, and making proper allowances for the rate of the clock, or by a ftar out of the equator, and making proper allowances for the declination in the proportion of the radius to the cofine, or, 2dly, by means of the equatorial circle, and a fixed land object; and here the quantity muft be diminifhed in the fame ratio as the radius to the fine of the polar diftance. We have made ufe of both methods as a confirmation of each other, and find the interval, which is equal in the three wires of my telefcope, to be $7' \, 34''.5 = 30''.3$ fiderial time; and thefe three

three wires divide the diameter of the field very nearly into four equal parts.

Second and third adjuſtments: *the hanging level.* By means of its proper handle *u*, move the declination circle about its axis, till the bubble of the hanging level *l m* reſts true between the indexes; there fix it by the clamp *w*, reverſe the level by taking it out of its pivots, and turning it end for end; if the bubble now ſtand true, the level is adjuſted; if not, correct $\frac{1}{2}$ the error by the declination handle, and the other $\frac{1}{2}$ by the ſmall ſcrew at the bottom of the level; then reverſe the level and repeat this operation till it does. The level, or rather a tangent to its curvature at its middle, will be parallel to the axis on which it ſwings, and both will be horizontal. At this time look through the teleſcope, and ſee what land object is covered by the horizontal wire; now invert the teleſcope by turning it 180° round the declination axis, and 180° round the polar, and bringing the level true, it will then point to nearly the ſame place; and if exactly the ſame object as before be now covered by the horizontal wire, the axis of the level is adjuſted parallel to the line of collimation in a vertical direction, if not, correct half the error by the little capſtan ſcrew at the bottom of the cock, or arm, that ſupports one end of the axis of the level, and the other half by the declination handle; invert the teleſcope, and repeat the operation, till the ſame object is covered in both poſitions, and the level is found true, then will the level and its axis be parallel to the line of collimation, and the object covered by the wire may be concluded to be in the horizon.

Fourth. *The index wires of the microſcopes.*—The line of collimation, with reſpect to eaſt and weſt, has been already adjuſted as above. Let then the declination axis, by its level, be reſtored to an horizontal poſition; at this time adjuſt the index wires in the two equatorial microſcopes W, X, to biſect the two oppoſite diviſions 360° and 180°, then will theſe wires be rectified to their proper place. That being done, bring 90°, or the diviſion that repreſents the equator on the declination circle, under its reſpective microſcope, and turn the whole inſtrument one quarter round on the polar axis, *viz.* till 90° on the equatorial circle be biſected by the micrometer; and, if at this time the bubble of the hanging level appear true, the index wire of the declination microſcope is correct; if not, correct $\frac{1}{2}$ the error by the declination handle *u*, and $\frac{1}{2}$ by the little ſcrews at the ſide of the hanging level, then reverſe the teleſcope, *viz.* turn it till 270° on the equatorial circle come under the micrometer wire, and if the level then reſt true the adjuſtment is complete; if not, repeat the operation, as before, till it does; then by its proper ſcrew bring the index wire of the declination micrometers to biſect the points 90° and 90°. The indexes of both circles will be then adjuſted, and the axis of the hanging level brought parallel to the line of collimation, with reſpect to eaſt and weſt, as well as with reſpect to north or ſouth. Note, this paralleliſm of the axis of the level, to the line of collimation in a direction eaſt and weſt, does not appear to be a very important rectification, but on ſome occaſions may have its uſe.

Fifth. *The refraction piece.*—After what has been done, this apparatus will be adjuſted. Bring the teleſcope, by means of its two levels P *k*, and *l m*, to point to the horizon, and in the meridian; then by the two points, *f*, *h*, *Plate* XI. *fig.* 2, of the refraction piece, bring its two levels *e* and *g* to reſt true; move the nonius *d*, of the little ſemicircle of the horary and vertical angles, *a*, *b*, *c*, to the middle of the diviſions, or 0°, 0′, and alſo that of the little quadrant of altitude, *l k*, to 0°, 0′, and this part is adjuſted.

Sixth. *The microſcopes.*—The magnifying power and ſcale of the microſcopes is all that remains to be conſidered. The magnifying power of a compound microſcope, as is well known, depends on the proportion between the diſtance of the object, and of its image from the object-glaſs, together with the proportion between the focus of the eye-glaſs and the ordinary focus of the eye looking at a ſmall object (ſuppoſe) of $\frac{1}{50}$th. or $\frac{1}{10}$th inch. Theſe two ratios compounded give the power of the microſcope. The former is called magnifying by diſtance, and is a material part in the conſtruction of theſe microſcopes; the ſcale of the micrometer being regulated by this part of the magnifying power. For example, let the diſtance of the object from the glaſs be = 1, and the diſtance of its image = 4, its power will be 4; and conſequently the ſcale of the micrometer or motion of its ſcrew, to anſwer to 10′, (ſuppoſe) muſt be 4 times as great as the ſpace occupied by 10′, on the limb of the circle; and if the radius of the circle be two feet, an arc of 10′ will be equal to 0.07 inch nearly on the limb, and = 0.28 inch on the ſcale, *viz.* = to the ſame arc on a circle of 8 feet radius: and if each revolution of the micrometer ſcrew be intended to deſcribe 1′, the ſcrew muſt contain about 35 threads in an inch. But as it would be difficult to adjuſt the ſcrew exactly to the ſcale, the advantage of the conſtruction of theſe micrometers is, the ſcale may at any time be adjuſted to the ſcrew; for let the interval between any two neareſt diviſions = 10′ on the limb, be meaſured by the ſcrew, and, ſuppoſe, inſtead of being = 10′ or 600″, it appears only = 570″; it is evident that the ſcale is bigger than it ſhould be, or, which is the ſame thing, that the image is leſs by $\frac{30}{600}$ or $\frac{1}{20}$. In this caſe, increaſe the diſtance between the micrometer wires and the object-glaſs = $\frac{1}{20}$, by unſcrewing or drawing out the tube that carries the micrometer and eye-glaſſes, and the ſcale is adjuſted. It will, at the ſame time, however, be right to re-adjuſt the object-glaſs of the microſcope to diſtinct viſion, by the ſcrew of the cell that contains it, until the image and the wires have no relative change of place by any motion of the eye. This will again occaſion ſome ſmall alteration in the ſcale, and muſt be corrected by repeated trials, and the ſcale adapted to the diviſions on the arc; and if the moveable wire of the microſcope be now brought to coincide exactly with the fixed one, and the moveable index brought to zero on the ſcrew-head, the micrometer is completely adjuſted. This having been done with all the microſcopes, and the oppoſite ones being made to agree, each with the other, in ſuch manner that the fixed wires may become a correct diameter, the whole inſtrument will have been completely adjuſted.

Before taking an obſervation of right aſcenſion and declination, the teleſcope muſt be adjuſted to the meridian mark, ſo as that the centre wire may exactly biſect it, in which ſituation care muſt be taken to make the index wires of the equatorial micrometers biſect the points of 360° and 180°, by means of the adjuſting ſcrew of the polar axis; and when an obſervation is made out of the meridian the altitude and angle of the horary and vertical circles muſt be taken by the refraction apparatus; then with theſe arguments, the refraction and parallax, in north polar diſtance, and in right aſcenſion, may be found by inſpection in the ſubjoined tables, by which any obſervation may be readily reduced to the meridian.

In this account of ſir George Shuckburgh, the reader may have obſerved, that the *order* of the adjuſtments propoſed is not that which is beſt in practice; as ſome of the *leading* adjuſtments muſt neceſſarily be deranged by the ſubſequent ones as he has deſcribed them, and indeed ſo as to

 render

tender new adjuftments neceffary; but we were unwilling to transform the baronet's directions that have met with the approbation of the Royal Society, though we cannot difmifs the account without this remark for the reader's confideration; *viz.* the rectification of the telefcope, levels, &c. ought certainly to *precede* the adjuftments of the circles, that depend on *their* accuracy of pofition.

The Armagh equatorial inftrument by Mr. Ed. Troughton.— The inftrument which now claims our attention is reprefented in *Plate* XVI. of *Aftronomical Inftruments*, and, though fimilar to its predeceffor fhewn in *Plate* XV, as to its ufe and properties, yet forms a ftriking contraft with it, in regard to compactnefs and beauty; too evident a contraft indeed to be overlooked at the firft glance of comparative infpection. The arrangement of its principal parts is fo novel, and at the fame time fo natural, as well as the connection of its fmaller ones effected with fuch fymmetrical precifion, that the mind is ftruck with the contemplation of it, and fpontaneoufly confiders it as an inftrument of a fuperior order, that feems to place at a diftance every other individual of its kindred: we therefore feel a peculiar pleafure in concluding our article with the account of an inftrument, which, though it comes laft, ought in our eftimation to ftand firft, as a model for future imitation. As the different component parts of the equatorial inftrument are now become familiar to the reader, who has perufed the preceding defcriptions, we fhall fatisfy ourfelves with a brief detail, unaccompanied by alphabetical references to the drawing, which prefents a perfpective view of all the leading features.

The horary or equatorial circle, without centre or radii, occupies the middle part of the inftrument; and is held in its proper place by eight conical tubes of brafs, four above and four below, which converge refpectively towards the upper and lower poles, and which ftand at the diftance of a quadrant from each other. A ftrong and light frame is thus formed of the fhape of two fimilar cones joining their bafes at the horary circle, and connected near their fummits by two pieces of metal that terminate each with a hollow cylinder of about two inches diameter; this frame is further braced by crofs connecting tubes, as well as by fide braces, or props, in the manner fufficiently explained by the figure; and the whole frame, thus firmly united, fupplies the place of a revolving axis, and carries the horary circle round with it, when it is made to turn on its cylindrical pivots. On thefe pivots the horary circle was finally turned true, after the frame was united and made faft in all its parts, fo that the excentricity of the circle, if it had any previoufly, was done away, by being turned on its own pivots. The inferior end of the polar axis or frame is fupported by a folid ftone, about 30 inches above the floor, with which it has no connection to produce unfteadinefs; this ftone is capped by an apparatus of ftrong brafs work, in which is produced the adjuftment for bringing the inftrument into the plane of the meridian, as well as that for giving the polar axis its proper elevation. This lower end of the axis terminates in a hemifpherical button of hardened and finely polifhed fteel, which preffes endwife againft a plane of agate, and is kept centrical by two rollers that form an angle to receive it on the lower part of the apparatus; all which contrivances may be readily conceived without more minute defcription. The fupport for the elevated pole confifts principally of a ftone pier, reaching from the ground to the centre of the inftrument; but on it is firmly fixed a ftrong frame of wrought iron, fo conftructed as to turn its edges towards the telefcope hereafter defcribed, in every direction; otherwife it would obftruct the field of view in elevations below the upper pole. The upper gudgeon is received between two rollers fimilar to thofe below, except that thefe are perforated, as well as the gudgeons, in order that as little light as poffible may be intercepted when the telefcope is pointed to the pole. At about fix feet diftance from each other, in the eaft and weft line, upon the fame folid foundation that fupports the bearing ftone and pier, are firmly fixed two pillars of ftone, each nearly three feet high; and on the tops of thefe are placed faft two ftrong cones of brafs to fupport the microfcopes for reading off the horary angles. The length of thefe two cones of brafs is fo proportioned as to correfpond to the effective length of one half of the frame, or polar axis, in its inclined ftate, in all changes of temperature, by which means the microfcopes preferve their relative fituations at the horary circle. This circle is divided into 5′ fpaces, or fpaces of 20 feconds of time, upon its extreme or exterior edge, which was made broad for this purpofe, and the heads of the equatorial micrometers are fo divided as to fubdivide the faid fpaces into tenths of a fecond of time. The axes of the microfcopes of courfe are horizontal. At the tops of the conical parts of the pillars are adjuftments for moving the microfcopes; one with refpect to perpendicular height, another with refpect to the diftance of the exterior edges of the horary circle, and a third along its plane. An apparatus alfo for quick or flow motion is attached to each of the cones in queftion, by means of which the inftrument may be fecurely fixed, either in the meridian, or in any other given pofition, as it regards the meridian. The declination circle likewife occupies the middle of the frame, and has its centre precifely in the fame point that is the centre alfo of the horary circle, thefe two circles being concentric, but having their planes exactly at right angles to each other, after the manner of the meridian and equatorial circles of a common ring-dial, when put into a ftate for ufe. The declination circle is double, or compofed of two complete circles united in feveral places by connecting pillars, and having each eight radii alfo connected in the fame manner, after being inferted into the common axis, which is of the fhape of a double cone. The telefcope paffes through the bafes of the united cones of the axis, and has an aperture of $2\frac{3}{4}$ inches, confequently the connecting pillars are long enough to admit fuch a telefcope between the united circles, in which fituation it is not very eafily diftinguifhable in the figure. Its eye-piece, however, is difcernible juft under the declination circle. It is 44 inches long, and revolves within the horary circle; confequently requires a diagonal or reflecting eye-piece when directed to the equator, in which fituation the aperture admits light enough, notwithftanding the interpofition of the horary circle. When the elevation is great, the head of the obferver muft neceffarily be admitted between two out of the four lower conical pillars of the frame, which circumftance points out the fcale of magnitude on which an inftrument of this conftruction ought to be made, to be ufeful at all degrees of elevation of the telefcope. The telefcope has various magnifying powers, which may be ufed according to circumftances. Two oppofite quadrantal arcs of the horary circle have chord-bars parallel to each other, at the middle points of both which are fockets for the gudgeons of the declination axis to work in as their fupports; which bearings made the braces of the frame and horary circle effentially neceffary to give ftrength and firmnefs to the whole. The declination axis, which is about three feet long, has an adjuftment at one end for fetting it at right angles to the polar axis, and carries alfo a very fenfible fpirit-level parallel to itfelf; with another of which the

the telefcope is likewife furnifhed, which it cannot be neceffary to particularize further, after our former defcriptions of fpirit-levels, except that in thofe the adjuftment fcrews had divided heads, whereas in thefe there are divided fcales of ivory, by means of which the half differences can be accurately eftimated to the *fraction of a fecond*. The declination circle is divided into fpaces of 5′, which are again fubdivided by the microfcopic micrometers into minutes and fingle feconds. One of thefe microfcopes is feen above the horary circle and the other below, but both are fupported by it, and point horizontally to oppofite points of the declination circle, as one of the others is feen at the top of one of the pillars pointing to the exterior edge of the horary circle. The apparatus for quick or flow motion, to govern the declination circle, is attached to the lower part of the frame, or polar axis, as reprefented in the figure. The excellence of this inftrument has been fully eftablifhed in public eftimation, by the ufe that has been made by Mr. Pond of the Armagh obfervations, taken with it in 1797, when he formed his catalogue of fome of the principal ftars, as we have already ftated; in which catalogue (fee our article DECLINATION,) it will be feen that the accuracy of its meafures accord very nearly with the refults derived from an average of the beft modern inftruments: and we may add, that the coincidence would doubtlefs have been ftill more remarkable, had not the divifions, which are by dots, been injured by an accident. An intenfe froft, to which the inftrument was expofed at the top of the maker's houfe, covered it with black fpots, and corroded its furface fo as almoft to obliterate the dividing points, which were neceffarily enlarged by hand, and of courfe might be altered a little by this manual operation, however carefully performed. The divifions of the other circle met alfo with an accident at the other fide of the water, which, though of a different nature, has rendered the divifions lefs correct than they were at firft. Befides which, two other circumftances ought alfo to be named as drawbacks in this inftrument, when compared with the circular inftruments with which it has been contrafted, namely, its verifications were not made with a plumb-line; and its polar pofition may be confidered as fomewhat unfavourable for taking declinations with the utmoft nicety; but notwithftanding all thefe deductions, the accurate performance of the inftrument has ftood the teft of a rigid comparifon with the inftruments of three modern obfervatories.

Adjuftments.—1. Turn the *wire-plate* round, if neceffary, fo as to make the middle vertical wire continue, throughout the whole field of view, on fome diftant and well defined point, while the telefcope is elevated or depreffed as it turns on the axis of the declination circle, to which the wire will in that cafe be perpendicular.

2. Slide the *object-glafs* of the telefcope in or out, while you view a ftar of the fecond magnitude, until the parallax of the wires is taken off, that is, until the vifion is as diftinct as poffible.

3. To adjuft the *level* of the *declination axis*. By the motion round the polar axis bring the bubble of the level to the middle of the tube, and in this fituation make its fcales or indices to coincide with both its ends; turn the level, end for end, and if it now ftand in the middle, as before, the axis is level; if not, alter one half of the deviation from the truth by a flight motion round the polar axis, and the other half by the fcrews of the level itfelf; and repeat thefe rectifications till the bubble will ftand always in the middle of the tube when its ends are reverfed. But the bubble of a hanging level may alfo require a lateral adjuftment; to examine it in this refpect, turn it round on its own axis a little, and if the bubble has a tendency to go to either end of the tube it muft be rectified by the fide fcrews till this tendency is removed, and then if the bubble will yet bear reverfing, the level is properly adjufted.

4. To adjuft the *pivot holes* of the level *parallel* to the *axis* of the declination-circle, and the *axis horizontal;* bring the bubble of the level to the indices on the tube, with the level above the axis, by moving the inftrument round the polar axis; then turn the declination-circle half round till the level is under its axis, and if the bubble now fettles to the middle, as pointed out by the indices, the level is right; if not, alter one half of the error by turning the polar axis round, and the other half by the two fcrews that govern the pivot-hole; in the next place turn the telefcope 90° round the declination-axis, and by the fcrews that govern the other pivot-hole, bring the bubble to the indices, and the axis will be horizontal, as well as the pivot-holes parallel to it in all directions; for when the level itfelf is adjufted, as above directed, it is evident that if the bubble keeps its place at the indices during a revolution of the declination-circle, the axis itfelf muft neceffarily be horizontal.

5. To fet the *declination-axis* at *right angles* to the *polar axis*, we may ufe the level itfelf inftead of the declination-axis, after it has been fet parallel thereto as juft directed; for this purpofe, bring the bubble to the indices by moving round the polar axis, and bifect oppofite points of the equatorial circle by the two wires of the microfcopes; turn the inftrument exactly half round by the help of the microfcopes fo adjufted, and if the bubble now fettles to the indices, the two axes are at right angles to each other; if not, alter one half of the error by the flow motion of the polar axis, effected by the equatorial tangent fcrew, and the other half by the two fcrews at one end of the declination-axis adapted for this purpofe.

6. To fet the *line of collimation* true in *right afcenfion*, let the bubble be brought to the middle of the tube, or to the indices as in the laft adjuftment, and look at any well-defined fmall object near the horizon, as bifected by the middle vertical wire; then having noted this mark, turn the inftrument half round the polar axis, as indicated either by the level or equatorial microfcopes, which are now adjufted to do the fame thing; and when the telefcope is turned back round the declination-axis, note if the fame object or mark be interfected as before, if not, alter one half of the deviation by the equatorial tangent fcrew, and the other half by moving the wires of the eye-piece in the telefcope; thus when the fame mark is bifected by the middle vertical wire, in reverfed pofitions of the telefcope, the line of collimation will be right with refpect to right afcenfion.

7. To place the *indices* of the declination-circle to read *polar diftances* truly. Before we defcribe this adjuftment, it may be proper to remark, that the microfcopes themfelves of this circle have each three feparate adjuftments, the firft, that which alters the power by altering the diftance of the object lens, fo as to make one minute on the circle equal to a revolution of the micrometer fcrew; the fecond, that which produces diftinct vifion by varying the diftance of the entire microfcope from the divifions of the circle; and the third, that which places zero on the fcale of minutes to agree with zero on the declination-circle, and alfo zero on the fcale of feconds, to agree with zero on the fcale of minutes, as effected by the head of the micrometer being made to turn independently of the fcrew. Thefe minor adjuftments being underftood, point the telefcope to any diftant land object, and let the middle horizontal wire bifect it, and read off the polar diftances fhewn by the indices, and take half their fum; make

the ſame obſervation when the inſtrument is turned half round the polar axis, and take another mean of the angles now ſhewn by the oppoſite indices; ſubtract the former mean from 180°, and add the difference to the latter mean, and *half of this ſum* is the angular diſtance from the pole of the inſtrument, to which quantity the indices muſt be put within the exactneſs of a minute or ſo, as this proceſs muſt hitherto be conſidered as an approximation only: repeat the operation we have deſcribed of obtaining two means of polar diſtances more accurately by uſing the ſcales of minutes and ſeconds; thus, read off by the indices the quantity to the diviſion next below the ſub-diviſions to be meaſured by the ſcales; then turn the micrometer head till the wire of the microſcope biſects the next following point, taking care to count the notches paſſed over as minutes, and the ſeconds and parts on the micrometer ſcale to be added to the quantity given by the indices alone; and the *ſupplement* of the mean of the two meaſures by the microſcopes, added to the mean read off in the ſame way, when turned half round the polar axis, being divided by two, will give the *true* angle from the pole of the inſtrument; and the ſcale of minutes, as well as ſcale of ſeconds on the micrometer head, muſt be finally adjuſted thereto.

8. To place the *declination-level parallel to the line of collimation* of the teleſcope, bring the declination-axis level, or nearly ſo, and let the bubble of the declination-level be brought to the middle of its tube, by the motion round the polar axis, and let the indices be put to its ends; turn the level a ſmall quantity round its own axis, and try if the bubble has any tendency to either end; if it has, adjuſt it laterally by the ſcrews that move one of its pivots ſideways, till it is right in this reſpect; now reverſe the level, and if the bubble does not ſtand in the middle, alter one half the error by moving the teleſcope in declination, by means of its ſcrew for ſlow motion, and the other half by the ſcrews that govern the pivots of the level, and the level itſelf will then be adjuſted. In this ſituation of things look for ſome object in the centre of the field of the teleſcope, and note it; turn the inſtrument half round the polar axis, and as much round the declination-axis as to bring the teleſcope exactly to the ſame object again; if the bubble now ſtands in the middle, the adjuſtment is right, but if otherwiſe, one half of the error muſt be altered by the motion of the teleſcope in declination, and the other half by altering the pivot-hole of the level. Laſtly, turn the inſtrument the ſpace of *ſix hours* round the polar axis, and adjuſt the other pivot hole till the bubble ſtands in the middle of its tube, and the adjuſtments are all complete, provided the polar axis of the inſtrument be exactly parallel to the axis of the earth, which we have all along taken for granted, and which may be effected by its own adjuſtments as pointed out by an obſervation of a circum-polar ſtar, agreeably to our directions given under our article EQUATORIAL *Sector*.

N° I. TABLE of the Effect of Refraction in North Polar Distance.

This correction is always +

Angle of the vertical with the horary circle.	Degrees of Altitude. 2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	Angle of the vertical with the horary circle.
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	18 1	11 42	8 25	6 30	5 15.6	4 24.0	3 46.4	3 17.5	2 54.7	2 36.3	2 20.9	2 8.0	1 57.2	1 47.6	1 39.0	90
2	18 0	11 42	8 24	6 30	5 15.3	4 23.8	3 46.3	3 17.4	2 54.6	2 36.2	2 20.8	2 7.9	1 57.1	1 47.5	1 38.9	88
4	17 58	11 40	8 24	6 29	5 14.7	4 23.4	3 45.9	3 17.0	2 54.3	2 35.9	2 20.6	2 7.7	1 56.9	1 47.3	1 38.8	86
6	17 55	11 37	8 22	6 28	5 13.8	4 22.5	3 45.2	3 16.4	2 53.7	2 35.4	2 20.1	2 7.3	1 56.6	1 47.0	1 38.5	84
8	17 50	11 35	8 20	6 26	5 12.6	4 21.4	3 44.2	3 15.6	2 53.0	2 34.8	2 19.5	2 6.8	1 56.1	1 46.6	1 38.0	82
10	17 44	11 31	8 17	6 24	5 10.8	4 20.0	3 43.0	3 14.5	2 52.0	2 33.9	2 18.8	2 6.1	1 55.4	1 46.0	1 37.5	80
12	17 37	11 27	8 14	6 21	5 8.7	4 18.2	3 41.4	3 12.8	2 50.9	2 32.9	2 17.8	2 5.2	1 54.6	1 45.2	1 36.8	78
14	17 29	11 21	8 10	6 18	5 6.3	4 16.2	3 39.7	3 11.6	2 49.5	2 31.7	2 16.7	2 4.2	1 53.7	1 44.4	1 36.1	76
16	17 19	11 15	8 5	6 15	5 3.3	4 13.7	3 37.6	3 9.8	2 47.9	2 30.2	2 15.4	2 3.0	1 52.7	1 43.4	1 35.2	74
18	17 8	11 7	8 0	6 11	5 0.3	4 11.1	3 35.3	3 7.8	2 46.1	2 28.7	2 14.0	2 1.7	1 51.5	1 42.3	1 34.1	72
20	16 56	11 0	7 54	6 7	4 56.7	4 8.1	3 32.8	3 5.6	2 44.1	2 26.9	2 12.4	2 0.3	1 50.1	1 41.1	1 33.0	70
22	16 41	10 51	7 46	6 1	4 53	4 4.8	3 29.9	3 3.2	2 42.0	2 24.9	2 10.6	1 58.7	1 48.7	1 39.7	1 31.8	68
24	16 28	10 41	7 41	5 56	4 48	4 1.2	3 26.9	3 0.5	2 39.6	2 22.8	2 8.7	1 56.9	1 47.1	1 38.3	1 30.4	66
26	16 12	10 31	7 34	5 50	4 44	3 57.3	3 23.5	2 57.6	2 37.0	2 20.5	2 6.6	1 55.0	1 45.4	1 36.7	1 29.0	64
28	15 55	10 20	7 26	5 44	4 39	3 53.1	3 20.0	2 54.5	2 34.2	2 18.0	2 4.4	1 53.0	1 43.5	1 35.8	1 27.4	62
30	15 36	10 8	7 17	5 38	4 33	3 48.6	3 16.1	2 51.1	2 31.3	2 15.1	2 2.0	1 50.8	1 41.5	1 33.1	1 25.7	60
32	15 17	9 55	7 8	5 31	4 28	3 43.9	3 12.0	2 47.6	2 28.1	2 12.6	1 59.5	1 48.5	1 39.4	1 31.2	1 24.0	58
34	14 56	9 42	6 58	5 23	4 22	3 38.9	3 7.8	2 43.8	2 24.8	2 9.6	1 56.8	1 46.1	1 37.2	1 29.1	1 22.1	56
36	14 34	9 28	6 48	5 16	4 15	3 33.6	3 3.2	2 39.9	2 21.3	2 6.5	1 54.0	1 43.6	1 34.9	1 27.0	1 20.1	54
38	14 12	9 13	6 38	5 7	4 9	3 28.0	2 58.4	2 35.6	2 17.6	2 3.2	1 51.0	1 40.9	1 32.4	1 24.7	1 18.0	52
40	13 48	8 58	6 27	4 59	4 2	3 22.2	2 53.4	2 31.3	2 13.7	1 59.8	1 47.9	1 38.0	1 29.8	1 22.3	1 15.8	50
42	13 23	8 41	6 15	4 50	3 55	3 16.1	2 48.2	2 26.7	2 9.7	1 56.1	1 44.7	1 35.1	1 27.1	1 19.9	1 13.5	48
44	12 58	8 25	6 3	4 40	3 47	3 9.9	2 42.9	2 22.1	2 5.6	1 52.4	1 41.4	1 32.1	1 24.4	1 17.4	1 11.2	46
46	12 31	8 7	5 51	4 31	3 39	3 3.4	2 37.3	2 17.1	2 1.4	1 48.6	1 37.9	1 28.9	1 21.5	1 14.7	1 8.8	44
48	12 3	7 49	5 38	4 21	3 31	2 56.6	2 31.5	2 12.1	1 56.9	1 44.6	1 34.3	1 25.6	1 18.5	1 12.0	1 6.2	42
50	11 35	7 31	5 24	4 11	3 23	2 49.7	2 25.6	2 6.9	1 52.3	1 40.5	1 30.6	1 22.3	1 15.4	1 9.1	1 3.6	40
52	11 6	7 12	5 11	4 0	3 14	2 42.5	2 19.3	2 1.6	1 47.5	1 36.6	1 26.8	1 18.8	1 12.2	1 6.2	1 1.0	38
54	10 35	6 52	4 57	3 49	3 6	2 25.2	2 13.8	1 56.6	1 42.7	1 34.9	1 22.9	1 15.2	1 9.0	1 3.2	0 58.2	36
56	10 4	6 33	4 42	3 38	2 57	2 27.6	2 6.6	1 50.5	1 37.7	1 27.4	1 18.8	1 11.6	1 5.6	1 0.1	0 55.4	34
58	9 33	6 12	4 27	3 27	2 47	2 19.9	2 0.0	1 44.7	1 32.6	1 22.9	1 14.7	1 7.8	1 2.2	0 57.0	0 52.9	32
60	9 0	5 51	4 12	3 15	2 38	2 12.0	1 53.2	1 38.7	1 27.3	1 18.1	1 10.4	1 4.0	0 58.6	0 53.8	0 49.5	30
62	8 27	5 30	3 57	3 3	2 28	2 3.9	1 46.3	1 32.7	1 22.2	1 13.3	1 6.2	1 0.1	0 55.0	0 50.5	0 46.5	28
64	7 54	5 8	3 41	2 51	2 18	1 55.7	1 39.3	1 26.6	1 16.6	1 8.5	1 1.8	0 56.1	0 51.4	0 47.1	0 43.4	26
66	7 19	4 46	3 25	2 39	2 8	1 47.4	1 32.1	1 20.3	1 11.1	1 3.5	0 57.3	0 52.1	0 47.7	0 43.7	0 40.3	24
68	6 45	4 23	3 9	2 26	1 58	1 38.9	1 24.9	1 14.0	1 5.5	0 58.5	0 52.8	0 47.9	0 43.9	0 40.3	0 37.1	22
70	6 10	4 0	2 52	2 13	1 48	1 30.3	1 17.5	1 7.6	0 59.8	0 53.5	0 48.2	0 43.8	0 40.1	0 36.7	0 33.9	20
72	5 34	3 37	2 36	2 1	1 37	1 21.6	1 9.9	1 1.1	0 54.0	0 48.3	0 43.6	0 39.6	0 36.3	0 33.2	0 30.6	18
74	4 58	3 13	2 19	1 47	1 27	1 12.8	1 2.4	0 54.5	0 48.1	0 43.1	0 38.9	0 35.3	0 32.6	0 29.6	0 27.3	16
76	4 22	2 50	2 2	1 34	1 16	1 3.9	0 54.8	0 47.8	0 42.1	0 37.8	0 34.1	0 31.0	0 28.4	0 26.0	0 24.0	14
78	3 45	2 26	1 45	1 21	1 5	0 54.9	0 47.1	0 41.1	0 36.1	0 32.5	0 29.3	0 26.6	0 24.3	0 22.4	0 20.6	12
80	3 8	2 2	1 27	1 7	0 55	0 45.8	0 39.3	0 34.3	0 30.2	0 27.1	0 24.4	0 22.2	0 20.3	0 18.6	0 17.2	10
82	2 30	1 38	1 10	0 54	0 44	0 36.7	0 31.6	0 27.5	0 24.3	0 21.7	0 19.6	0 17.8	0 16.3	0 14.9	0 13.8	8
84	1 53	1 13	0 53	0 41	0 33	0 27.6	0 23.5	0 20.7	0 18.4	0 16.3	0 14.7	0 13.4	0 12.2	0 11.4	0 10.3	6
86	1 15	0 49	0 35	0 27	0 22	1 8.4	0 15.8	0 13.7	0 12.3	0 10.9	0 9.8	0 8.9	0 8.2	0 7.5	0 6.9	4
88	0 38	0 25	0 17	0 13	0 11	0 9.3	0 7.9	0 6.9	0 6.2	0 5.5	0 4.9	0 4.3	0 4.1	0 3.8	0 3.5	2
90	0 0	0 0	0 0	0 0	0 0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0

Refraction in Right Ascension × Sec. of Declination.

This correction is — on the East, and + on the West side of the Meridian.

N° I. TABLE of the Effect of Refraction in North Polar Distance—*continued.*

This correction is always +

Angle of the Vertical with the Horary Circle.	Degrees of Altitude. 32°	34°	36°	38°	40°	42°	44°	46°	48°	50°	52°	54°	56°	58°	60°	Angle of the Vertical with the Horary circle.
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″	″	″	°	°
0	1 31.5	1 24.7	1 18.7	1 13.2	1 8.2	1 3.6	59.3	55.3	51.6	48.1	44.9	41.7	38.7	35.8	33.1	90
2	1 31.4	1 24.6	1 18.7	1 13.2	1 8.2	1 3.6	59.3	55.3	51.6	48.1	44.9	41.7	38.7	35.8	33.1	88
4	1 31.3	1 24.5	1 18.5	1 13.2	1 8.0	1 3.4	59.2	55.2	51.5	48.0	44.8	41.6	38.6	35.7	33.0	86
6	1 31.0	1 24.2	1 18.3	1 12.8	1 7.8	1 3.3	59.0	55.0	51.3	47.8	44.7	41.5	38.5	35.6	32.9	84
8	1 30.6	1 23.9	1 17.9	1 12.5	1 7.5	1 3.0	58.7	54.8	51.1	47.6	44.5	41.3	38.3	35.5	32.8	82
10	1 30.1	1 23.4	1 17.5	1 12.1	1 7.2	1 2.6	58.4	54.5	50.8	47.4	44.2	41.1	38.1	35.3	32.6	80
12	1 29.5	1 22.8	1 17.0	1 11.6	1 6.7	1 2.2	58.0	54.1	50.5	47.0	43.9	40.8	37.8	35.0	32.4	78
14	1 28.8	1 22.2	1 16.4	1 11.0	1 6.2	1 1.7	57.5	53.7	50.1	46.7	43.6	40.5	37.5	34.7	32.1	76
16	1 28.0	1 21.4	1 15.6	1 10.4	1 5.6	1 1.2	57.0	53.2	49.6	46.2	43.2	40.1	37.2	34.4	31.8	74
18	1 27.0	1 20.5	1 14.8	1 9.6	1 4.9	1 0.5	56.4	52.6	49.1	45.7	42.7	39.6	36.8	34.0	31.5	72
20	1 26.0	1 19.7	1 13.9	1 8.8	1 4.1	0 59.8	55.7	52.0	48.5	45.2	42.2	39.2	36.3	33.6	31.1	70
22	1 24.9	1 18.5	1 12.9	1 7.9	1 3.2	0 59.0	55.0	51.3	47.9	44.6	41.6	38.6	35.9	33.2	30.7	68
24	1 23.6	1 17.4	1 11.9	1 6.9	1 2.3	0 58.2	54.2	50.5	47.1	43.9	41.0	38.1	35.3	32.7	30.2	66
26	1 22.3	1 16.1	1 10.7	1 5.8	1 1.3	0 57.2	53.3	49.7	46.4	43.2	40.3	37.4	34.8	32.2	29.8	64
28	1 20.9	1 14.8	1 9.5	1 4.7	1 0.2	0 56.2	52.4	48.9	45.6	42.5	39.6	36.8	34.2	31.6	29.2	62
30	1 19.3	1 13.3	1 8.1	1 3.4	0 59.1	0 55.2	51.4	47.9	44.8	41.6	38.9	36.1	33.5	31.0	28.7	60
32	1 17.7	1 11.7	1 6.7	1 2.1	0 57.9	0 54.0	50.3	46.9	43.8	40.8	38.1	35.3	32.8	30.3	28.1	58
34	1 15.8	1 10.2	1 5.2	1 0.7	0 56.6	0 52.7	49.2	45.9	42.8	39.9	37.2	34.5	32.0	29.6	27.5	56
36	1 14.0	1 8.5	1 3.6	0 59.3	0 55.2	0 51.5	48.0	44.8	41.8	38.9	36.3	33.7	31.3	28.9	26.8	54
38	1 12.1	1 6.7	1 1.9	0 57.7	0 53.8	0 50.1	46.8	43.6	40.7	37.9	35.4	32.8	30.4	28.2	26.1	52
40	1 10.1	1 4.8	1 0.2	0 56.1	0 52.3	0 48.8	45.5	42.4	39.6	36.9	34.4	31.9	29.6	27.4	25.4	50
42	1 8.0	1 2.8	0 58.4	0 54.4	0 50.7	0 47.3	44.1	41.2	38.4	35.8	33.3	30.9	28.7	26.5	24.6	48
44	1 5.9	1 0.8	0 56.5	0 52.7	0 49.1	0 45.8	42.7	39.9	37.2	34.6	32.3	29.9	27.8	25.7	23.8	46
46	1 3.4	0 58.7	0 54.6	0 50.9	0 47.4	0 44.2	41.3	38.5	35.8	33.4	31.2	28.9	26.8	24.8	23.0	44
48	1 1.1	0 56.7	0 52.7	0 49.0	0 45.7	0 42.5	39.8	37.0	34.5	32.2	30.0	27.8	25.9	23.9	22.2	42
50	0 58.8	0 54.4	0 50.6	0 47.1	0 43.9	0 40.9	37.8	35.5	33.2	30.9	28.8	26.8	24.9	22.9	21.3	40
52	0 56.3	0 52.1	0 48.4	0 45.1	0 42.1	0 39.2	36.5	34.1	31.8	29.7	27.6	25.7	23.8	22.0	20.4	38
54	0 53.8	0 49.7	0 46.2	0 43.1	0 40.2	0 37.4	34.9	32.5	30.4	28.3	26.4	24.5	22.7	21.0	19.5	36
56	0 51.2	0 47.3	0 44.0	0 41.0	0 38.2	0 35.6	33.2	31.0	28.9	26.9	25.1	23.3	21.6	19.9	18.6	34
58	0 48.4	0 44.9	0 41.7	0 38.9	0 36.2	0 33.7	31.5	29.4	27.4	25.5	23.8	22.1	20.5	18.9	17.6	32
60	0 45.8	0 42.3	0 39.3	0 36.6	0 34.1	0 31.8	29.6	27.6	25.8	24.0	22.5	20.8	19.3	17.9	16.5	30
62	0 42.9	0 39.7	0 36.9	0 34.4	0 32.1	0 29.9	27.9	26.0	24.2	22.5	21.1	19.5	18.1	16.8	15.5	28
64	0 40.1	0 37.1	0 34.4	0 32.1	0 30.1	0 27.9	26.1	24.3	22.7	21.0	19.7	18.2	16.9	15.7	14.5	26
66	0 37.2	0 34.4	0 31.9	0 29.8	0 27.8	0 25.9	24.2	22.6	21.0	19.5	18.3	16.9	15.7	14.5	13.4	24
68	0 34.3	0 31.6	0 29.4	0 27.4	0 25.6	0 23.8	22.2	20.8	19.4	18.0	16.9	15.5	14.4	13.4	12.4	22
70	0 31.3	0 29.0	0 26.9	0 25.1	0 23.4	0 21.7	20.4	18.9	17.6	16.4	15.4	14.3	13.2	12.2	11.3	20
72	0 28.3	0 26.2	0 24.3	0 22.7	0 21.1	0 19.7	18.3	17.1	16.0	14.8	13.9	12.9	12.0	11.0	10.2	18
74	0 25.3	0 23.3	0 21.7	0 20.2	0 18.8	0 17.6	16.4	15.3	14.3	13.2	12.4	11.5	10.6	9.8	9.1	16
76	0 22.2	0 20.5	0 19.0	0 17.8	0 16.6	0 15.4	14.4	13.4	12.5	11.6	10.9	10.1	9.3	8.6	8.0	14
78	0 19.0	0 17.6	0 16.3	0 15.3	0 14.2	0 13.2	12.4	11.5	10.8	10.0	9.4	8.6	8.0	7.4	6.9	12
80	0 15.9	0 14.6	0 13.6	0 12.8	0 11.9	0 11.0	10.3	9.6	8.9	8.3	7.8	7.2	6.7	6.1	5.7	10
82	0 12.8	0 11.7	0 10.9	0 10.3	0 9.6	0 8.9	8.3	7.8	7.2	6.7	6.3	5.7	5.4	5.0	4.6	8
84	0 9.6	0 8.8	0 8.2	0 7.7	0 7.2	0 6.7	6.3	5.8	5.4	5.0	4.7	4.4	4.0	3.8	3.4	6
86	0 6.5	0 5.8	0 5.4	0 5.2	0 4.8	0 4.5	4.2	3.9	3.7	3.4	3.1	2.9	2.6	2.5	2.3	4
88	0 3.2	0 2.9	0 2.7	0 2.6	0 2.4	0 2.3	2.1	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	2
90	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

No. I. TABLE of the Effect of Refraction in North Polar Distance—*continued.*
This correction is always +

Angle of the Vertical with the Horary circle.	Degrees of Altitude.														Angle of the Vertical with the Horary circle.
	62°	64°	66°	68°	70°	72°	74°	76°	78°	80°	82°	84°	86°	88°	90°	
°	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	°
0	30.5	28.0	25.5	23.2	20.9	18.7	16.5	14.4	12.3	10.2	8.1	6.1	4.0	2.0	0.0	90
2	30.5	28.0	25.5	23.2	20.9	18.7	16.5	14.4	12.3	10.2	8.1	6.1	4.0	2.0		88
4	30.4	27.9	25.4	23.1	20.8	18.7	16.5	14.4	12.3	10.2	8.1	6.1	4.0	2.0		86
6	30.3	27.8	25.4	23.0	20.8	18.6	16.4	14.3	12.2	10.1	8.1	6.1	4.0	2.0		84
8	30.2	27.7	25.2	23.0	20.7	18.5	16.3	14.3	12.2	10.1	8.0	6.0	4.0	2.0		82
10	30.0	27.6	25.1	22.8	20.6	18.4	16.2	14.2	12.1	10.0	8.0	6.0	3.9	2.0		80
12	29.8	27.4	24.9	22.7	20.4	18.3	16.1	14.1	12.0	10.0	7.9	6.0	3.9	2.0		78
14	29.6	27.2	24.7	22.5	20.3	18.1	16.0	14.0	11.9	9.9	7.9	5.9	3.9	1.9		76
16	29.3	26.9	24.5	22.3	20.1	18.0	15.9	13.8	11.8	9.8	7.8	5.9	3.8	1.9		74
18	29.0	26.6	24.2	22.1	19.9	17.8	15.7	13.7	11.7	9.7	7.6	5.8	3.8	1.9		72
20	28.7	26.3	24.0	21.8	19.6	17.6	15.5	13.5	11.6	9.6	7.6	5.7	3.8	1.9		70
22	28.3	26.0	23.6	21.5	19.4	17.3	15.3	13.3	11.4	9.5	7.5	5.7	3.7	1.8		68
24	27.8	25.6	23.3	21.2	19.0	17.1	15.1	13.1	11.2	9.3	7.4	5.6	3.6	1.8		66
26	27.4	25.2	22.9	20.8	18.8	16.8	14.8	12.9	11.1	9.2	7.3	5.5	3.6	1.8		64
28	26.9	24.7	22.5	20.5	18.4	16.5	14.6	12.7	10.9	9.0	7.1	5.4	3.5	1.8		62
30	26.4	24.2	22.1	20.1	18.1	16.2	14.3	12.5	10.6	8.8	7.0	5.3	3.5	1.7		60
32	25.8	23.7	21.6	19.7	17.7	15.9	14.0	12.2	10.4	8.6	6.9	5.2	3.4	1.7		58
34	25.3	23.2	21.1	19.2	17.3	15.5	13.7	11.9	10.2	8.5	6.7	5.1	3.3	1.7		56
36	24.7	22.6	20.6	18.8	16.9	15.1	13.3	11.6	9.9	8.2	6.5	4.9	3.2	1.6		54
38	24.0	22.1	20.1	18.3	16.5	14.7	13.0	11.3	9.7	8.0	6.4	4.8	3.1	1.6		52
40	23.4	21.4	19.5	17.8	16.0	14.3	12.6	11.0	9.4	7.8	6.2	4.7	3.1	1.5		50
42	22.7	20.8	18.9	17.2	15.5	13.9	12.3	10.7	9.1	7.6	6.0	4.5	3.0	1.5		48
44	22.0	20.1	18.3	16.7	15.0	13.4	11.9	10.4	8.8	7.3	5.8	4.4	2.9	1.4		46
46	21.1	19.4	17.7	16.1	14.5	13.0	11.5	10.0	8.5	7.1	5.6	4.2	2.8	1.4		44
48	20.4	18.7	17.1	15.5	14.0	12.5	11.0	9.6	8.2	6.8	5.4	4.1	2.7	1.3		42
50	19.6	18.0	16.4	14.9	13.4	12.0	10.6	9.3	7.9	6.6	5.2	3.9	2.6	1.3		40
52	18.8	17.2	15.7	14.3	12.9	11.4	10.2	8.9	7.6	6.3	5.0	3.8	2.5	1.2		38
54	17.9	16.5	15.0	13.6	12.3	11.0	9.7	8.5	7.2	6.0	4.8	3.6	2.3	1.2		36
56	17.1	15.7	14.3	13.0	11.7	10.5	9.2	8.0	6.9	5.7	4.5	3.4	2.2	1.1		34
58	16.2	14.8	13.5	12.3	11.1	9.9	8.7	7.6	6.5	5.4	4.3	3.2	2.1	1.1		32
60	15.2	14.0	12.7	11.6	10.4	9.3	8.2	7.2	6.1	5.1	4.0	3.0	2.0	1.0		30
62	14.3	13.1	12.0	10.9	9.8	8.8	7.7	6.8	5.8	4.8	3.8	2.9	1.9	0.9		28
64	13.4	12.3	11.2	10.2	9.2	8.2	7.2	6.3	5.4	4.5	3.5	2.7	1.7	0.9		26
66	12.4	11.4	10.4	9.4	8.5	7.6	6.7	5.9	5.0	4.1	3.3	2.5	1.6	0.8		24
68	11.4	10.5	9.5	8.7	7.8	7.0	6.2	5.4	4.6	3.8	3.0	2.3	1.5	0.7		22
70	10.5	9.6	8.7	7.9	7.1	6.4	5.6	4.9	4.2	3.5	2.8	2.1	1.4	0.7		20
72	9.4	8.6	7.9	7.2	6.5	5.6	5.1	4.4	3.8	3.1	2.5	1.9	1.2	0.6		18
74	8.4	7.7	7.0	6.4	5.8	5.1	4.5	4.0	3.4	2.8	2.2	1.7	1.1	0.5		16
76	7.4	6.8	6.2	5.6	5.1	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5		14
78	6.3	5.8	5.3	4.8	4.3	3.9	3.4	3.0	2.6	2.1	1.7	1.3	0.8	0.4		12
80	5.3	4.9	4.4	4.0	3.6	3.2	2.9	2.5	2.1	1.8	1.4	1.1	0.7	0.3		10
82	4.3	3.9	3.5	3.2	2.9	2.6	2.3	2.0	1.7	1.4	1.1	0.8	0.6	0.3		8
84	3.2	2.9	2.7	2.4	2.2	1.9	1.7	1.5	1.3	1.1	0.8	0.6	0.4	0.2		6
86	2.2	1.9	1.8	1.6	1.5	1.3	1.1	1.0	0.9	0.7	0.6	0.4	0.3	0.1		4
88	1.1	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.4	0.4	0.3	0.2	0.1	0.1		2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0

Nº II. TABLE of the Effect of Parallax in North Polar Diftance and Right Afcenfion,
The horizontal Parallax = 8″.6 This correction is always −

Angle of the verti-cal and horary.	Degrees of Altitude.										Angle of the verti-cal and horary.
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	
°	″	″	″	″	″	″	″	″	″	″	°
0	8.60	8.47	8.08	7.45	6.59	5.53	4.30	2.94	1.49	0.0	90
10	8.47	8.34	7.96	7.34	6.49	5.45	4.23	2.90	1.47	0.0	80
20	8.08	7.96	7.60	7.00	6.19	5.20	4.64	2.77	1.40	0.0	70
30	7.45	7.34	6.99	6.45	5.71	4.79	3.72	2.55	1.29	0.0	60
40	6.59	6.49	6.18	5.70	5.05	4.23	3.29	2.26	1.15	0.0	50
50	5.53	5.44	5.19	4.79	4.23	3.55	2.76	1.89	0.96	0.0	40
60	4.30	4.23	4.04	3.72	3.30	2.76	2.15	1.47	0.74	0.0	30
70	2.94	2.90	2.77	2.55	2.26	1.89	1.47	1.01	0.51	0.0	20
80	1.49	1.47	1.40	1.29	1.14	0.95	0.75	0.50	0.26	0.0	10

Parallax in Right Afcenfion, × Sec. of Declination.
This correction is + on the Eaft, and − on the Weft fide of the Meridian.

Nº III. TABLE of the Effect of Parallax in North Polar Diftance and Right Afcenfion
The horizontal Parallax being = 10″. This correction is always −

Angle of the verti-cal and horary.	Degrees of Altitude.										Angle of the verti-cal and horary.
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	
°	″	″	″	″	″	″	″	″	″	″	°
0	10.00	9.85	9.40	8.66	7.66	6.43	5 00	3.42	1.73	0.0	90
10	9.85	9.70	9.26	8.53	7.54	6.33	4.92	3.37	1.70	0.0	80
20	9.40	9.25	8.83	8.14	7.20	6.04	4.70	3.21	1.63	0.0	70
30	8.66	8.53	8.14	7.51	6 64	5.57	4.33	2.96	1.50	0.0	60
40	7.66	7.54	7.20	6.63	5.87	4.93	3.83	2.62	1.32	0.0	50
50	6.43	6.33	6.04	5.56	4.92	4.13	3.21	2.21	1.11	0.0	40
60	00	4.92	4.70	4.33	3.83	3.21	2.50	1.71	0.86	0.0	30
70	42	3.37	3.21	2.96	2.62	2.20	1.71	1.17	0.59	0.0	20
80	73	1.71	1.63	1.50	1.33	4.11	0.87	0.59	0.30	0.0	10

Parallax in Right Afcenfion, × Sec. of Declination.
This correction is + on the Eaft, and − on the Weft fide of the Meridian.

Nº IV. TABLE of Natural Secants.

Deg.	Nat. Sec.	Deg.	Nat. Sec.	Deg.	Nat. Sec.	Deg.	Nat. Sec.	Deg.	Nat. Sec.	Deg.	Nat. Sec.
1	1002	16	10403	31	11666	46	14396	61	20627	76	41336
2	1006	17	10457	32	11792	47	14663	62	21301	77	44454
3	1014	18	10515	33	11924	48	14945	63	22027	78	48097
4	1024	19	10576	34	12062	49	15243	64	22812	79	52408
5	1038	20	10642	35	12208	50	15557	65	23662	80	57588
6	10055	21	10711	36	12361	51	15890	66	24586	81	63925
7	10075	22	10785	37	12521	52	16243	67	25593	82	71853
8	10098	23	10864	38	12690	53	16626	68	26695	83	82055
9	10124	24	10946	39	12868	54	17013	69	27904	84	95668
10	10154	25	11034	40	13054	55	17434	70	29238	85	114737
11	10187	26	11126	41	13250	56	17883	71	30716	86	143356
12	10223	27	11223	42	13456	57	18361	72	32361	87	191075
13	10263	28	11326	43	13673	58	18871	73	34203	88	286537
14	10306	29	11434	44	13902	59	19416	74	36280	89	572987
15	10353	30	11547	45	14142	60	20000	75	38637	90	Infinite.

N° V. TABLE of the Correction of the Time ſhewn by an Equatorial on account of Refraction, when the Inſtrument is not previouſly adjuſted to the true Meridian.

Angle of the Vertical with the Horary Circle.	Degrees of Altitude.												
	7°	10°	15°	20°	25°	30°	35°	40°	45°	50°	60°	70°	80°
°	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.
5	338.	241.	161.3	118.9	94.2	74.9	62.0	51.7	43.7	36.8	25.3	16.1	8.0
10	169.	120.	80.7	59.4	47.0	37.4	31.0	25.9	21.9	18.4	12.6	8.1	4.0
15	114.	81.	54.3	40.0	31.8	25.2	20.9	17.4	14.7	12.4	8.5	5.4	2.7
20	86.	61.	41.0	30.4	24.1	19.1	15.8	13.2	11.2	9.4	6.5	4.1	2.1
25	70.	50.	33.4	24.6	19.5	15.5	12.8	10.7	9.1	7.6	5.2	3.3	1.7
30	59.	42.	28.2	20.6	16.4	13.0	10.8	9.0	7.6	6.4	4.4	2.8	1.4
35	51.	36.	24.4	18.0	14.3	11.4	9.4	7.8	6.6	5.6	3.8	2.4	1.2
40	46.	33.	21.8	16.0	12.7	10.1	8.4	7.0	5.9	5.0	3.4	2.2	1.1
45	41.	30.	19.9	14.6	11.8	9.2	7.6	6.3	5.4	4.5	3.1	2.0	1.0
50	38.	27.	18.3	13.4	10.7	8.5	7.1	5.9	5.0	4.2	2.9	1.8	0.0
55	36.	26.	17.1	12.6	10.1	7.9	6.6	5.5	4.6	3.9	2.7	1.7	0.9
60	34.	24.	16.2	11.9	9.5	7.5	6.3	5.2	4.4	3.7	2.5	1.6	0.8
65	32.	23.	15.5	11.4	9.1	7.2	6.0	4.9	4.2	3.5	2.4	1.5	0.8
70	31.	22.	14.9	11.0	8.8	6.9	5.8	4.8	4.0	3.4	2.3	1.5	0.7
80	30.	21.	14.2	10.5	8.3	6.6	5.5	4.6	3.9	3.2	2.2	1.4	0.7
90	29.	21.	14.0	10.3	8.2	6.5	5.4	4.5	3.8	3.2	2.2	1.4	0.7

× Secant of Declination.

This Equation is − on the Eaſt, and + on the Weſt ſide of the Meridian.

N° VI. TABLE ſhewing the Correction of the Meridian Line found by an Equatorial, ariſing from the Effect of Refraction, in Minutes and Decimals.

Angle of the Vertical with the Horary circle.	Degrees of Altitude.												
	7°	10°	15°	20°	25°	30°	35°	40°	45°	50°	60°	70°	80°
°	′	′	′	′	′	′	′	′	′	′	′	′	′
5	84.5	60.3	40.0	29.8	21.9	18.3	15.5	12.6	10.9	9.2	6.3	4.0	2.3
10	41.7	29.7	19.8	14.8	11.4	9.1	7.7	6.2	5.4	4.5	3.1	2.0	1.1
15	27.3	19.5	13.1	9.7	7.5	5.9	5.0	4.1	3.5	3.0	2.0	1.3	0.7
20	20.1	14.4	9.6	7.2	5.5	4.4	3.7	3.0	2.6	2.2	1.5	1.0	0.5
25	15.8	11.4	7.6	5.6	4.3	3.4	2.9	2.4	2.0	1.7	1.2	0.8	0.4
30	12.7	9.1	6.1	4.5	3.4	2.8	2.3	1.9	1.6	1.4	0.9	0.6	0.3
35	10.2	7.5	5.0	3.7	2.8	2.3	1.9	1.6	1.3	1.1	0.8	0.5	0.3
40	8.7	6.2	4.2	3.1	2.4	1.9	1.6	1.3	1.1	0.9	0.6	0.4	0.2
45	7.3	5.2	3.5	2.6	2.0	1.6	1.3	1.1	0.9	0.8	0.5	0.3	0.2
50	6.1	4.4	2.9	2.2	1.7	1.3	1.1	0.9	0.8	0.6	0.4	0.3	0.2
55	5.1	3.7	2.4	1.8	1.4	1.1	0.9	0.8	0.7	0.5	0.4	0.2	0.1
60	4.2	3.0	2.0	1.5	1.1	0.9	0.8	0.6	0.5	0.4	0.3	0.2	0.1
65	3.4	2.4	1.6	1.2	0.9	0.8	0.8	0.5	0.4	0.3	0.2	0.2	0.1
70	2.7	1.9	1.3	0.9	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0.1
80	1.3	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

× Secant of the Altitude.

Note. If the obſervation is on the $\left\{\begin{array}{l}\text{eaſt}\\\text{weſt}\end{array}\right\}$ ſide of the Meridian, then is the true Meridian ſo many minutes to the $\left\{\begin{array}{l}\text{eaſt}\\\text{weſt}\end{array}\right\}$ of that found by the Inſtrument.

N° VII. TABLE of the Effect of Refraction in Right Ascension in Time, when the Equatorial is adjusted to the Meridian.

Angle of the vertical with the horary Circle.	Degrees of Altitude.														
	3°	5°	7°	10°	15°	20°	25°	30°	35°	40°	45°	50°	60°	70°	80°
°	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	Sec.	
5	5.1	3.5	2.5	1.8	1.2	0.9	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0.1
10	10.1	6.9	5.1	3.7	2.5	1.8	1.4	1.1	0.9	0.8	0.7	0.5	0.4	0.3	0.1
15	15.0	10.3	7.6	5.4	3.6	2.7	2.1	1.7	1.4	1.2	1.0	0.8	0.6	0.4	0.2
20	19.9	13.5	10.0	7.2	4.8	3.5	2.8	2.2	1.9	1.4	1.2	1.1	0.7	0.5	0.2
25	24.5	16.6	12.3	8.8	5.9	4.3	3.4	2.7	2.3	1.9	1.6	1.3	0.9	0.6	0.3
30	29.0	19.7	14.6	10.5	7.0	5.2	4.1	3.3	2.7	2.3	1.9	1.7	1.1	0.7	0.3
35	33.4	22.7	16.8	12.0	8.0	5.9	4.7	3.7	3.1	2.6	2.2	1.8	1.3	0.8	0.4
40	37.4	25.4	18.6	13.5	9.0	6.7	5.2	4.2	3.4	2.9	2.4	2.1	1.3	0.9	0.4
45	41.3	28.0	20.7	14.9	9.9	7.3	5.7	4.6	3.9	3.2	2.7	2.3	1.5	1.0	0.5
50	44.7	30.3	22.5	16.1	10.7	7.9	6.2	5.0	4.1	3.5	2.9	2.5	1.7	1.1	0.5
55	47.7	32.4	24.0	17.2	11.5	8.5	6.7	5.3	4.4	3.7	3.1	2.7	1.8	1.1	0.5
60	50.3	34.2	25.3	18.1	12.1	8.9	7.0	5.7	4.7	3.9	3.3	2.8	1.8	1.2	0.6
65	54.8	35.9	26.5	19.0	12.8	9.3	7.4	5.9	4.9	4.2	3.5	2.9	2.0	1.3	0.6
70	54.6	37.0	27.5	19.7	13.1	9.7	7.7	6.1	5.1	4.3	3.5	3.0	2.1	1.3	0.6
80	57.6	39.1	28.9	20.7	13.8	10.1	8.0	6.5	5.3	4.5	3.8	3.2	2.2	1.4	0.7
90	58.4	39.6	29.3	21.0	14.0	10.3	8.2	6.5	5.4	4.5	3.8	3.2	2.2	1.4	0.7

× Secant of Declination.

This Correction is − on the East, and + on the West side of the Meridian.

N° VIII. TABLE of the Effect of Refraction in Declination when the Equatorial is adjusted to the Meridian.

Angle of the vertical with the horary Circle.	Degrees of Altitude.														
	3°	5°	7°	10°	15°	20°	25°	30°	35°	40°	45°	50°	60°	70°	80°
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″
0	14 36	9 54	7 20	5 15	3 30	2 35	2 2	1 38	1 21	1 8	57	48	33	21	10
10	14 24	9 46	7 14	5 11	3 27	2 32	2 0	1 37	1 20	1 7	57	48	33	21	10
20	13 39	9 16	6 52	4 56	3 17	2 26	1 55	1 32	1 16	1 4	53	45	31	20	9
25	13 12	8 59	6 38	4 45	3 10	2 20	1 50	1 29	1 14	1 2	52	44	30	19	9
30	12 35	8 33	6 20	4 32	3 1	2 14	1 45	1 25	1 10	0 59	49	42	29	18	9
35	11 55	8 6	6 0	4 18	2 52	2 7	1 40	1 20	1 6	0 56	46	39	27	17	8
40	11 11	7 35	5 37	4 1	2 40	1 59	1 33	1 15	1 2	0 52	43	37	25	16	8
45	10 19	7 0	5 11	3 43	2 28	1 50	1 26	1 9	0 58	0 48	40	34	23	15	7
50	9 22	6 21	4 42	3 22	2 15	1 40	1 18	1 3	0 52	0 44	36	31	21	14	6
55	8 21	5 40	4 12	3 0	2 0	1 29	1 10	0 56	0 46	0 39	33	27	19	12	6
60	7 16	4 56	3 39	2 37	1 45	1 18	1 1	0 49	0 40	0 34	29	24	16	11	5
65	6 7	4 9	3 4	2 12	1 28	1 5	0 51	0 41	0 34	0 28	24	20	14	9	4
70	4 58	3 22	2 30	1 48	1 12	0 53	0 42	0 33	0 28	0 23	19	16	11	7	3
75	3 45	2 34	1 54	1 21	0 54	0 40	0 32	0 25	0 21	0 18	15	12	9	6	3
80	2 32	1 43	1 16	0 55	0 37	0 27	0 21	0 17	0 14	0 12	10	8	6	4	2
85	1 16	0 52	0 38	0 27	0 18	0 13	0 11	0 9	0 7	0 6	5	4	3	2	[illegible]

Explication and Ufe of the Tables.

The three firft tables are particularly calculated for the ufe of a large equatorial inftrument, for the purpofe of clearing obfervations made with it from the effects of refraction and parallax, when neither Dollond's refraction apparatus is ufed, nor the micrometer circle of Ramfden's for adjufting the wire ufed in taking altitudes; but the four laft are adapted more peculiarly for portable inftruments. They are copied from fir George Shuckburgh's account in the Philofophical Tranfactions, and, being adapted for all latitudes, are a fuitable appendage to the defcriptions we have given of the different inftruments.

Table I. gives the correction of the refraction in north polar diftance, by entering it with the altitude at the top, and the angle of the horary and vertical circles on the left hand fide; and in the common point of meeting is found a quantity in feconds and decimal parts, that is in all cafes to be *added* to the *apparent* polar diftance to give the *true*; but if it be entered with the angle of the horary and vertical circle in the right hand column, it will give the refraction in right afcenfion, by multiplying the quantity here found by the fecant of the declination to be found in Tab. IV., which is a readier operation than dividing by the cofine, and amounts to the fame thing.

Table II. gives the effect of the fun's parallax in right afcenfion and north polar diftance, and is to be entered with the fame arguments as Tab. I.; and the parallax in right afcenfion is to be multiplied by the fecant of the declination as before; the fun's horizontal parallax being affumed = 8.″6.

Table III. is a fimilar table, only calculated to an horizontal parallax of 10″; fo that whatever be the parallax of the fun or planets, this correction may readily be found, almoft by infpection, *viz.* by multiplying the tabular number by the exact quantity of parallax of the body obferved, and cutting off the decimal quantity.

Table IV. contains the natural fecants to each degree, extracted from Sherwin's tables, to be ready for the operations required above.

Table V. gives the correction of the *time*; *viz.* of the fun or ftar's diftance from the meridian, as afcertained by a portable inftrument not previoufly adjufted to the meridian; this quantity alfo is to be multiplied by the fecant of the declination.

Table VI. gives the correction of the meridian line in minutes and decimals, which may be near enough for portable inftruments; but the quantity here found muft be multiplied by the fecant of the altitude.

Table VII. (like Table I.) is adapted to feconds of *time*, and gives the refraction in right afcenfion in terms fuited to fuch inftruments as have the equatorial circle divided into hours and minutes.

Table VIII., in like manner, gives the refraction in declination. The arguments are the fame in all the tables.

Thefe tables were conftructed by fir G.S. in the year 1774, for his own ufe, and were founded on the principles explained by the Hon. S. M'Kenzie in *fig.* 4. of *Plate* XIII., where I F is a portion of a vertical circle = the refraction in altitude; C F a parallel to the equator; I C a portion of an horary circle = the refraction in declination, found by Tab. I and Tab. VIII., the angle C I F, the angle of the horary and vertical circle; C F the refraction in right afcenfion, found by Tab. I. and Tab. VII.; D I (a parallel to the horizon) the correction of the meridian, found by Tab. VI.; and D F the correction of the time, found by Tab. V; and as I F will hardly ever be found to exceed 30′, thefe triangles have been confidered all as plane; making due allowance, in the proportion of the fine to the radius, for the diftances of the arcs D I, F C, and D F, from their refpective poles, which has been noticed at the foot of each table. The refraction in altitude was taken from Mayer's Tables, 1770, London; which is calculated for a denfity of the air expreffed by 29.6 inches of the barometer, and 50° of Fahrenheit's thermometer.

Equatorial *Micrometer*, is an apparatus applied to a telefcope, that has an equatorial motion, for the purpofe of meafuring fmall differences of right afcenfion and declination of any two heavenly bodies, that pafs either fucceffively, or at the fame time nearly, through the field of view, fo as to be both vifible at the fame elevation of the telefcope. This method requires no graduated circles with verniers or compound microfcopes, and yet is capable of great accuracy within certain limits of difference between the relative fituations of the bodies to be compared together; and if the right afcenfion and declination of one of the two obferved bodies be previoufly known with fufficient accuracy, the place of the other can be determined therefrom by the obferved differences. The common wire micrometer has been long in ufe as an appendage to the eye-piece of a telefcope, and was ufed by Dr. Bradley in making aftronomical obfervations, his manner of doing which was communicated to the Royal Society in the year 1772 (vol. lxii.) by Dr. Mafkelyne; but as the telefcopes then in ufe were from ten to fifteen feet long, for want of the achromatic object-glaffes, an equatorial motion was given, not from one centre, but by means of fupporters at each end of the wooden tubes, fo contrived as to be manageable both in altitude and azimuth; which apparatus is ftill preferved at the Royal Obfervatory. The wires of the micrometer have been adapted differently by different makers, fome making only one moveable, and fome more; but they all agreed in placing them in the focus of the eye-piece of the telefcope. It is not, however, our intention to enter into a detail in this place of all the different conftructions of the micrometer, as applied to various purpofes, but to confine ourfelves to a notice of thofe that have been more particularly applied to telefcopes having an equatorial motion. For the other conftructions, we refer to the article Micrometer.

Soon after the difcovery of the properties of the achromatic object-glafs of a telefcope had reduced the length of the aftronomical telefcope to a portable fize, without diminifhing either its power or fize of its field of view, not only were equatorial inftruments contrived of various conftructions, as we have already defcribed, but equatorial ftands for fimple telefcopes were invented, and continue to be in ufe with the beft telefcopes to the prefent day. To thefe telefcopes the micrometers are a very neceffary and ufeful appendage, inafmuch as they render it capable of being applied with advantage in afcertaining the right afcenfion and declination of a comet, planet, or other body out of the meridian, when they happen to be near enough to a known body to admit of being taken into the fame field of view without altering the elevation. Though the wire micrometer was firft invented, as applied to the focus of the eye-piece, and continues to be ufed in many inftruments, yet fince the invention of the achromatic object-glafs, Dollond's object-glafs micrometer has by fome aftronomers been preferred, or at leaft deemed equally ufeful, particularly when the crofs wires are alfo ufed in conjunction, as defcribed by Dr. Mafkelyne in his paper on this fubject read to the Royal Society of London on Dec. 12, 1771, which was the year after Smeaton finifhed his wire micrometer, that had been begun about forty years before. If we give an an account of thefe two kinds of micrometers in fucceffion, the reader will perceive the varieties that may arife from them by flight deviations of conftruction. We will begin with Smeaton's, as being of prior origin.

We are not aware that Mr. Smeaton has left behind him any perfpective drawing of his equatorial micrometer, though we have heard that there is an undefcribed fketch of one among his papers, at prefent in the poffeffion of Mr. Lloyd; but there is a fection of one accompanying his paper read to the Royal Society of London on June 7, 1787, which is fufficient for explaining the principle of its application. *Fig.* 3. of *Plate* XIII. of *Aftronomical Inftruments*, is the faid fection, as viewed from the eye-end of the telefcope. "This micrometer," fays the author, "is furnifhed with five horary wires, denominated in their order, *a*, A, B, C, D, (B being the middle horary wire,) and the two declination wires are denominated A, B, each moveable by a feparate and independent micrometer-fcrew, from the outfide of the field to the centre, and a little beyond it; fo that each wire can be moved into the place of the other, when at or near the centre." The field of view was only 1° 17′, and the magnifying power as low as 20, with an eye glafs of 1¾ inch focus, and a double object-glafs of 34½ focal length; notwithftanding the author calculates that a difference of only 2½″ may be read by fuch apparatus, which he concluded was near enough for any inftrument to read out of the meridian. In the conftruction of the ftand every thing was done to enfure ftability of pofition at any given elevation, and the fruftum of an hexagonal ftone was ufed as a pedeftal, detached from the floor of the obfervatory. With an apparatus fo fteady, it was not neceffary to confine the obfervations to two bodies, to be compared, whofe difference of right afcenfion was only a few minutes, but even hours could be admitted of for the interval of the fucceffive tranfits, provided the difference of the declinations did not exceed the interval between the two adjuftable crofs wires. The difference of the right afcenfions was eafily afcertained by a regulator or chronometer, meafuring the interval between the tranfits, and the diftance between the bodies as meafured by the interval between the crofs wires, gave the difference of the declinations. The firft trial of the fteadinefs and accuracy of this apparatus was made with Saturn and γ Capricorni, from which it was found that the ftar had the fame right afcenfion and declination, determined on two feparate evenings, at the diftance of 48 hours, though the inftrument had not been touched during the interval. But the principal obfervations noticed in the memoir, are thofe relating to the elongation of Mercury, as taken from Sep. 23, to Oct. 13, 1786, the refult of which was, that at $5^h\ 22^m\ 35^s$ mean time on Sep. 23, A.M. Mercury's right afcenfion, deduced from a comparifon with α Orionis, was 163° 59′ 21″, and his declination north 7° 44′ 25″. For the particulars of the calculations and the tables of the obfervations, fee the Phil. Tranf. of 1787. Alfo for the manner in which a fimple telefcope may be made to move in an equatorial direction, fee our article EQUATORIAL *Stand* of a telefcope.

The object-glafs micrometer of Dollond, of his moft improved conftruction, is reprefented by *fig.* 4. of *Plate* XII. agreeably to a drawing given in Mr. Dollond's pamphlet that accompanies his equatorial inftrument. By the improvement, fays the author, this micrometer has received, it is rendered capable of being applied to telefcopes of fmall aperture; the focal length of the object-glafs being confiderably increafed, the fcale by which the angles are meafured is much enlarged. By this increafe in the focal length of the object-glafs of the micrometer, the perfection of the telefcope is lefs injured; but the greateft advantage that is derived from the improvement, is the length of the fegments, which admit of the whole aperture of the telefcope, even in meafuring the largeft diameters of the fun or moon, and the object retains the fame brightnefs in meafuring the largeft angles as in meafuring the fmalleft.

Notwithftanding thefe feveral advantages, the inftrument is greatly reduced in fize, as will appear by infpecting the figure reprefenting the micrometer on the end of the telefcope; the defcription of which is as follows:—

a and *b* are two long fegments of an achromatic object-glafs, divided into feparate pieces by a diametrical line, and fitted into feparate frames, fo that by fliding one or both the fegments, they may be made to form in effect either one object-glafs or two, it being the property of half a well ground glafs to give as diftinct an image as the whole would do; the fegment *a* is moved by turning the milled head *c*, and the fegment *b* is moved by turning the handle *d*. When an obfervation is to be made, it is generally known what number of minutes the angle will contain nearly; fuppofe, for example, the diameter of the fun were to be meafured, which is known to be about 32′; move the fegment *a* till the index *e* comes to 32 on the fcale *ff*, then looking through the telefcope, move the fegment *b*, by turning the handle *a* till the circumferences of the two images, formed refpectively by the two fegments, are brought to touch one another externally, and the quantity that the fegments have moved will be meafured by the fcale *gg*, and vernier *h*, by which an inch is divided into five hundred parts: the greateft exactnefs is required in this fcale, as the angle is abfolutely to be determined by the meafure taken with it; the fcale *ff* being only of ufe to fet the fegment *a*, fo that in meafuring the angle by moving the fegment *b*, they may be both moved nearly the fame quantity.

The handle *i* is to turn the micrometer round, to bring the line dividing the two fegments of the object-glafs into the plane paffing through the two objects, whofe diftance is to be meafured. It is neceffary, in making obfervations with the micrometer, that the telefcope, when the micrometer is on, be adjufted to the *moft perfect vifion* of the object to be obferved, as a fmall error in this refpect may occafion a confiderable difference in the obfervation. To find if there is any error in the adjuftment of the micrometer fcale *gg*, turn the handle *d*, fo as to make the two images perfectly unite, and the number fhewn by the fcale and vernier will be the error of adjuftment, if there is any; this error may either be allowed for in the obfervations, or be corrected by the vernier fcrews at *k*. The object proper to be ufed for adjufting the focus of the telefcope with the micrometer on, may be any of the celeftial bodies, or fome diftant well defined land object; but for adjufting the micrometer fcale, the object may be nearer, fuch as a printed paper at two or three hundred feet diftance, provided the focus be firft well adjufted to this object. A table is ufually given with the micrometer, which fhews the number of minutes and feconds anfwering to the divifions on the fcale. When the micrometer is on the end of the tube of the telefcope, it is neceffary that the fcrew at the centre of motion be tight, otherwife, which is better, that there be a counterpoife at the eye-end to preferve the equilibrium in any elevation. Alfo, as the object-glafs of the micrometer is concave, the common focus of the object-glafs of the telefcope end of it is lengthened, which circumftance requires the tube of the eye-glafs

to

to be longer than when the telefcope is ufed without the micrometer.

The properties peculiarly afcribable to the two kinds of micrometers we have defcribed are, that the one at the focus of the eye-glafs is adapted for meafuring the differences of right afcenfions and declinations of two bodies, one of which has its plane known; but the one placed at the object end of the telefcope is calculated, by means of its graduated fcale, to meafure abfolute fmall diftances; and the accuracy of its fcale may be brought to the teft by a comparifon with a known interval between two ftars or other diftant bodies. Dr. Mafkelyne, in the paper we have already noticed, has however fhewn how, by the addition of two crofs-wires in the focus, the differences of right afcenfions and declinations may alfo be meafured by Dollond's micrometer, thus: "Suppofe it be required to meafure the difference of right afcenfion and declination of two ftars, whofe difference of declination does not exceed the extent of the fcale of the micrometer, and the diftance of the meridians paffing through the ftars does not exceed the femi-diameter of the field of view, turn the wires about till the weftern ftar runs exactly along the crofs-wire by the diurnal motion; then feparate the two fegments of the divided object-glafs to a convenient diftance, and turn the micrometer about, by means of its proper handle, till the two images of the fame ftar, formed by the two fegments of the object-glafs, pafs the horary or vertical wire at the fame inftant. Laftly, partly by the feet-fcrews of the ftand, and partly by the handle that feparates the fegment, caufe the fouthermoft image of the northermoft ftar, and the northermoft image of the fouthermoft ftar to appear both upon and run along the crofs or horizontal wire: the numbers ftanding upon the fcale of the micrometer will then fhew the difference of declination of the faid ftars; and if the times be noted when they pafs fucceffively the horary or vertical wire, the difference of the two times will give the difference of their right afcenfions alfo." (See Phil. Tranf. vol. lxi. article xlix.) It was one of Dollond's object-glafs micrometers, attached to an 18 inch reflecting telefcope by Short, and another attached to a two feet reflector, that lieutenant (afterwards captain) J. Cook, of the Endeavour, and Mr. Charles Green, formerly affiftant at the Royal Obfervatory, ufed in obferving the tranfit of Venus over the fun's difc on June 3, 1769, in King George's ifland, or Otaheite, in the South fea, as recorded in the fame volume of the Philofophical Tranfactions.

For an account of the hiftory of the micrometer, and its various conftructions by different artifts and ingenious men, fee the article MICROMETER.

EQUATORIAL *Sector*, an inftrument fometimes ufed in *Practical Aftronomy*. This inftrument was invented by Mr. George Graham, F. R. S. for meafuring greater differences of right afcenfion and declination of a heavenly body, as compared with another body, than the equatorial micrometer alone will give, and may be made of any convenient dimenfions. One of thefe inftruments made by Mr. Graham, is yet preferved at the Royal Obfervatory at Greenwich, and is occafionally employed to determine the right afcenfions and declinations of a comet or other body out of the meridian, for doing which it is ftill found to be ferviceable. Doctor Robert Smith has defcribed the principle and conftruction of Graham's fector, in the year 1738, and Mr. B. Martin copied the account verbatim in his magazine, from one or other of which authors the different dictionaries have their defcription tranfcribed.

Graham's Equatorial Sector.—In juftice to the contriver of the equatorial fector, we propofe to defcribe it agreeably to its original conftruction; but as we have caufed the different parts of the drawings, as given by Dr. Smith, to be thrown into one perfpective inftrument, it becomes neceffary to vary the detail accordingly. *Fig.* 1. of *Plate* XIII. (of *Aftron. Inftr.*) is a perfpective view of the principal parts of the fector lying in its inclined ftand or bed, which we have fuppofed to be firmly fixed to a floping pedeftal, exactly parallel to the earth's axis. This inclined bed, A B, is a ftrong brazen plate or bar, turned up at the ends in a perpendicular direction at C and D; the lower end C has a fcrew, entering it from below, ftrong enough to bear the inferior end of the fector's axis E F G, the conical hole made in the end of the latter at E, refting on the conical point of the former; the upper end D has a flit in it, into which the axis is demitted at the cylindrical part F, below the circular plate H attached to the axis. The whole length of the axis is 18 inches, of which the fquare part E F is 12. On the pofterior part of the bent end D of the inclined fupporting plate A B, is a clamp I, turning on two pivots, fo that it may be elevated or depreffed without turning round in an equatorial direction; this clamp fixes the circular plate H, in any given place on its edge from turning round, but adapts itfelf to the plate, fo as to prefs equally on both furfaces, by means of its vertical motion on pivots; confequently the axis E F G, to which the plate H is attached, may have a motion like the polar axis of the earth when wanted, and may be firmly fixed by the clamp acting on its plate in any given fituation. At the fuperior end G of the axis is fixed another circular brazen plate K L on one of the flat fides of the fquared axis, and having a motion round a pin with fcrews and a tightening collar; on this plate a crofs of brafs is fcrewed faft, compofed of four bars at right angles to each other, two of which bars conftitute an inverted cock, on the bent parts of this the long radial bar M N is fixed, which is made ftrong by an edge-bar on its under fide. Whenever, therefore, the circular plate K L moves round its central pin at G, the radial bar, carried by it, partakes of its motion, and *vice verfâ*; this plate has alfo a clamp O, fimilar to the clamp I in every refpect, by which it may be made fteady in any given fituation. The length of the radial bar is $2\frac{1}{2}$ feet, and its breadth at M and N $1\frac{1}{2}$ and 2 inches refpectively: at N is a fmall arch of a circle, 6 inches long and $1\frac{1}{2}$ broad, graduated into 10°, and fubdivided into quarters, that read and are figured both ways. Upon this radial bar is mounted a telefcope P, of $2\frac{1}{2}$ feet in length, moveable on the point M, as an axis of motion, near the object-end, and having a vernier near the eye-end with 16 quarters of a degree divided into fifteen equal parts, fo as to read off exact minutes. This vernier is moved by the nut of an endlefs fcrew Q, that is adapted as an apparatus for faft or flow motion, in the ufual way. The diameters of the two circular plates are each 5 inches, and the plates are ftrong enough to hold the telefcope in any given pofition that an obferved body may require.

The polar axis E F G of this inftrument muft be placed *truly* in the meridian and parallel to the earth's axis, which may be done by bringing the telefcope parallel to the axis itfelf, and, after fixing it, by following a circumpolar ftar therewith, and noting the apparent path as it refpects the interfection of the crofs-wires of the telefcope: the deviation above or below the crofs-wire will point out the error of elevation of the axis, and the difference in the times of the ftar's paffage through the two femicircles, eaft and weft refpectively, will difcover the deviation from the meridian line;

line; then half these errors may be corrected by the screws that fix the inclined bar A B to the pedestal, and the other half by altering the position of the telescope, till, after several successive trials, the star will accompany the intersection of the wires through its entire circle. It is necessary, however, that the polar axis be placed, by means of a small quadrant or other such contrivance, very nearly in its proper degree of elevation, as well as nearly in the meridian on the pedestal previously to the adjustment by a circumpolar star. It is also necessary that the line of collimation of the telescope be parallel to the plane of the sector, as well as the latter at right angles to the circular plate H, which represents the equator; the former may have its truth examined by a distant plumb-line suspended in a vertical position; for if the intersection of the cross-wires of the telescope will pass along this line, when the plane of the sector is vertical, and when the telescope derives its motion from the screw of the vernier alone, it may be concluded that the line of collimation is parallel to the plane of the sector; but the plane of the sector itself must be previously set right, as it regards the equatorial plate H, by the screws that fix it to the inverted cock of the cross, attached to the circular plate K L. From a consideration of this instrument, as we have described it, it is obvious, that, provided the telescope, thus having a polar motion and bearing a graduated sector, be made perfectly steady, and placed in the true direction of an hour circle in the heavens, the difference of declination of any two bodies in the celestial regions, that does not exceed the extent of the sector's limb, may be measured to the accuracy of a minute of space, and that whether the two bodies pass the telescope together or successively, provided the elevation of the telescope does not vary in the mean time; and also the difference of right ascension of any two bodies, similarly situated, may be had by noting the difference of siderial time, (by a regulator,) of their passages over the horary wire; provided the situation of the sector itself does not alter while the telescope is raised or depressed; but much of the accuraryof the results will depend on the steadiness of the parts that are clamped. Were the equatorial sector to be constructed at this time, the reading by a microscopic micrometer would greatly enlarge the powers of this instrument.

"But however well adapted this instrument may be to the purposes for which it was intended," says professor Vince (Treatise on Pract. Astron. p. 141, and sec. 7.) "yet it will not conveniently admit of a large telescope; Dr. Maskelyne, therefore, thought of a construction which would admit of one of a larger size, and which has, besides, several other advantages in respect to the adjustments, as will be evident when we come to describe them. The instrument was made by Mr. Sisson, the construction of which we will first describe, and then proceed to its adjustments."

Equatorial sector by Mr. Jonathan Sisson.—A B, in *fig.* 1. of *Plate* XVII. (of *Astron. Inst.*) is a polar axis, H I a circle fixed upon, and at a small distance from it, on the centre of which is an axis, about which the telescope C D turns, carrying the indices *a*, *b*, each having a vernier which subdivides to minutes, and the circle is graduated to shew north polar distances; this, which is called the cross axis, goes through A B into a fixed case E on the other side, and is moveable by a screw *q* in order to fix it perpendicular to the polar axis: L M is an arc of 22° fixed upon A B, and concentric with H I; *v w* is a vernier whose arm K may be screwed to the axis on which the telescope turns, and consequently in that case will turn with it, but if the screws be released, the telescope will turn without it. N O P Q is a brass frame, the two ends of which, O N, P Q, consist of two pieces, one of which goes over the arc L M, and the other under, so that by means of two screws at *y* and *x* to press them together, the frame may be fixed to the arc, in which case the screw *c d*, passing through a nut at *s* on the arm K, will move the vernier *v w*; V is a brass circle graduated on the edge, and moveable with the screw *c d*, against which is fixed a piece of brass *r* as an index; W is a piece of brass fixed on an immoveable piece of wood, on which is another piece not seen to receive the end of the axis B, and in which it turns, and this piece is moveable east or west by a screw of adjustment; the end turns in a brass socket *e f*, moveable by a screw T in order to alter the inclination of the axis A B, and thence adjust it to the latitude; R S is an equatorial circle fixed perpendicular to A B, having a vernier *m n*; this circle is divided into 24 hours, and each hour into minutes, and the vernier subdivides into seconds.

The adjustments are three; first, to set A B parallel to the earth's axis; secondly, to adjust the line of collimation parallel to the circle H I; thirdly, to adjust the cross axis perpendicular to the polar axis. The first adjustment consists of two parts, to set the axis at the proper angle, and to place it in the plane of the meridian. Now to adjust the axis to an angle equal to the latitude of the place, the instrument is supposed to be at first fixed as nearly as possible to the true angle, and then the error is to be corrected by adjustment; to do which, turn about the polar axis until the circle H I becomes perpendicular to the horizon, and direct the horizontal wire of the telescope to the pole star, or any other whose polar distance is known, when it comes above or below the pole; then turn the axis half round (which is shewn on the equatorial circle); in which case the circle becomes perpendicular to the horizon again; then if the axis be at the proper angle, it is manifest that the telescope is now directed to a point as much below or above the pole as it was above or below before, that is, to the polar distance of the star increased or diminished by the refraction of the star at the first observation; hence, if we turn the telescope till the star be again observed at the same wire, the indices *a*, *b*, will have moved over twice the refraction, supposing the star to be so near to the pole, that the refraction may be considered the same both above and below; for if the star be first observed above, its apparent place is above the true, and therefore if the telescope and star revolve about the axis till they come below, the telescope is now directed to a point below the true place by the refraction, and as the apparent place is now above the true place by refraction, the telescope is directed to a point distant from the apparent place of the star by twice the refraction; but if it do not move over twice that distance, then half the difference is the error of the angle of the elevation of the axis; move the telescope therefore through twice the distance which the indices *a* or *b* will shew, then turn the telescope, and bring it half way to the star, and by the screw T bring the star to the wire, and the axis is adjusted to an angle equal to the latitude of the place; in the same manner we determine whether the axis be in the plane of the meridian, by observing the star in the equator, either in the east or west, and then turning the axis half round, if the axis be rightly adjusted to the meridian, the telescope must be moved 180° in order to bring the star to the same wire; hence if the telescope do describe 180° the axis is right; if not, half the difference is the error; move, therefore, the telescope through 180°, and then by turning it bring it half way to the star, and by the screw at top out of sight bring

bring it the other half, and the polar axis is truly adjusted. Secondly, to adjust the line of collimation parallel to the circle H I. Observe a star in the equator, and note the time of its transit over the middle wire of the telescope by a clock, adjust it to siderial time, and note also the time shewn by the vernier *m n* on the hour circle R S; turn the polar axis half way round according to the order of the figures on the hour circle R S, and the vernier shews a difference of 12 hours; now as the line of collimation is first directed to the equator, it must be perpendicular to the polar axis, and therefore by turning the polar axis about, it must continue to be directed to the equator, whether or not it be parallel to the plane of the circle H I; and if this could be done, and the telescope turned about, and the observation repeated without loss of time, the star would appear on the same wire, provided the line of collimation were parallel to the plane of the circle H I, for then the line of collimation in the second observation being parallel to what it was in the first, it must be directed to the same point in the heavens, the telescope being turned half round; but as this operation will take up some time, the polar axis must be turned a little more than half round in order to bring the star to the same wire, and the vernier would point out the same difference of times as the clock shews in the interval of the observations; but if these differences of times shewn by the clock and the hour circle be not equal, the line of collimation is not parallel to the plane of the circle, and half that inequality of times is the error, which must be corrected by the adjustment for that purpose. Thirdly, to adjust the cross axis perpendicular to the polar axis, or to the line of collimation. By the last adjustment, the line of collimation was made to move in a plane; therefore, if that plane be adjusted to the polar axis, the line of collimation will describe a secondary to the equator. On this supposition, if we take a star of any declination, and note the time of its transit over the middle wire by the clock, and also the hour on the hour circle; then turn the polar axis half round, and observe again as in the last position, and the differences of the times of the two observations shewn by the clock, and on the hour circle diminished by 12, must be equal; but if the line of collimation do not describe a secondary, the differences will not be equal. To correct, therefore, this error, let E Q, *fig.* 2. *Plate* XVII. be the equator, E P Q a great circle passing through the pole P, E F Q the great circle described by the line of collimation, and let the telescope be directed to a star at *b*, and let *d b y* be a portion of its parallel, take $a d = a b$, and draw the secondaries P *d m*, P *b c*. Now it is manifest, that if we turn the polar axis half round, the plane E F Q will then lie as much on the contrary side of E P Q; and, therefore, when the telescope is directed to the star's parallel, it will cut it at *d*, and half *m* C, or E *c*, is the error of right ascension. Note the time on the hour circle, and continue to turn (in the present instance) the polar axis until the star, now at *x*, on account of its motion, be again brought to the middle wire, and note again the time on the hour circle, and we have the difference *m r* shewn by the hour circle, from which subtract the time *c r*, shewn by the clock between the observations, and we have *m* C, the half of which is E *c*. Now the star being on the middle wire, move the polar axis so as to cause the hour circle to move through an arc *rs* equal to E *c*, and by the screw *q*, *fig.* 1, alter the position of the cross axis, and consequently of the plane E F Q till the star appears again on the same wire, moving, if necessary, the telescope on the circle H I to bring the star into the field; and then as $y x = a b$, the line of collimation would have been corrected so as to make it pass through P, and the adjustment would have been truly made, provided the star had not moved in the time of this last operation. Correct again, therefore, and you will get the line of collimation to describe a secondary to the equator, when the telescope is moved on the circle H I. Thus the instrument is adjusted for use.

To find any object in the heavens, whose right ascension and declination are known.—Find its distance, at the time required, from the meridian in the usual way, and reduce it to siderial time, and turn about the polar axis, that way the object lies from the meridian, until the hour circle points out that distance of the telescope from it; then turn the telescope till the indices *a*, *b*, shew the polar distance, and the object will be in the field of view. By this means we direct the telescope to a comet, or any other body whose place is known, which is invisible to the naked eye.

To find the true place of a body, and trace out its path in the heavens.—Screw the index K to the cross axis of the telescope; bring the body upon the wire parallel to the equator, and take the time of its transit over the middle wire perpendicular to it, and note the degrees on the arc L M, pointed out by the vernier *v w*; then if there be any known fixed star near its parallel, move the telescope on the circle H I (the polar axis remaining fixed) to the star's parallel, wait till the star enters the field of view, and make it run along the same wire as the body did, and take the time of its transit at the middle wire, and the difference of these times will give the difference of their right ascensions, and the difference of the arcs on L M, pointed out by the vernier *v w* at the times of the transits, gives the difference of their declinations; hence the right ascension and declination of the body is known. Continue these observations as long as the body is visible, and you will get its path in the heavens. The utility and convenience of this method is, that we can at any time determine the place of a body without waiting for its coming to the meridian; where, besides the inconvenience of waiting, an observation might be hindered by the badness of the weather, or the body might come to the meridian in the day-time, when it could not be seen.

An instrument, somewhat similar in construction, but with considerable improvements, was begun by Mr. Bird in the last year of his life, or the year preceding, for the observatory at Oxford, and was finished by Mr. Troughton (the senior) about the year 1773, by order of Mr. Bird's executors. We regret that we have not had the means, in due time, of obtaining a perspective drawing of this instrument, that we might have gratified our readers with a description of it.

Equatorial *Stand* of a telescope is a contrivance for making a common telescope follow a celestial body in its apparent path along, or parallel to, the equator; and answers the purpose of a polar axis of motion, while it adds but little to the expence of a simple stand for horizontal and vertical motions only. The thing required to be done to a common stand, was to give the horizontal motion an equatorial direction, and then the vertical motion, of itself, becomes a motion in declination, or in an horary circle, as well out of, as in the meridian. Various methods have been devised of effecting this purpose in the simplest way; but the contrivance invented by Mr. Smeaton, usually called Smeaton's Block, and which has all the advantages of cheapness, stability and simplicity, has been preferred to all others, and in our opinion merits a place in our collection of astronomical instruments.

Fig. 5. of *Plate* XIII. of *Astron. Inst.* is a representation of an equatorial stand of Smeaton's construction, in which the

the three legs are of mahogany, well braced together, and ſhortened at the lower extremities for the purpoſe of bringing them within the plate. The part *a b*, at the top of the legs, in the ſhape of a blunt wedge, is of mahogany, and is faſt to the legs; the other ſimilar part *c d*, above it, is alſo mahogany, and ſloped exactly like the part *a b*; the two parts taken together are called the *block*, the lower half of which is fixed, and the upper moveable on a ſtrong cylindrical piece of braſs fixed to the piece *c d*, at right angles to the line of ſection, or plane of contact, and paſſing through the piece *a b* ſo as to be fixed, when neceſſary, by a finger ſcrew below the block, and within the junction of the three legs. The plane of contact of the two halves of the block is ſo ſloped as to make an angle exactly equal to one half of the co-latitude of the place of obſervation, with a horizontal line, in which the under-face of the block is ſuppoſed to be by its poſition; but as the upper half of the block is exactly ſimilar to the under one, its face, when in the preſent equatorial poſition, makes an angle with the horizon equal to the whole co-latitude of the place; *i. e.* when in the meridian, is coincident with the plane of the equator. When the part *c d* is turned half round, ſo that the point *d* may coincide with the point *a*, and the point *c* with the point *b*, the ſlopes of the two halves of the block are then reverſed, and the face of *c d* becomes horizontal: hence it appears that a motion of the half block *c d* round its axis of motion, will carry any teleſcope *g*, or other body, placed on it parallel to its face, in the direction of the equator, provided it be placed in the meridian of the place when it has the greateſt elevation. Accordingly an axis of motion of a ſmall graduated equatorial circle *e* is attached perpendicularly to the face of the half block *c d*, round which the ſaid circle is moveable; and over this circle is mounted a graduated ſemicircle of declination *f*, or of altitudes, when the block is in its horizontal poſition, to which the teleſcope is made faſt. The circle *e* is divided into half degrees, or two minutes of time, and is ſubdivided by a vernier into $\frac{1}{30}$th of this quantity, that is, into minutes of ſpace, and four ſeconds of time; the declination-ſemicircle is alſo ſubdivided into minutes of ſpace by a vernier; and by enlarging the radii the ſubdiviſions might be rendered ſtill more minute; but the uſe of theſe graduations is merely to *find* a ſtar or planet, by its right aſcenſion and declination, to which purpoſe the inſtrument is quite competent. Mr. Troughton informs us, that he has made this ſtand an univerſal one ſometimes, by dividing the block diagonally by an angle of 45°, in which caſe it would take any degree of elevation from a horizontal to a vertical poſition, and one of the half blocks, being graduated into 360°, was read by a vernier fixed to the other, ſo as to aſcertain any given quantity of elevation; but as the conſtruction of the inſtrument does not admit of great accuracy in its adjuſtments and motions, he conſidered ſuch addition rather as curious than really uſeful in aſtronomy. Still, however, when the teleſcope is fitted up with the beſt micrometer for meaſuring the difference of right aſcenſions and declinations, and when the ſtand is made very ſteady, the inſtrument may be very ſerviceable in an obſervatory, and is often made a part of its furniture.

The ſliding tubes *h* are ſometimes ſuperadded to brace the eye-end of the teleſcope, and are found to anſwer a good purpoſe, when well made, and fitted to any pair of the legs that may happen to be turned towards this end of the teleſcope. Both the equatorial circle *e* and ſemicircle *f* have the uſual apparatus for quick or ſlow motion; and when the block is in the horizontal poſition. the teleſcope may be fixed, by the finger ſcrew under the block, to be conveniently uſed for viewing terreſtrial objects; in which poſition the inſtrument makes no contemptible theodolite, as well as equal-altitude inſtrument, when a level is added.

EQUEA, in *Geography*, a town of Africa, on the Gold coaſt.

EQUERY, or Ecury, a grand ſtable or lodge for horſes, furniſhed with all the conveniences thereof; as ſtalls, manger, rack, &c.

The word is formed from the French, *eſcurie*, which ſignifies the ſame thing. Some again derive *eſcurie* from the Latin, *ſcuria*, which not only denotes a place for beaſts to be put up in, but alſo a grange or barn. But a more probable derivation is from *equile*, a ſtable for horſes, of *equus*, horſe.

Some hold that the word ſtable, in propriety, relates only to bullocks, cows, ſheep, hogs, &c. and equery, to horſes, mules, &c.

A ſimple equery is that provided for one row of horſes; a double equery that provided for two, with a paſſage in the middle, or two paſſages; the horſes being placed head to head, as in the little equery at Verſailles.

Under equery are ſometimes alſo comprehended the lodgings and apartments of the equeries, grooms, pages, &c.

Equery, *eſcuyer*, is alſo an officer who has the care and management of the horſes of a king or prince.

EQUERIES, or Equerries, popularly called *querries*, are particularly uſed amongſt us for offices of the king's ſtables, under the maſter of the horſe, five in number, who, when his majeſty goes abroad, ride in the leading-coach, are in waiting, one at a time, monthly, and have a table with the gentlemen-uſhers during the time, and a ſalary of 300*l.* a year each: that of the firſt equerry and clerk-martial being 500*l.*

They uſed to ride on horſeback by the coach ſide when the king travelled: but that being more expenſive to them than neceſſary to the ſovereign, it has been diſcontinued.

Equeries *of the crown ſtable*, have that appellation, as being employed in managing and breaking the ſaddle-horſes, and preparing them for the king's riding.

The equerry of the crown ſtable has an annual ſalary of 200*l.* and is, or always ſhould be, in cloſe waiting at court; and when his majeſty rides holds the ſtirrup, while the maſter of the horſe, or one of the equerries in his abſence, aſſiſts in mounting him; and when his majeſty rides, they uſually attend him. To the eſtabliſhment of the queen's houſhold belong two equerries with a ſalary of 220*l.* each. There are alſo two belonging to the prince of Wales's houſhold. Officers under the ſame denomination form a part of the eſtabliſhed houſholds of the royal dukes, &c.

EQUES Auratus, is uſed to ſignify a knight bachelor, called *auratus*, q. d. *gilt*, becauſe anciently none but knights might gild or beautify their armour, or other habiliments of war, with gold.

In law this term is not uſed, but inſtead of it *miles*, and ſometimes *chevalier*.

EQUESTRIA, among the Romans, a place in the theatre where the equites or knights ſat.

EQUESTRIS, Equestrian, formed of the Latin, *eques*, knight, horſeman, of *equus*, horſe, a term chiefly uſed in the phraſe equeſtrian ſtatue, which ſignifies a ſtatue repreſenting a perſon mounted on horſeback.

The Fortuna equeſtris, in ancient Rome, was a ſtatue of the goddeſs on horſeback. We ſometimes alſo ſay, *equeſtrian* column, which ſee.

Equestrian *cohort*, in *Antiquity*. See Cohors *equitata*.

Equestrian *games*, *ludi equeſtres*, among the Romans, horſe-races, of which there were five kinds, the prodromus, or or plain horſe-race, the chariot race, the decurſory race, about funeral piles, the ludi ſevirales, and the ludi neptunales.

Equestrian *order*, among the Romans, ſignified the order of the knights or equites.

EQUI, in *Ancient Geography*, a ſmall town of Africa Propria, near a lake in the vicinity of Utica. According to Diodorus Siculus it was taken by Agathocles.

EQUIANGULAR, in *Geometry*, is applied to figures whoſe angles are all equal; ſuch are the ſquare, and all regular figures.

All equilateral triangles are alſo equiangular.

An equilateral figure inſcribed in a circle is always equiangular; but an equiangular figure inſcribed in a circle is not always equilateral, except when it has an odd number of ſides. If the number of the ſides be even, then they may be either all equal, or elſe half of them will always be equal to each other, and the other half to each other; the equals being placed alternately. See Hutton's Math. Miſc. p. 272.

Equiangular is alſo applied to any two figures of the ſame kind, when each angle of the one is equal to a correſponding angle in the other, whether each figure, ſeparately conſidered, be an equiangular figure or not, that is, having all its angles equal to each other. Thus, two triangles are equiangular to each other, if, *e. g.* one angle in each be of 30°, a ſecond angle in each of 50°, and the third angle of each equal to 100°.

Equiangular triangles have not their like ſides neceſſarily equal, but proportional to each other; and ſuch triangles are always ſimilar to each other.

EQUICRURAL Triangle, is what we more uſually call an iſoſceles triangle.

EQUICULUS, Equuleus, or *Equus minor*, in *Aſtronomy*, a conſtellation of the northern hemiſphere. See Equuleus.

EQUIDIFFERENT, in *Arithmetic*. If in a ſeries of three quantities there be the ſame difference between the firſt and ſecond as between the ſecond and third, they are ſaid to be continually equidifferent; but, if in a ſeries of four quantities, there be the ſame difference between the firſt and ſecond as between the third and fourth, they are ſaid to be diſcretely equidifferent.

Thus, 3, 6, 7, and 10, are diſcretely equidifferent, and 3, 6, and 9, continually equidifferent.

EQUIDISTANT, in *Geometry*, a term of relation between two things which are every where at an equal or the ſame diſtance from each other. Thus, parallel lines are ſaid to be equidiſtant, as they neither approach nor recede.

EQUILATERAL, of *æquus*, equal, and *latus*, ſide, is applied to any figure whoſe ſides are all equal. Thus, an equilateral triangle is that whoſe ſides are of equal length. In an equilateral triangle all the angles are likewiſe equal. See Equiangular.

All regular polygons and regular bodies are equilateral. See Polygon, Regular, &c.

Equilateral *Hyperbola*, is that in which the conjugate axes, and every pair of conjugate diameters, are equal to each other. The aſymptotes are alſo at right angles to each other, and each of them forms a right angle with the axis. Such an hyperbola is alſo equal to its oppoſite hyperbola, and likewiſe to its conjugate hyperbola, ſo that all the four conjugate hyperbolas are mutually equal to each other.

Hence, as the parameter is a third proportional to the conjugate axes, they are all mutually equal; conſequently, if in the equation for the hyperbola $y^2 = \frac{p}{t} \times \overline{tx + x^2}$, or $= \frac{c^2}{t^2} \times \overline{tx + x^2}$, in which t is the tranſverſe axis, c the conjugate, p the parameter, x the abſciſs, and y the ordinate, t, c, and p being made equal, the equation for the equilateral hyperbola becomes $y^2 = tx + x^2$; differing from that of the circle merely in the ſign of the term x^2, which in the circle is $-$. See Hyperbola.

EQUILIBRIUM, or Equipoise, in *Mechanics*, means an equality of forces acting in oppoſite directions, ſo that they mutually balance each other. Thus, the ſcales of a balance are ſaid to be in equilibrio, when neither of them preponderates, in conſequence of which the beam of the balance remains perfectly horizontal. But, it muſt not be imagined, that the equality of weights alone determines the equilibrium of mechaniſms in general; for that is only the caſe when the velocities and directions are equal, as in the above-mentioned caſe of the balance, where the two arms of the beam being equal, the weights in the ſcales have equal velocities, ſuppoſing that the balance is made to vibrate, and move in vertical directions. Therefore, it has been ſaid above, that the equilibrium takes place, when the *forces*, which act in oppoſite directions, are equal; for the forces are eſtimated from the weight of the bodies, their velocities, and directions conjointly. Thus, in the common mechanical powers, the equilibrium takes place, when the power is to the weight as the velocity of the weight is to the velocity of the power. The equlibrium of ſolids forms a conſiderable part of the ſcience of ſtatics, and the equilibrium of fluids forms a conſiderable part of hydroſtatics.

Equilibrium is alſo uſed figuratively on other occaſions. A painter muſt take care to obſerve the equilibrium of his figures, *i. e.* diſpoſe them well on their centre of gravity, that they may not ſeem ill-ſupported, or ready to tumble. Thus, *e. gr.* if one arm be moved forward, the other muſt be proportionably backward to poiſe the figure.

In a picture there ſhould always be an equilibrium between one part and another; that is, the objects are to be diſtributed ſo as to balance and contraſt each other; and not too many, *e. gr.* be crowded on one ſide, and the other be left bare.

EQUIMULTIPLE, in *Arithmetic* and *Geometry*, is applied to ſimple magnitudes when multiplied equally, *i. e.* by equal quantities or multipliers.

Thus, taking A as many times as B, or multiplying them equally, there will ſtill remain the ſame ratio between the magnitudes thus multiplied, as between the primitive magnitudes before multiplication.

Now thoſe magnitudes, thus equally multiplied, are called equimultiples of the original ones A and B; whence we ſay, that equimultiples have the ſame ratio as the ſimple quantities. In arithmetic, we generally uſe the term equimultiples for numbers which contain equally or an equal number of times their ſubmultiples.

Thus 12 and 6 are equimultiples of their ſubmultiples 4 and 2, inaſmuch as each of them contains its ſubmultiple three times.

EQUINA Sella. See Sella.

EQUINOCTIAL, in *Aſtronomy*, a great circle of the ſphere, under which the equator moves in its diurnal motion.

The equinoctial is conceived by ſuppoſing a ſemidiameter of the ſphere produced through a point of the equator, and there, by the rotation of the ſphere about its axis, deſcribing a circle on the immoveable ſurface of the primum mobile.

The

The poles of this circle are the poles of the world. The ſphere is divided by it into two equal parts, the northern and ſouthern. It interſects the horizon of any place in the eaſt and weſt points; and at the meridian its elevation above the horizon is equal to the co-latitude of the place.

Whenever the ſun, in his progreſs through the ecliptic, comes to this circle, it makes equal days and nights all around the globe; as he then riſes due eaſt and ſets due weſt, which he never does at any other time of the year. And hence the denomination from *æquus* and *nox*, night, *quia æquat diem nocti*. All the ſtars that are under this circle, or that have no declination, do alſo riſe due eaſt and ſet due weſt.

The equinoctial, then, is the circle which the ſun deſcribes, or appears to deſcribe, at the time of the equinoxes: that is, when the length of the day is every where equal to that of night, which happens twice a year. (See Equinox.) From this circle is the declination in the heavens or latitude of places on the earth counted in degrees of the meridian. Upon this circle is reckoned the longitude, 180° weſt and 180° eaſt, in all 360°. Hence, 1° of longitude anſwers to 4′ of time; 15′ to 1′ of time; and 1′ to 4 ſeconds of time, &c.

The ſhadows of thoſe who live under this circle are caſt to the ſouthward of them for one-half of the year, and to the northward of them during the other half; and twice in a year, *viz.* at the equinoxes, the ſun at noon caſts no ſhadow, being in their zenith.

Equinoctial *colure*, is that paſſing through the equinoctial points. See Colure.

Equinoctial *dial*, is that whoſe plane lies parallel to the equinoctial. See Dial.

Equinoctial *hours*, *line*, *orient*. See the ſubſtantives.

Equinoctial *points*, are the two points wherein the equator and ecliptic interſect each other: the one, being in the firſt point of Aries, is called the vernal point, or equinox; and the other, in the firſt point of Libra, the autumnal point, or equinox.

The equinoctial points, and, indeed, all the other points of the ecliptic, are found, by obſervation, to be continually moving backwards, or in antecedentia, *i. e.* towards the weſt. This retrograde motion is called the *Preceſſion of the equinoxes*; which ſee.

EQUINOX, in *Aſtronomy*, the time when the ſun enters one of the equinoctial points.

The equinoxes happen when the ſun is in the equinoctial circle, of conſequence the days are equal to the nights throughout the world, which is the caſe twice a year, *viz.* about the 21ſt of March, and the 22d of September, the firſt of which is the vernal, and the ſecond the autumnal equinox.

As the ſun's motion is unequal, that is, ſometimes ſwifter and ſometimes ſlower (from the cauſes already explained under the article Equation), it comes to paſs, that there are about eight days more from the vernal to the autumnal equinox than from the autumnal to the vernal, the ſun ſpending ſo much more time in travelling through the northern than the ſouthern ſigns.

According to the obſervations of M. Caſſini, the ſun is $186^d\ 14^h\ 53'$ in the northern ſigns, and only $178^d\ 14^h\ 56'$ in the ſouthern. The difference of which is $7^d\ 23^h\ 57'$.

The ſun, continually advancing forwards in the ecliptic and gaining a degree every day, makes no ſtay in the equinoctial points, but the moment he arrives in them he alſo leaves them.

Of courſe, therefore, though the day the ſun enters the equinoctial point is called the equinox, as being reputed equal to the night; yet it is not preciſely ſo, unleſs the ſun enter the equator at mid-day: for if the ſun riſing, ſhould enter the vernal equinox at ſetting, he will have departed from it, and have got northwards about 12′; conſequently, that day will be ſomewhat longer than 12 hours, and the night proportionably ſhorter.

The time of the equinoxes, *i. e.* the moment in which the ſun enters the equator, is found by obſervation, the latitude of the place of the obſervation being given.

Thus, in the equinoctial day, or near it, take the juſt meridian altitude of the ſun; if this be equal to the altitude of the equator, or the complement of the latitude, the ſun is that very moment in the equator: if it be not equal, the difference is the ſun's declination. The next day obſerve the meridian altitude as before, and find his declination; if the declination be of different kinds, *viz.* the one north and the other ſouth, the equinox has happened in the interval of time between them; otherwiſe, the ſun has not entered the equinoctial, or had paſſed it at firſt. From theſe obſervations a trigonometrical calculus gives the time of the equinox.

Thus, let D G (*Plate* XII. *Aſtronomy, fig.* 110.) repreſent the equator, A C the ecliptic, E the equinoctial point; the points A, B, C, the places of the ſun at the times of obſervation; the arcs A D, B F, C G, the correſponding declinations; in the right-angled ſpherical triangles C E G, B E F, the obliquity of the ecliptic, and the declinations are known; whence may eaſily be found E C, E B; then B C, the ſum or difference of E C, E B is the ecliptic arc deſcribed in 24 hours: then ſay as B C : B E :: 24 hours for B C : time for B E; and this time ſhews the diſtance of the equinox from the time of the middle obſervation.

EQUINUS Barbatus, a kind of comet. See Hippeus.

Equinus *ellipticus* and *quadrangularis*. See Hippeus.

Equinus *venter*. See Venter *equi*.

EQUIP, *To*, in *Naval Language*, a term borrowed from the French marine, and frequently applied to the buſineſs of fitting a ſhip for ſea, or arming her for war. See Fitting-out.

EQUIPAGE, in *Navigation*. See Crew and Fitting-out.

Equipage, *Camp*. Under this term we confine ourſelves entirely to what relates to the tents generally in uſe; remarking, that ſuch as ſuit admirably for a cold climate, would be found totally unſerviceable in higher latitudes, where the air, confined in a ſmall ſpace, under a vertical ſun, while probably not a leaf is in motion, could not fail to be unfit for reſpiration. Therefore, we ſhall give the regulation ſizes of tents, both according to the home ſervice, and to what is found neceſſary for troops employed in the Eaſt Indies.

Home Service, *Laboratory Tent*, with mallets, poles, pins, &c. ſhould weigh 3 cwt. 24lb.; and ought to be ſuſtained on poles of $14\frac{1}{2}$ feet each in length; the ridge pole ſhould be 18 feet. Some of theſe are made with half-walls; that is, their flies, or canopies, do not come within three feet of the ground, but are there faſtened to a half-wall, or curtain, which being laced or hooked to the interior of the fly, hangs perpendicularly to the ground, to which it is ſecured by wooden pins, or pegs.

India Service, *Laboratory Tent*.—This claſs of tents is nearly ſimilar, but they have commonly extra flies, ſtanding at about a yard diſtant from the inner ſhell, which are ſometimes well

well foaked in oil, or flightly with tar, at leaft fufficiently to throw off rain. This occafions them to be extremely ponderous; the poles being fome feet longer, and the fpread of canvas confiderably greater; the average weight of a laboratory tent may here be taken at nearly half a ton. Such a weight could only be conveyed on an elephant, or on a cart, (the latter being far too dilatory for moft fituations,) were it not that the fly, the fhell, and the walls, are all made to feparate. By this means two camels may conveniently bear one of thefe tents.

Home Service, Bell Tent, fhould, according to the new conftruction, have a pole of 9 feet long, and form a circular fpread of 14 feet in diameter, fo as to give fhelter to twelve men. Since it has been found neceffary to reduce the quantity of baggage attached to our armies, little or no ufe is made of any tents that are inadequate to the fhelter of a certain number of perfons; confequently thofe bell tents, which were called "Bells of Arms," have in a manner ceafed to be known in our arfenals, they being totally incompetent to any effential fervice. The modern bell tent is, therefore, to be confidered as a medium between the bells of arms, and the private tents formerly in ufe; they are extremely portable, and, in proportion to their weight, which ought not to exceed 45lb. are far more ferviceable; as they cover twelve men better than the common infantry tents, that weighed 27lb., did five. The facility with which a tent, having only a pole, is raifed, or ftruck, the great fafety it infures from prefenting no flat fide to the wind, and the paucity of pins, &c. requifite for its ufe, give it a very confiderable claim to preference.

Indian Service, Bell Tents, are made of very ftout canvas, fupported on poles of about 7 feet in length, and overlapping in their front, for the purpofe of keeping the arms they contain perfectly dry. The mufquets, &c. are filed round the pole of a bell tent by means of two fticks, about 18 inches in length, paffing at right angles to each other, and to the pole alfo, through two holes made in the latter. Thefe, which may be drawn at pleafure, form a crofs, in the four divifions of which the arms of the company are filed. Average weight, when dry, 1 cwt.; when wet, 1 cwt. 1 qr. 14lb.

Home Service, Common Infantry (or Private) Tents, which are now lefs ufed than formerly, require two ftandard poles, each 6 feet in length, and a ridge pole of 7 feet. They fhould weigh *in toto* 27lb., and be capable of covering five men. It is obvious, that a tent of this defcription muft be lefs fafe, and lefs comfortable to its inhabitants, than the bell tent now fubftituted

Indian Service, Private Tents, ftand upon two poles, each 9 feet long, and have a ridge pole of 8 feet. Thefe tents are made of very ftrong canvas, and are fometimes lined feparately; whereby they are rendered tolerably cool. They fhould be capable of fheltering twelve men commodioufly; but in hot weather not more than eight ought to be allotted to one tent. Confiderable relief is afforded by the walls of thefe tents; which are generally about 30 inches high. The average weight of one, complete, may be about 2 cwt. 1 qr. when dry; but when wet, it will perhaps exceed 4 cwt.

Home Service, Officer's Marquee, fhould have two ftandard poles, each 8 feet high, and a ridge pole of 7 feet: the total weight about 130lb. This kind of tent has walls about 4 feet in height, and is generally furnifhed with a feparate lining throughout.

Indian Service, Marquees, are upon a very different conftruction. The proportions are as follows; *viz.*

	Length.	Breadth.	Ridge Poles.	Standard Poles.
Captain's marquee on two poles lined throughout with gingham, and having walls of 5 ft. 6 in.	23 feet.	15 feet.	10 feet.	12 feet.
Subaltern's tent on 1 pole	14 feet.	14 feet.	——	11 feet.

Thefe proportions may feem very great, but they are found to be actually neceffary in that climate. The total weight of a captain's marquee may be eftimated, when dry, at 4 cwt.; when wet, at $6\frac{1}{2}$ cwt. A fubaltern's marquee, when dry, $3\frac{1}{2}$ cwt.; and when wet, 5 cwt.

With refpect to the larger claffes of tents, fuch as are ufed by our colonels and general officers, they approach fomewhat towards the conftruction of what, in the Indian fervice, are called field officers' fleeping tents, which generally have from 12 to 14 feet between two poles of 14 feet in height. They are chiefly compofed of ftrong fhells made of Ruffia-duck, with flies of canvas, and are ordinarily lined with perpet. The weight of fuch a tent may be computed at 5 cwt. when dry; and when wet at $7\frac{1}{2}$ cwt. State tents may meafure about 18 feet in the ridge, and have ftandards of full 16 feet in height. Their poles are generally made in two pieces, joining in their centres by means of a cylinder of iron; on the fame principle as the fliding ferrils in ladies' parafols.

We have thus given fome infight into the proportions between the tents appropriated to the feveral claffes, fo far as they could tend to inftruct the reader; who will, of courfe, underftand, that in proportion as the ftandards of a tent are lengthened, fo will the feveral flopes of the fly be lengthened in a fuitable ratio. The ordinary computation is, that the direct depth of the flope ought to be two-thirds the length of the poles where a full wall is to be attached; four-fifths where a half-wall is to be furnifhed; and that the pole fhould be one-quarter, or even a third, lefs in length than the direct flope of the fly is deep, if no walls whatever are to be added. The climate will indicate the neceffity for more or lefs fteepnefs in the flope; for if little rain falls, lefs declivity will anfwer; whereas, if, as in India, the rains are abundant and heavy, fuch a flope muft be given as may infure that the interior fhould remain dry.

It is of the utmoft importance, that all camp equipage fhould be made not only conformably to a particular pattern, thereby to preferve uniformity of appearance; but, as nearly as practicable, of the fame kind of materials, and of a given weight; fo that a very correct eftimate may be formed both of the bulk and gravity of the whole, when about to be conveyed either by land or by water. Befides, it is expedient, that the camp-colourmen, batmen, &c. fhould have a perfect underftanding of this branch of military economy, and have the whole of the tents handed to them, when about to be laden, or conveyed, packed in a regular manner; fo as to occupy as little fpace as poffible; otherwife they never can ftow to advantage, fo as to be fafe, and to afford as much fpace as can be fpared for other articles.

Equipage, in the *Military Art,* denotes all forts of utenfils, artillery, &c. neceffary for commencing and profecuting with eafe and fuccefs any military operations.

EQUIPOLLENCE, in *Logic,* is when there is an equivalence between any two or more terms or propofitions; *i. e.* when they fignify one and the fame thing, though they exprefs it differently. Such propofitions, &c. are faid to be equipollent.

EQUIPPE', in *Heraldry*, expreffes a cavalier equipped, *i. e.* armed at all points.

EQUIRIA, in *Antiquity*, a feftival inftituted by Romulus, and celebrated on the 27th of February, in honour of Mars, at which there were horfe-races.

EQUISELIS, in *Natural Hiftory*, the name of a large fly, of the fize of a hornet, but having only two wings and no fting: it otherwife much refembles the common hornet in fhape. This fly is found only in Macedonia. We have alfo in England flies which nearly refemble the hornet, wafp, and bee, but in their wanting ftings and having only two wings.

Equiselis, in *Ichthyology*, a name ufed by fome authors for a fea-fifh, caught on the Spanifh fhores, and fuppofed by many to be the fame with the *Dorado*, or *Coryphæna*, with the forked tail of Artedi. See Coryphæna.

EQUISETUM, in *Botany*, from *equus*, a horfe, and *feta*, a ftrong hair or briftle. Horfetail. Plin. Hift. Nat. lib. 26. cap 13. Linn. Gen. 559. Schreb. 753. Mart. Mill. Dict. v. 2. Sm. Fl. Brit. 1102. Hedwig. Theor. 33. t. 1, 2. Juff. 17. Clafs and order, *Cryptogamia Filices*. Linn. *Cryptogamia Mifcellaneæ*. Schreb. Nat. Ord. *Filices fpicatæ*.

Gen. Ch. *Fructifications* in an ovate-oblong terminal catkin, compofed of whorled, ftalked fcales. Each fcale peltate, fomewhat orbicular, but with many fides, bearing on its under fide from four to feven tubular, angular, obtufe fheaths, parallel to and furrounding the ftalk of two valves, burfting internally, containing numerous florets. *Stam.* Filaments four, coiled up round the germen, in a fpiral manner, while moift, divaricated when dry; anthers terminal, fimple, fpatulate. *Pift.* Germen globofe, wrapped up in the ftamens; ftyle none; ftigma obfolete, acute. *Seeds* globofe, deciduous, accompanied by the ftamens.

Eff. Ch. Catkin with peltate fcales, fructifying on their infide. Partial involucrums tubular, of two valves. Seeds numerous, naked, furrounded by four fpiral ftamens.

Many different opinions have exifted concerning the fructification of this genus, but Hedwig's, as above given, feems to us the moft fatisfactory. In the artificial claffification we retain it among the ferns, to which it is clofely allied in natural affinity, though of itfelf a moft natural and diftinct genus; nor do we think Schreber's order, entitled *Mifcellaneæ*, leffens in any degree the difficulties refpecting this tribe.

Seven fpecies of *Equifetum* are found in Britain, and two or three foreign ones are imperfectly known befides.

E. *fylvaticum*, Engl. Bot. t. 1874, known by its compound drooping branches, is one of the pretticft. It occurs chiefly in mountainous countries, in moift, fhady fpots.

E. *hyemale*, Engl. Bot. t. 915, called Shave-grafs or Dutch rufh, is remarkable for the callous roughnefs of the ribs of its naked ftem, which renders it ufeful in polifhing wood, ivory, and even brafs. Being rare in England, it has for thefe purpofes been imported from Holland. Profeffor Davy has detected a large proportion of flinty earth in the cuticle, to which its hardnefs and afperity are owing.

E. *variegatum*, Engl. Bot. t. 1987, found on the fandy fea-coaft of Scotland, by Mr. G. Don, and a native alfo of Sweden, Denmark, Switzerland, &c. is a fmaller fpecies, nearly related to the laft, and having a fimilar roughnefs.

Equisetum, in *Natural Hiftory*, is the name by which fome writers have denominated certain foffil plants, (phytolithii,) which are found bearing fome faint refemblance to the recent plant called horfe-tail. Mr. William Martin, after defcribing an organic remain of this kind in his "Petrificata Derbienfia," fays, "there are other plants with ftellate leaves, to which it might with as much propriety be referred: hippuris, afperiala, and galium, for inftance," and he continues, "we may here obferve, that little has yet been done with refpect to difcriminating the original genera of foffil plants: thofe parts indeed, on which fuch difcrimination *muft* be founded, are rarely, if ever, vifible in the petrified ftate. The characteriftic diftinctions of the fpecies are frequently attainable, if ftudioufly fought after, by a diligent and careful comparifon of various fpecimens; and the habit or general appearance of the foffil often leads to the knowledge of the natural clafs and order of the recent plant: but its genus, for the moft part, remains undetermined or doubtful." The great importance of the organic remains or *reliquia* in tracing and identifying the ftrata, according to the new difcoveries of Mr. Smith and his pupils, will, it is hoped, ere long, induce naturalifts ferioufly to turn their attention to this neglected branch of fcience.

EQUISONANCE, in *Mufic*, a name by which the ancients diftinguifhed octaves from other concords. Octaves being the only *paraphoni*, or concords, when doubled above or below. This is a diftinction which would be as ufeful in modern mufic as in the ancient. All other concords, doubled, become difcords.

EQUITANTIA, Folia, in *Botany*, is applied to leaves fo folded at the bafe, as to embrace each other in two ranks. See Leaf.

EQUITATA Cohors, in *Antiquity*. See Cohors *Equitata*.

EQUITY, Æquitas, denotes juftice or right, mitigated and tempered by the confideration of particular circumftances; or a correction and abatement of the feverity of fome law; or a temperament, which, without being unjuft, abates the rigour of fome juft law.

Equity, as Grotius defines it, is the correction of that, wherein the law (by reafon of its univerfality) is deficient. For fince in law all cafes cannot be forefeen or expreffed, it is neceffary, that when the general decrees of the law come to be applied to particular cafes, there fhould be fomewhere a power vefted of defining thofe circumftances, which (had they been forefeen) the legiflator himfelf would have expreffed. And thefe are the cafes which, according to Grotius, "lex non exacté definit, fed arbitrio boni viri permittit."

This is what the Greeks call ἐπιείκεια. The utmoft feverity of a good law is frequently contrary to juftice; it fhould always have equity for its rule and guide. "Summum jus, fæpe fumma injuria."

The foundation of equity is not that there is any miftake in the law, but that the law was laid down univerfally, becaufe all circumftances could not be confidered or taken in under one law.

For an inftance, fuppofe it an exprefs law, that the city being now befet with an enemy, the gates be all fhut; and fuppofe it fall out that the enemy is then in purfuit after fome of the citizens by whom it is defended, fo that it would be highly prejudicial thereto not to open for them the gates; equity here decrees the gates to be opened, contrary to the exprefs words of the law.

As equity depends, effentially, upon the particular circumftances of each individual cafe, there can be no eftablifhed rules and fixed precepts of equity laid down, without deftroying its very effence, and reducing it to a pofitive law. And, on the other hand, the liberty of confidering all cafes in an equitable light, muft not be indulged too

 far;

far; leſt we thereby deſtroy all law, and leave the deciſion of every queſtion entirely in the breaſt of the judge. And law, without equity, though hard and diſagreeable, is much more deſirable for the public good, than equity without law; which would make every judge a legiſlator, and introduce infinite confuſion, as there would then be almoſt as many different rules of action laid down in our courts, as there are differences of capacity and ſentiment in the human mind.

Equity is of two kinds, and thoſe of contrary effects; the one abridges, and takes from the letter of the law; and the other enlarges, and adds to it.

The firſt is defined the correction of a law, made generally in that part wherein it fails; as ſuppoſe a ſtatute made, "that whoſoever does ſuch a thing ſhall be a felon, or ſuffer death:" yet if a mad-man, or an infant, who hath no diſcretion, do the ſame, he ſhall neither be a felon nor ſuffer death.

The other is defined an extenſion of the words of the law to caſes which are not expreſſed, which yet come under the ſame reaſon: ſo that when one thing is enacted, all other things which are of the like degree are ſo too.

Thus, the ſtatute which ordains, that in action of debt againſt executors, he who appears by diſtreſs ſhall anſwer, extends by equity to adminiſtrators; and ſuch of them as ſhall appear firſt by diſtreſs, ſhall anſwer by the equity of the ſaid act, "quia ſunt in æquali genere."

Equity is alſo uſed for the virtue of juſtice. See Justice.

Equity, in our *Laws*, &c. is alſo frequently uſed for the Court *of Chancery*, (which ſee,) where controverſies are ſuppoſed to be determined according to the exact rules of equity and conſcience, by mitigating the rigour of the common law.

"Æquitas ſequitur legem," is an old maxim in law; but, from the great increaſe of ſuits in chancery, ſome have thought fit to give it this conſtruction, that in all caſes after a man has been at law, he muſt go to equity.

Judge Blackſtone has given a brief, but comprehenſive view of the nature of equity, as it is now underſtood and practiſed in our ſeveral courts of judicature. Equity, he ſays, in its true and genuine meaning, is the ſoul and ſpirit of all law; *poſitive* law is conſtrued, and *rational* law is made by it. In this, equity is ſynonymous to juſtice: in that, to the true ſenſe and ſound interpretation of the rule. But the very terms of a court of *equity*, and a court of *law*, as contraſted to each other, are apt to confound and miſlead us; as if the one judged without equity, and the other was not bound by any law. Whereas every definition or illuſtration to be met with, which now draws a line between the two juriſdictions, by ſetting law and equity in oppoſition to each other, will be found either totally erroneous, or erroneous to a certain degree. Thus, in the *firſt* place, it is ſaid, that it is the buſineſs of a court of equity in England to abate the rigour of the common law; but no ſuch power is contended for. The learned judge ſpecifies various caſes of poſitive law, in which the court of equity can give no relief, and in which theſe, as well as the courts of law, muſt ſay with Ulpian, "hoc quidem perquam durum eſt, ſed ita lex ſcripta eſt." Again it is ſaid, that a court of equity determines according to the ſpirit of the rule, and not according to the ſtrictneſs of the letter: but ſo alſo does a court of law. Both, for inſtance, are equally bound, and equally profeſs, to interpret ſtatutes according to the true intent of the legiſlature. In general laws, all caſes cannot be foreſeen; or, if foreſeen, cannot be expreſſed: ſome occur that will fall within the meaning, though not within the words of the legiſlator; and others, which may fall within the letter, may be contrary to his meaning, though not expreſsly excepted. Theſe caſes, thus out of the letter, are often ſaid to be within the equity of an act of parliament; and ſo caſes within the letter are frequently out of the equity. Here by equity we mean nothing but the ſound interpretation of the law; though the words of the law itſelf may be too general, too ſpecial, or otherwiſe inaccurate or defective. Theſe are the caſes to which Grotius refers in the paſſage cited above. But there is not a ſingle rule of interpreting laws, whether equitably or ſtrictly, that is not equally uſed by the judges in the courts both of law and equity: the conſtruction muſt in both be the ſame, or, if they differ, it is only as one court of law may alſo happen to differ from another, each endeavours to fix and adopt the true ſenſe of the law in queſtion: neither can enlarge, diminiſh, or alter that ſenſe in a ſingle tittle.

It has been further ſaid, that *fraud*, *accident*, and *truſt*, are the proper and peculiar objects of a court of equity. But every kind of *fraud* is equally cognizable, and equally adverted to, in a court of law. Many *accidents* are alſo ſupplied in a court of law. And, although a technical *truſt*, created by the limitation of a ſecond uſe, was forced into the courts of equity; and this ſpecies of truſts, extended by inference and conſtruction, has ever ſince remained as a kind of *peculium* in theſe courts; yet there are other truſts which are cognizable in a court of law. Moreover, it has been ſaid that a court of equity is not bound by rules or precedents, but acts from the opinion of the judge, founded on the circumſtances of every particular caſe. Whereas the ſyſtem of our courts of equity is a laboured, connected ſyſtem, governed by eſtabliſhed rules, and bound down by precedents, from which they do not depart, although the reaſon of ſome of them may perhaps be liable to objection.

In ſhort, if a court of equity in England did really act, as many ingenious writers have ſuppoſed it (from theory) to do, it would riſe above all law, either common or ſtatute, and be a moſt arbitrary legiſlator in every particular caſe. Formerly, indeed, our courts of equity arrogated to themſelves ſuch an unlimited authority as hath totally been diſclaimed by their ſucceſſors for more than a century paſt. But the ſyſtems of juriſprudence, in our courts, both of law and equity, are now equally artificial ſyſtems, founded in the ſame principles of juſtice and poſitive law; but varied by different uſages in the forms and mode of their proceedings; the one being originally derived (though much reformed and improved) from the feudal cuſtoms, as they prevailed in different ages in the Saxon and Norman judicatures; the other (but with equal improvements) from the imperial and pontifical formularies, introduced by their clerical chancellors.

The ſuggeſtion indeed of every bill, to give juriſdiction to the courts of equity (copied from thoſe early times) is, that the complainant hath no remedy at the common law. But he, who ſhould from thence conclude, that no caſe is judged of in equity, when the law might have given relief, and, at the ſame time, caſts his eye on the extent and variety of the caſes in our equity reports, muſt think the law a dead letter indeed. The rules of property, rules of evidence, and rules of interpretation, in both courts, are, or ſhould be, exactly the ſame; both ought to adopt the beſt, or muſt ceaſe to be courts of juſtice. Neither a court of equity nor of law can vary men's wills or agreements, or (in other words) make wills or agreements for them. Both are to underſtand them truly, and therefore both of them uniformly.

uniformly. The rules of decifion are in both courts equally appofite to the fubjects of which they take cognizance. Such then being the parity of law and reafon which governs both fpecies of courts, it may be afked what conftitutes their effential difference? It principally confifts in the different modes of adminiftering juftice in each; in the mode of proof, the mode of trial, and the mode of relief. Upon thefe, and upon two other accidental grounds of jurifdiction, which were formerly driven into thefe courts by narrow decifions of the courts of law, *viz.* the true conftruction of fecurities for money lent, and the form and effect of a truft or fecond ufe; upon thefe main pillars hath been gradually erected that ftructure of jurifprudence which prevails in our courts of equity, and is inwardly bottomed upon the fame fubftantial foundations as the whole fyftem of law. As to the mode of proof, when facts, or their leading circumftances, reft only in the knowledge of the party, a court of equity applies itfelf to his confcience, and purges him upon oath with regard to the truth of the tranfaction; and, that being once difcovered, the judgment is the fame in equity as it would have been at law. But, for want of this difcovery at law, the courts of equity have acquired a concurrent jurifdiction with every other court in all matters of account. From this compulfive difcovery upon oath, the courts of equity have acquired a jurifdiction over all matters of fraud. As to the mode of trial, this is by interrogations adminiftered to the witneffes, upon which their depofitions are taken in writing, wherever they happen to refide. With refpect to the mode of relief, the want of a more fpecific remedy, than can be obtained in the courts of law, gives a concurrent jurifdiction to a court of equity in a great variety of cafes. Thus it is in executory agreements, and in various kinds of frauds, &c. The true conftruction of fecurities for money lent is another fountain of jurifdiction in courts of equity. The form of a truft, or fecond ufe, gives the courts of equity an exclufive jurifdiction as to the fubject-matter of all fettlements and devifes in that form, and of all the law terms created in the prefent complicated mode of conveyancing. This is a very ample fource of jurifdiction. Blackft. Com. vol. iii.

Equity *of redemption*, on mortgages, is that right which a mortgagor has of redeeming his eftate upon payment of the money borrowed. This enables a mortgagor to call on the mortgagee who has poffeffion of his eftate to deliver it back, and account for the rents and profits received, on payment of his whole debt and intereft; thereby turning the *mortuum* into a kind of *vivum vadium*. But on the other hand, the mortgagee may either compel the fale of the eftate in order to get the whole of his money immediately, or elfe call upon the mortgagor to redeem his eftate prefently, or, in default thereof, to be for ever foreclofed from redeeming the fame, that is, to lofe his equity of redemption without poffibility of recall. And alfo in fome cafes of fraudulent mortgages, (ftat. 4 & 5 W. & M. c. 16.) the fraudulent mortgagor forfeits all equity of redemption whatfoever. This is done by proceedings in the court of chancery. But the chancery cannot fhorten the time of payment of the mortgage money, where it is limited by exprefs covenant, though it may lengthen it; and then upon non-payment, the practice is to foreclofe the equity of redemption of the mortgagor. 2 Vent. 364.

To foreclofe the equity, a bill in chancery is exhibited, to which an anfwer is put in, and a decree being obtained, a mafter in chancery is to certify what is due for principal, intereft, and cofts, which are to be prefixed by the decree, whereupon the premifes are to be re-conveyed to the mortgagor; or, in default of payment, the mortgagor is ordered to be foreclofed from all equity of redemption, and to convey the premifes abfolutely to the mortgagee. Law of Securities, p. 129. 133.

By ftat. 7 Geo. II. cap. 20, after payment or tender by the mortgagor of principal, intereft, and cofts, the mortgagee can maintain no ejectment, but may be compelled to re-affign his fecurities.

Equity, in *Mythology*, fometimes confounded with Juftice, a goddefs among the Greeks and Romans, reprefented with a fword in one hand and a balance in the other.

EQUIVALENT, is underftood of fomething that is equal in value, force, or effect, to another.

Equivalence is of various kinds, in propofitions, in terms, and in things.

Equivalent *propofitions*. See Equipollence.

Equivalent *terms*, are where feveral words that differ in found have yet one and the fame fignification; as "every body was there," and "nobody was abfent," *nihil non*, and *omne*.

Equivalent *things*, are either moral, phyfical, or ftatical. Moral, as when we fay that the commanding or advifing a murder is a guilt equivalent to that of the murderer. Phyfical, as when a man who has the ftrength of two men is faid to be equivalent to two men. Statical, whereby a lefs weight becomes of equal force with a greater, by having its diftance from the centre increafed.

EQUIVOCAL, Equivocum, denotes a word or expreffion that is dubious and ambiguous, or that may have feveral fenfes, one true and another falfe.

Equivocal terms anfwer to what are otherwife called *homonyma*, or homonymous terms.

Such is the word *emperor*, which is both the name of a dignity, the proper name of a perfon, and the name of a plant. So alfo the Latin *gallus*, which ftands indifferently for a cock and a Frenchman.

In thefe cafes, one word denotes two or more different ideas, or different forts of objects: whence that common definition of equivocals in the fchools, "quorum nomen eft commune ratio vero effentiæ fecundum illud nomen diverfa." Philofophers diftinguifh equivocals into active and paffive; or æquivoca æquivocantia, and æquivocata.

Æquivoca æquivocantia, or thofe that denominate and fignify things, are words common to feveral things in a very different fignification, *i.e.* to feveral things which have a fimilar effence correfpondent to the fimilar denominations. *E. gr.* The word *taurus*, which ftands for a fign, a mountain, and an animal; and in one fignifies a lowing animal; in another, a heap of ftones and earth; and in the third, a conftellation or fyftem of ftars.

Æquivoca æquivocata, or thofe that are called or denominated, are the things fignified by ambiguous names, *e. gr.* a fign, a mountain, and an animal; which laft fpecies of equivocals alone Ariftotle feems to have had in view in his definition, which agrees to thefe, and thefe only.

Equivocal *action and caufe*. See Action and Cause.

Equivocal *generation*, is a method whereby animals and plants are fuppofed to be produced, not by the ufual way of coition between male and female, but by fome fuppofed plaftic power or virtue in the fun, &c.

Thus, infects, maggots, flies, fpiders, frogs, &c. have ufually been fuppofed to be produced by the heat of the fun warming, agitating, and impregnating the duft, earth, mud, and putrified parts of animals.

This method of generation, which we alfo call *fpontaneous*, was commonly afferted and believed among the ancient philofophers; but the moderns, from more and better obfervations, unanimoufly reject it, and hold that all animals,

animals, nay, and vegetables too, are univocally produced; that is, from parent animals, and vegetables of the fame fpecies and denomination.

It were a thing, one would imagine, fufficient to difcredit the Ariftotelian, or rather the Egyptian doctrine of equivocal generation, to find flies, frogs, lice, &c. to be male and female, and accordingly to ingender, lay eggs, &c.

The doctrine of equivocal generation we call an *Egyptian doctrine*, as having, in all probability, had its rife in Egypt, to folve the hypothefis of the original production of men, and other animals, out of the earth, by the help of the fun's heat.

To prove which, the Egyptians, as Diodorus Siculus obferves, produce this obfervation, that about Thebes, when the earth is moiftened by the Nile, and afterwards impregnated by the intenfe heat of the folar rays, an innumerable fwarm of mice come forth: whence he infers, that all kinds of animals might equally have arifen out of the earth at the beginning of things; and from thefe bifhop Stillingfleet takes the other writers and adherents to the doctrine of equivocal generation, Mela, Pliny, Ovid, &c. to have borrowed the hypothefis without inquiring into its truth. Derham's Phyf. Theol. lib. iv. cap. 15. See GENERATION.

EQUIVOCATION, ÆQUIVOCATIO, the ufing a term or expreffion that has a double fignification.

Equivocations are expedients to fave telling the truth, and yet without telling a falfity. The fathers are great patrons of equivocations and mental refervations, holding, that the ufe of fuch fhifts and ambiguities is in many cafes allowable.

St. Auguftine, particularly, is reproached with endeavouring to vindicate Ifaac for faving his wife from a crime by an equivocation; "tacuit aliquid veri, & non dixit aliquid falfi." To advance a dubious propofition, knowing it will be underftood in a fenfe different from that you give it in your mind, is an equivocation, and a breach of good faith and fincerity.

In moral theology, it is ftrictly underftood of a term or phrafe with two different fignifications, the common and obvious, the other more unufual and remote; the latter of which being underftood by the fpeaker, but the former by the hearers, they conceive fomething different from one another.

Of this we have an inftance in St. John, chap. xi. where our Saviour is reprefented as faying, "Lazarus fleepeth," for the difciples who took the word fleeping in the ufual fignification, concluded that Lazarus, whom they had been told, was fick, began to take reft, and would foon recover; but Jefus, ufing the word in a lefs direct and ufual fignification, meant that Lazarus was dead.

When the equivoque confifts of feveral words, it is properly called an *amphibology*, (which fee,) of which we have an inftance in St. John, chap. ii. "Deftroy this temple," fays Jefus, fpeaking to the Jews, "and I will raife it again in three days."

The lawfulnefs of the ufe of equivocations has been greatly difputed among the modern cafuifts; many grave authors deny that it is allowable to ufe them on any occafion whatever. Their reafon is, that an equivoque is to all intents and purpofes the fame thing with a lie.

EQUIVOQUE, L', in *Mufic*, is when a fharp, by extraneous modulation, becomes a flat, and *è contra*. As the chord of D♭ becoming the chord of C♯ with a fharp 3d, &c. See MODULATION, and EXTRANEOUS.

EQUULEUS, or ECULEUS, in *Antiquity*, a kind of rack, or engine of torture, ufed for extorting the truth; at firft chiefly on flaves, but afterwards turned againft the Chriftians.

The patient's arms and legs being faftened on the equuleus with cords, he was hoifted aloft, and extended, in fuch manner that all his bones were diflocated. In this ftate, red-hot plates were applied to his body, and he was alfo goaded in the fides with an iron-forked inftrument, called *ungula*.

The equuleus was of wood, and had holes at certain diftances, with a fcrew, by which the criminal was ftretched to the third, fometimes to the fourth or the fifth hole: at intervals, the fcrew was flackened again, by which he had fome refpite; but then he was tormented with queftions.

The equuleus in more ancient times was conftructed in the form of a horfe; the criminal was laid on his back, and his arms were turned under the breaft of the equuleus, his hands were bound, and his feet ftretched out towards his tail. A rope faftened to the feet was made to pafs over a fmaller pulley between the hind-legs of the equuleus, and made to coil over another larger pulley fixed under the belly by means of a handle, which the executioner turned round till all the bones, &c. were diflocated. See a learned differtation on the form and ufe of this inftrument, by Dr. Ward, in the Phil. Tranf. vol. viii. part iv. p. 32, &c.

Hieronymus Magius, when a prifoner among the Turks, wrote an exprefs treatife "De Equuleo;" and another of Bells, merely as it is faid from his memory, without any affiftance of books. Sigonius had another treatife on the fame fubject.

EQUULEUS, *Equiculus*, and *Equus minor*, *equi fectio*, the *Horfe's Head*, in *Aftronomy*, a conftellation of the northern hemifphere, whofe ftars in Ptolemy's Catalogue are 4, in Tycho's 4, in Hevelius's 6, and in Mr. Flamfteed's 10. See CONSTELLATION.

EQUULEUS, in *Arts* and *Manufactures*. See HORSE.

EQUUS, in *Zoology*, a genus of the Belluæ order. The fore-teeth in the upper jaw are fix, erect, and parallel; the lower fix, and more prominent; tufks folitary, included, remote; teats two, inguinal.

Species.

CABALLUS. Tail with long flowing hair. *Equus cauda undique fetofa*, Linn. *Equus auriculus brevibus erectis, juba longa*, Briff. Ἵππος. Ariftot. Ælian, &c. *Equus, equa, equiferus*, Pliny. Gefn. Aldr. &c. *Cheval*, Buff. *Rofs*, Gefn. *Horfe*.

FERUS. α. *equus ferus*, Haffelq. *Wilde Pferde*, Gmel. Pallas. *Tarpany*, Rytfchk. Orenb. *Wild horfes*, Bell.

DOMESTICUS. β. *equus domefticus*. *Domeftic horfe*.

This generous animal is cultivated in moft parts of the earth, and is found in a wild ftate in the deferts of Great Tartary, in the fouthern parts of Siberia, the banks of the river Don, and other parts of Afia and Africa. See HORSE.

HEMIONUS. Longitudinal dorfal ftripe without humeral tranfverfe band; tail hairy at the tip only. *Equus hemionus*, Pallas Nov. Comm. Petrop. v. 19. Gmel. *Czigitai*, Buff.

This curious animal, defcribed by Pallas in the Tranfactions of the Royal Academy of Peterfburgh, is fuppofed by that naturalift to be the hemionos of Ariftotle, and which appears, if this conjecture be correct, to have remained almoft unnoticed from the time of Pliny, who mentions it as a native of Cappadocia.

The

The *Czigitai*, or, as more commonly called, *Dſhiggetéi* in the Mongolian language, is a native of the deſert regions between the rivers Onon and Argun, in the ſouthern parts of Siberia, and eſpecially thoſe of Gobi, which extend even to the confines of China and Thibet. The name *Dſhiggetéi* ſignifies *Great Ears*, and is given to this ſpecies of wild horſe, becauſe its ears exceed in proportion the ſize of thoſe of the common kind. They are, nevertheleſs, ſtraighter and better formed than thoſe of the mule, to which the whole conformation of the animal bears much ſimilitude. His ſtature is that of a mule of the common dimenſions: the length being more than five feet, and his weight from four to five hundred pounds. The head is large, with an appearance of heavineſs, and the front flattened: the eyes moderate, with aſh-coloured irides. The mouth is furniſhed with thirty-four teeth. The neck is ſlender, and compreſſed with a ſoft, ſhort, erect mane, and on the fore-top a tuft of downy hair about two inches in length. The body is rather long; the breaſt large and protuberant; the back ſomewhat concave or depreſſed, with the flanks and poſterior part thin, as in the mule. The limbs are long and ſlender, with an oval callus within the fore legs; the hoofs like thoſe of the aſs; and the tail, which is two feet in length, correſponding with that of the cow, in being naked for half its length, and having the tip hairy.

During ſummer the prevailing colour of this animal is yellowiſh brown, with the upper part of the head and inner part of the limbs tawny, and ſometimes the inſide of the hind thighs and belly are ſaid to be whitiſh. The noſe is white; the mane and tail blackiſh; and the back marked with a line of cheſnut or deep black, extending from the mane to the tail. The dorſal line is rather dilated on the loins, and becomes narrower towards the tail. The ſummer coat is much ſmoother than that which it aſſumes in winter, for the hair during the latter ſeaſon is longer, and changes to a deeper or more ruddy hue, inclining at the tips to grey.

Theſe animals are of a ſocial diſpoſition among themſelves, living together in troops of twenty or thirty, or ſometimes an hundred. They prefer the open plains, abounding in ſalt marſhes; and never approach the foreſts nor mountainous ſituations. Each of thoſe troops is placed under the guidance of a leader, who is conſtantly on the watch while the reſt of the herd is at reſt, or feeding; and who, in caſe of danger, gives the ſignal of alarm, by leaping and looking ſteadfaſtly at the object which excites his fears. This vigilant leader is often killed, becauſe he is ſtationed at ſome diſtance from the herd, and oftentimes approaches ſtill nearer to the hunters, in order to watch them attentively; and when he falls the herd does not diſperſe till many of them are killed. When alarmed and put to flight the beſt horſes could not overtake them; their ſwiftneſs ſurpaſſes that even of the antelopes. They have the ſenſes of ſight and ſmell in exquiſite perfection In their manners they are naturally timid, but when cloſely preſſed by an enemy are very fierce, and defend themſelves both with their teeth and feet. Their neigh is more ſhrill than that of a horſe. The pregnant females are with young from Auguſt till the following ſpring, when each produces a foal, or rarely two.

The Czigitais would form an excellent race of ſmall horſes, could they be reduced to a ſtate of domeſtication, but ſuch is the untractableneſs of their diſpoſition, that the difficulties of training them for this purpoſe appear unſurmountable. The people of the vaſt deſerts which they inhabit purſue them only for the ſake of their fleſh and ſkin, the former of which they eſteem a delicacy.

Asinus. Tail briſtly at the extremity; a black croſs on the ſhoulders. Linn. The Aſs.

This animal is deſcribed at length under the article Asinus.

Zebra. Body pale buff, with perpendicular fuſcous bands; limbs tranſverſely ſtriped with fuſcous. *Equus zebra, faſciis fuſcis verſicolor*, Linn. *Equus indicus*, Jonſt. *Equus braſilienſis*, Jacob. *Zecora*, Ludolf. *Aſne de beauté extraordinaire*, Thevenot. *Indianiſch Maulthier*, Geſn.

The zebra is one of the moſt beautiful quadrupeds known; uniting to the grace of the horſe, and ſwiftneſs of the ſtag, a peculiar combination of colours, that renders its appearance admirable. This animal is rather larger than the common aſs, and bears ſome reſemblance to the mule. The head is of moderate ſize, and well formed, the ears long, the legs delicate, the body graceful, and the beauty of its ſhape heightened by the ſmoothneſs of the ſkin. The colour is either milk white, or faintly tinged with brown, or pale ferruginous, and the whole animal adorned with alternate pale and fuſcous bands diſpoſed with ſuch amazing regularity as to have rather the appearance of art than nature. The ſtripes run in a tranſverſe direction both on the body and limbs. The head is ſtriped with fine bands of black and whitiſh, forming a centre in the forehead. The neck is adorned with ſtripes of the ſame, running in the ſame direction as thoſe on the back, all which point perpendicularly towards the belly. The thighs and legs are faſciated tranſverſely with fuſcous. The tail is of moderate length, round, rather ſlender, marked with blackiſh bands, and terminated by a thick tuft of browniſh hair. The colours in the male are remarkably vivid, being ſometimes of a fine yellow or yellowiſh, with the ſtripes nearly black, the female is almoſt white, with the ſtripes brown.

Theſe animals are found in the hotter regions of Africa, from Ethiopia to the Cape of Good Hope; and are in particular met with in great plenty in the extenſive ſolitary mountainous waſtes of the latter tract of country. They live in large herds, and poſſeſs much of the manners both of the horſe and the aſs, are exceſſively ſwift and vigilant, and prefer ſubſiſting on the hard and dry herbage their ſterile haunts afford, to deſcending into the more fertile and more frequented plains. The diſpoſition of the zebra is more unmanageable than that either of the horſe or aſs; and even ſuch as have been taken when very young have evinced the ſame invincible degree of paſſion for liberty, when grown up, as thoſe caught at an age of maturity. The Dutch have taken great pains to train them for domeſtic purpoſes, but with little ſucceſs, and which is the more to be regretted as the domeſtication of theſe animals would be of eſſential utility to the colony. This is teſtified from the actual obſervations of many travellers.

The zebra, tranſported into the temperate climates of Europe, have been known to produce young; but their offſpring degenerates. It has been known to couple with the Arabian horſe, and to give birth to a ſmall mule not very unlike the hybrid creature formed between the horſe and aſs. According to Sparrmann, the zebra is hunted by the Hottentots for the ſake of its fleſh, which they deem excellent; but, in reality, it is in no reſpect ſuperior to that of the horſe. Le Vaillant deſcribes the manners of theſe animals: the cry of the zebra, according to this writer, is very ſingular.

Quagga. Above cheſnut faſciated with fuſcous, ſides ſpotted; belly, legs, and thighs white. *Equus quagga*, Gmel. *Opeagha*, or *quagga*, of the Hottentots. Maſſon's Travels, Phil. Tranſ.

The quagga approaches ſo nearly in reſemblance to the zebra, as to have remained till very lately confounded with it, and from various circumſtances to be conſidered as the female. This animal is inferior in ſize to the zebra. The prevailing

prevailing colour reddifh brown, and the upper part is marked with bands of black, but one of the principal differences confifts in the belly, legs, and thighs being white, and deftitute of bands, as are alfo the flanks and buttocks. There is an obvious diftinction between the two fexes of this animal, the colours of the male being far more vivid than thofe of the female.

The more folitary regions in the fouthern parts of Africa are the haunts of this beautiful animal. They are of a focial difpofition, and in a ftate of wildnefs, herd in troops of a hundred or more together; and it is obferved that though they inhabit the fame deferts as the zebra they never affociate with that fpecies. The quagga, unlike the zebra, is of a tractable nature: in fize it is fmaller, but ftronger, and in proportion more robuft. The attempts of the colonifts of the Cape to reduce this animal to a ftate of fervitude, like the horfe, has been attended with fome fuccefs; an inftance of this is mentioned by Sparrmann. Quagga, opeagha, and alfo *cwah*, or *kwah*, are the names by which the Hottentots diftinguifh this animal; its cry refembles the barking of a dog, in which founds, fimilar to the latter words, are frequently repeated. Its flefh, which refembles that of the zebra, is eaten by the natives.

Appendix.

Bifulcus. Hoofs cloven. Gmel. *Guémul*, or *Huémul*, Molina. Hift. Chili.

The cloven-footed, or Chilefe horfe, is an animal of very ambiguous character, and which, if our fufpicions be well founded, will be removed from the equus tribe whenever naturalifts become better acquainted with this fuppofed fpecies than they appear to be at prefent. The animal feems to have been unknown till obferved by Wallis in the ftraits of Magellan. Molina, in his "Storia Naturale del Chili," defcribes it as a horfe, under the title of *Guémul* or *Huémul*, and, as later writers depend on the authority of Molina for their defcription of this anomalous animal, it may not be amifs to repeat the particular information his account affords us. The guemul is defcribed by him as refembling in different refpects both the horfe and the afs; it bears an affinity to both, but cannot appertain to either; the divifion of the hoofs alone being fufficient to remove it from thefe apparently congenerous animals. In point of ftature and appearance, the texture of the hair, and colour, the guemul, according to Molina, refembles the afs. The form and difpofition of the teeth correfpond with thofe of the horfe. The ears are not long, as in the afs; they are fhort, ftraight, and pointed, as in the horfe; neither is the back or fhoulders of the guemul marked with the black ftripe by which the afs is ufually diftinguifhed. The head is better formed than that of the afs, the cheft more elegant, and the tail and buttocks more graceful. The internal conformation affords the moft obvious diverfity; and the voice, dependant, in a material degree, on this interior organization, rather refembles the neighing of the horfe than the bray of the afs. Gmelin is not correct in his tranflation from Molina, when he defcribes the "ftructura interna," &c. as correfponding with that of the afs; this point may be thought material to the developement of the true character of the animal, and fhould be therefore mentioned; and the more efpecially fince the fame miftake prevails in all the Englifh defcriptions of this cloven-footed, or Chilefe horfe, that we have feen.

Molina fpeaks of the guemul as an animal of a vicious nature, wild, and of furprizing velocity. It inhabits the heights of the moft inacceffible mountainous regions of the Andes of Chili; and it is faid, befides, to be found in other Alpine tracts of South America.

The information upon which this animal is defcribed appears to be not fufficiently explicit. We think the guemul ought not to be retained with the horfe or equus tribe. Perhaps it is of the camelus tribe, or that, with ftill more propriety, it ought to be allowed to conftitute a new genus. An ingenious writer obferves, that "if only a fingle fpecimen of this animal had been defcribed, we might have hefitated as to admitting it otherwife than as an accidental variety." We could have wifhed the other authorities alluded to had been adduced. The continental naturalifts offer argument and fpeculation dependant on the defcription given by Molina only; any farther information would therefore prove acceptable. In the Gmelinian "Syftema Naturæ" this animal is claffed as a horfe. Sonnini confiders it as allied to the lama, or camelus glama, and camelus vicugna. According to the character "pedes ungula indivifa," eftablifhed by Linnæus for the equus genus, nothing can be more abfurd than a cloven-footed horfe. Its affinity to the camel appears rather more evident, or, as before intimated, if it be not of that tribe, it is not improbable that it may conftitute a new genus.

Equus *Marinus*, in *Ornithology*, the *Fulmar* of Pennant and Latham, and the Procellaria *Glacialis* of other writers, which fee.

Equus *Marinus*, in *Zoology*, a name given by fome to an animal very different from the hippopotamus, or riverhorfe, and more ufually known by the name of the *Morfe*. See Trichechus *Rofmarus*.

ERA, in *Chronology*. See Æra.

Era, in *Geography*, a river of Tufcany, which runs into the Arno; 14 miles above Pifa.

ERABA, a town of Perfia, fituated on the eaftern bank of the river that anfwers to the Arabius of Alexander and Nearchus.

ERACLISSA, in *Botany*, fo named by Forfkall, from the Greek village near which he gathered it, is according to Juffieu, no other than *Andrachne telephioides* of Linnæus. See Forfk. Fl. Ægyptiaco-Arab. 208.

ERACTUM, in *Ancient Geography*, a town of European Sarmatia, in the country of the Baftarnæ, according to Ptolemy. It has been thought to be the modern *Row*, a fmall town of Podolia.

ERADICATIVE, in *Medicine*. See Radical.

ERÆ, in *Ancient Geography*, a fmall maritime, fortified town of Afia Minor, in Ionia, according to Strabo, who fays that it was either founded or poffeffed by the Teians.

ERAGE, a town of Africa, in the Pentapolis, according to Ptolemy.

ERAGISA, Rajik, a town of Syria, in the Cyrrhaftii territory, upon the banks of the Euphrates, according to Ptolemy, fituated S. S. E. of Hierapolis.

ERAGROSTIS, in *Botany*, from ἔρος, *love*, and ἄγρωστις, *grafs*, the name of an elegant grafs, *Poa Eragroftis* of Linnæus, called in Latin *Gramen Amoris*, and in French *Amourettes*. See Sm. Fl. Græc. Sib. t. 73, where the Linnæan *Briza Eragroftis* is given as a fynonym.

ERANA, in *Ancient Geography*, a borough of Afia, in Cilicia; being the chief place of mount Amanus, upon which it was fituated, on the fame fide with the altars of Alexander. Cicero fays it refembled a town rather than a village.

ERANARCHA, formed of ἔρανος, *alms*, *contribution*, and ἀρχὴ, *command*, a public officer among the ancient Greeks, whofe bufinefs was to prefide over and direct the alms given, and provifions made for the poor.

The eranarcha was properly the adminiftrator or fteward of the poor: when any perfon was reduced to poverty, taken captive, or had a daughter to marry, which he could not effect for want of money, &c. this officer called an affembly of friends and neighbours, and taxed each, according to his means and eftate, to contribute towards his relief. This is what we learn from Cornelius Nepos, in his life of Epaminondas.

ERANG, in *Geography*, a town of the ifland of Ceram.

ERANGELIA, in *Botany*, (Ηϱαγγελια, the herald of fpring), a name given by Renealm in his Specimen Hiftoriæ Plantarum, 97, to the Snow-drop. See GALANTHUS.

ERANNA, in *Ancient Geography*, a town of the Peloponnefus, in Triphylia, a province of the Elide. Strabo calls it *Erana*, and places it between Cypariffia and Pylus.

ERANNOBOAS, or ERRANOBOAS, a river of India, according to Arrian; fituated within the Ganges, into which it difcharged itfelf near the town of Palibothra. This river was of the third degree of magnitude among the Indian rivers, and inferior to none but the Ganges and Indus. Major Rennell cannot apply the name Erranoboas to any particular river. Pliny certainly fays, that the Jomanes (Jumnah) entered the Ganges by Palibothra, between Methora and Clifobara (otherwife Caryfobora and Cyrifoborea): but it is equally true, that in another place he mentions the conflux of the Ganges and Jomanes, and in the very next article fays that Palibothra is fituated 425 miles below that very point of conflux. Strabo does not give the name of the adjoining river. See PALIBOTHRA.

ERANTHEMUM, in *Botany*, from ερα, *the earth*, and ανθος, *a flower*, according to Linnæus (Phil. Bot. 177.) who is the author of the name; but fuch a derivation is, in the prefent inftance, wholly deftitute of any appropriate meaning. We fhould have fuppofed it rather from ερος, love, on account of the beauty of the flower, which might well juftify fuch a denomination; and it is not impoffible that Linnæus might have had this idea in his mind when he wrote the Flora Zeylanica, but forgot it when compofing his Philofophia Botanica. Linn. Fl. Zeyl. 6. Diff. Nov. Gen. Pl. 1. Am. Acad. v. 1. 384. Gen. Pl. ed. 4. 418. ed. 6. 11. Schreb. 15. Willd. Sp. Pl. v. 1. 51. Mart. Mill. Dict. v. 2. Juff. 110.

Gen. Ch. *Cal.* Perianth five-cleft, tubular, very narrow, erect, fhort, pointed, permanent. *Cor.* of one petal, funnel-fhaped; tube very long and thread-fhaped; limb deeply five-cleft, (occafionally four-cleft), flat, its fegments obovate. *Stam.* Filaments two, very fhort, in the mouth of the corolla; anthers nearly ovate, compreffed, projecting beyond the tube. *Pift.* Germen ovate, minute; ftyle thread-fhaped, reaching to the top of the ftamens; ftigma fimple. *Peric.* and *feeds* not known. Linnæus adds, that he had feen only a fingle fpecimen, (which by the mark †, was a dried one), and therefore he left the genus to the attentive examination of other botanifts.

Eff. Ch. Corolla five-cleft; tube thread-fhaped. Anthers projecting beyond the tube. Stigma fimple. Fruit ....

Such are the characters given by Linnæus, and copied by Schreber, but the plant whence they were taken being no other than a *Jufticia*, very near, if not the fame with *J. pulchella*, Roxb. Corom. t. 177, *Eranthemum* falls to the ground. Linnæus indeed, in his own Gen. Pl. has made the following manufcript corrections: that the two upper fegments of the calyx are the fhorteft; fegments of the corolla not obovate but oblong, two of them joined together; anthers within the mouth of the tube.—Whence thefe corrections were taken we have no knowledge; probably from fome of the plants he fubfequently referred to *Eranthemum*, for he certainly never again faw the fpecimen he originally defcribed from Herman's herbarium, nor had he in his own any thing to illuftrate the fubject. In the Species Plantarum one fpecies only is mentioned, by the name of *E. capenfe*, faid to grow in Ethiopia, and to have the habit of a *Chironia*; yet he comprehends under it the plant of his Flora Zeylanica, which, as we have faid, is a *Jufticia*, and with this laft the fynonyms of Herman's Paradifus, Amman and Ray have certainly no connection. In the thirteenth and fourteenth editions of the Syftema Vegetabilium *Selago dubia* of Sp. Pl. having but two ftamens and its fruit not afcertained, is called *Eranthemum anguftifolium*; while another fpecies, called *parvifolium*, is adopted from Bergius, along with a fynonym of Commelin, who figures it with four ftamens and all the afpect of a *Selago*; indeed Linnæus, in his own copy of Bergius, has expreffed a fufpicion of its being fuch. *E. falfoloides*, from Teneriffe, the only fuppofed fpecies befides, is defcribed in the Suppl. Pl. but wholly unknown to us. How far the above, and other fpiked fpecies of *Selago*, may conftitute a genus by themfelves, as Juffieu fufpects, we muft leave in doubt; but if fo, they cannot have any thing to do with the name or the above generic characters of *Eranthemum*. S.

ERANUSA, in *Ancient Geography*, a fmall town of Italy, placed by Pliny near the promontory of Lavinium.

ERARIUM. See ÆRARIUM.

ERAS, in *Ancient Geography*, a town of Afia Minor, in Ionia, in the vicinity of Ephefus, according to Thucydides.

ERASED, in *Heraldry*, expreffes any thing that feems violently torn off from its proper place. It is ufed in contradiftinction to couped, which fignifies a thing clean cut off. The family of Card bears ermine, a demy lion rampant erafed, azure, &c.

ERASINUS, in *Ancient Geography*, a river of the Peloponnefus, in Arcadia, according to Strabo, who fays that this river had its mouth near Bura, in the gulf of Corinth.—Alfo, a river of Greece, in Eretria. Strabo.—Alfo, a river of Greece, in Attica, near Brauron. Strabo.—Alfo, a river of Afia Minor, in Lycia.—Alfo, a river of the Argolide, towards the S. E. of Cenchrea, which formed a confluence with the Phryxus.

ERASISTRATUS, in *Biography*, a phyfician of great reputation among the ancients, but of whofe parentage and birth-place, as well as of the æra in which he flourifhed, different accounts have been tranfmitted to us by different writers. It appears moft probable, however, that he was born at Julis, in the ifle of Cea or Ceos, (and not in Cos, the birth-place of Hippocrates, as has been afferted,) that he was the moft diftinguifhed pupil of Chryfippus, the Cnidian phyfician, and had attained a high character in his profeffion in the 123d olympiad. His fame acquired him the notice and efteem of Seleucus Nicanor, king of Syria, at whofe court he is faid to have evinced his fagacity in the following manner. Antiochus, the king's fon, was feized with a fevere malady, and the moft ingenious phyficians of the time were unable to difcover the caufe of it; until Erafiftratus, obferving the prince moft attentively, remarked, that whenever Stratonice, his father's fecond wife, entered his apartment, he became confiderably agitated, a blufh fuffufed his countenance, his voice grew more feeble, and his pulfe quickened:—whence the phyfician decided that his diforder was the effect of a concealed paffion for Stratonice. In order to inform the king of this delicate affair, he ftated that

Antiochus's difeafe was the refult of a paffion, the more unfortunate as it could not be gratified. The king, furprifed at the impracticability of gratifying the inclinations of his fon, demanded eagerly who was the object of his love. "My wife," replied Erafiftratus, promptly. Seleucus having urged him ftrongly not to occafion the death of his fon, by refufing to give up his wife, Erafiftratus inquired, if he would give up Stratonice to fave his fon's life, were fhe the object of his affection; with which the king expreffed his ready compliance, and Erafiftratus avowed that this would be the only means of preferving the life of Antiochus. Seleucus immediately declared him king of the provinces in Upper Afia, and gave him Stratonice in marriage, although fhe had already had one child.

The great character of Erafiftratus, however, is founded upon more folid ground than this anecdote difplays. He may be confidered as the father of anatomical fcience, at leaft conjointly with Herophilus. It feems to be clearly eftablifhed, that, before the time of thefe phyficians, no one had dared to diffect human bodies; anatomical examinations had been confined exclufively to the bodies of brutes. Human bodies had, indeed, been opened for the purpofe of embalming, among the Egyptians, but no anatomical inquiry had refulted from that practice. The Ptolemies, efpecially Soter and Philadelphus, being defirous that the arts fhould be cultivated, and having furmounted the prejudices of the age, granted the bodies of malefactors to the phyficians for diffection, of which opportunity Erafiftratus and Herophilus availed themfelves largely, and made feveral important difcoveries. To what extent thefe difcoveries were carried, it is not eafy to afcertain, fince the works of thefe phyficians are loft; and what we learn refpecting them is chiefly through the medium of Galen, who deeming Erafiftratus in fome fort a rival of his idol, Hippocrates, feldom quotes him but to confute him. It is afferted by Celfus (De Medicinâ, Præfat.), that the monarchs above-mentioned took the condemned criminals from prifon, and gave them up to Erafiftratus and Herophilus, who diffected them alive, in order to obtain a more accurate knowledge of the vital motions. (See Empiric.) It has been doubted, however, whether they were guilty of this barbarous practice, in confequence of their adoption of the opinion of Praxagoras, that the veins only received blood, and the arteries, and left ventricle, air; fince, if they had opened the living body, they muft have had ocular demonftration of the exiftence of blood in the latter: and this imputation is fuppofed to have been thrown upon them in a fabulous age; juft as Medea is faid to have boiled living men, becaufe fhe was the firft who practifed warm bathing. (See Eloy Dict. Hift.) It would appear, however, from the ftatement of Galen, that the evidence of their fenfes, upon this fubject, was contravened by this fort of fubterfuge: "as foon as the left ventricle of the heart is opened," they obferved, "the air is diffipated, and the ventricle is inftantaneoufly filled with blood." (Galen, an fanguis fit naturâ in arteriis.)

Erafiftratus and Herophilus were the firft who diffected the human brain accurately; according to the fragments preferved by Galen, Erafiftratus defcribed the brain minutely, its convolutions, the divifion of cerebrum and cerebellum, its cavities or ventricles, with their paffages of communication, and the origin of the nerves; and he inferred that the brain was the common fenforium, or fource of all the vital actions and fenfations, which were effected through the medium of the nerves. (Galen, De Hippoc. et Platon. decret. lib. vii. cap. 3.) He alfo examined minutely the ftructure of the heart and of the great veffels, and was the firft to point out the valvular apparatus, and its peculiar form in each of the cavities of that vifcus. (Loc. cit lib. i. cap. 10. and lib. vi. cap. 6.) He affirmed that the veins divided in the liver, for the purpofe of fecreting the bile; and knew that the urine was fecreted by the kidnies.

His phyfiology, in general, was not, however, very profound, and his pathology neceffarily imperfect; although he attempted to explain the caufes of difeafes from his knowledge of the ftructure of the body. The function of refpiration ferved, in his opinion, merely to fill the arteries with air. "The thorax being dilated," he faid, "the lungs expand at the fame time, and receive air: this air paffed to the extremities of the divifions of the trachea, and from them into the extremities of the pulmonary artery, whence it is pumped into the heart, by the dilatation of that organ, in order to be diftributed to all parts of the body, by the great artery." He attributed digeftion to attrition produced by the coats of the ftomach; but he did not attempt to explain the particular manner in which the ftomach accomplifhed fuch attrition.

The hypothefis, by which Erafiftratus attempted to explain the origin of inflammation, refembled, in its leading feature, that modern fuppofition, which, fanctioned by the name of Boerhaave, was generally received in the medical world for a long feries of years. (See Error *loci.*) He maintained, as we have already ftated, that the great vein (*vena cava*) was the refervoir of blood, and the great artery (*aorta*) the refervoir of air. "Thefe refervoirs are divided and fubdivided," he affirmed, "until they arrive at the furface, where the ramifications become fo minute, that the blood cannot pafs farther. Here the mouths or extremities of the arteries and veins clofe to each other, but the blood continues within its proper bounds, and does not enter the arterial or air-veffels, fo that the body continues in the natural ftate. But when any caufe of violence occurs to difturb this regularity, the blood is infinuated into the arteries, and hence the origin of difeafes. Among the caufes of difturbance juft alluded to, too great abundance of blood is the principal; for by it the coats of the veins are preternaturally dilated, and their extremities, which are ordinarily impervious, open, and admit of the paffage of the blood into the arteries. This transfufed blood becomes an impediment to the courfe and motion of the arterial fpirit or air, which is fent from the heart; and if the oppofition of the two matters is direct, or if the blood be arrefted near a vital part, a *fever* is produced; but if the air repel the blood, fo that it pafs not farther than the extremity of the artery, *inflammation* of that part is the confequence." (Galen, de venâ fect. adverf. Erafiftratum.)

The practice of Erafiftratus, like that of his mafter Chryfippus, was extremely fimple. He did not employ bloodletting, nor purgatives; confidering the former as hazardous in the operation, and debilitating in its effects, and the latter as not bringing away the proper humours of the body, but humours in a fort of corrupted ftate. He fometimes employed glyfters, but thefe of the mildeft qualities. All thefe remedies operated, in his opinion, by reducing plethora, which might be effected more fafely and naturally by fafting, or abftinence in diet, efpecially when aided by exercife. He advifed his patients, therefore, to ufe fuch articles of diet as contained little nutriment, as melons, cucumbers, and vegetables in general. He was exceedingly averfe from the employment of compound medicines, and efpecially of the mixture of mineral, vegetable, and animal fubftances; and he exclaimed againft the ufe of the antidotes of the phyficians of his day, in which fimplicity was altogether fhunned.

From the fragments of his writings to be found in Galen and

and Cælius Aurelianus, it would appear, that Erafiftratus wrote an accurate treatife on the dropfy, in which he difapproves of the operation of tapping; and that he had left other books on the following fubjects:—*viz.* on the Difeafes of the Abdomen, on the Prefervation of Health, on wholefome Things, on Fevers, and Wounds, on Habit, on Palfy, and on Gout.

Having lived to extreme old age, and fuffering feverely from the pains of an ulcer in the foot, Erafiftratus is faid to have terminated his exiftence by fwallowing the juice of cicuta, or hemlock. See Le Clerc, Hift. de la Medicine, Eloy, Dict. Hift. Cælius Aurel.

ERASMUS, Desiderius, a man of great celebrity in the republic of letters, was born at Rotterdam on the 28th of October, 1467. He was the natural fon of Gerard, a native of Tergou, by Margaret the daughter of a phyfician, whom he intended to marry, but being deceived by a report of her death, he entered into the church, and on this account Erafmus has been called, by way of reproach, the fon of a prieft, though his father was not in orders at the time of his birth. When Erafmus was about nine years old he was fent to fchool at Deventer, where he made very confiderable progrefs in learning, and was particularly diftinguifhed by the excellence of his memory. His mother, who followed him to Deventer, to watch over his health, died of the plague when he was about 13 years of age. He was now left an orphan, and his guardians, forgetful of the facred truft repofed in them, forced him into the church with a view of embezzling his property. Erafmus refifted their importunity for a confiderable time, but at length, when he was nineteen years old, he entered among the regular canons in the monaftery of Stein, near Tergou. He was of a delicate conftitution, and his health was not fufficiently robuft for the life of a monk. His temper and fentiments were likewife averfe from the habits of the profeffion; he accordingly, with the leave of his fuperiors, accepted, in his 23d year, an invitation to refide with the archbifhop of Cambray; but finding the patronage of that prelate not equal to his expectations, he went to Paris and ftudied in the college of Montaigne. Here he fupported himfelf by giving private lectures to thofe who were lefs advanced in their learning than himfelf. His neceffities required great exertion, and thus he acquired habits of induftry which raifed him to the higheft pitch of literary excellence. Some of his pupils at Paris were the fons of Englifhmen of confiderable confequence, by whofe liberality and earneft requeft he vifited their country, and contracted many valuable friendfhips. This was in the year 1497; from England he went to Italy, continued a year or more at Bologna, from thence to Venice, where he publifhed his Adagia; afterwards to Padua, and at laft he vifited the capital, Rome, where his reputation was very high, and where he might have fettled to great advantage, had he not determined, at the entreaties of his friends, and by the exprefs invitation of Henry VIII. to return to England. Henry, while prince, had contracted a friendfhip and high refpect for Erafmus, and in a few months after he fucceeded to the crown, we find Erafmus at the court of London high in favour with the monarch, with Wolfey, with the archbifhop of Canterbury, and with other perfons of diftinction.

At firft he lived with fir Thomas More, under whofe roof he wrote his "Moriæ Encomium," or "Praife of Folly," a witty and fatirical compofition. He afterwards went to Cambridge, and read lectures to the ftudents in Greek and theology. For this he was remunerated with a living and many valuable prefents, though not of fo fubftantial a nature as to fatisfy his expectations. He wifhed for an independency, and not being able to fecure that in England, he went over to Flanders in 1514, and was fhortly after created nominal counfellor to prince Charles of Auftria, with a ftipend. Soon after this he paid a vifit to Bafil, where he formed an intimacy with fome valuable friends, which induced him to fpend his latter days in that place. At Bafil he publifhed, in the year 1516, his New Teftament, in Greek and Latin, which was received with the utmoft eagernefs by all thofe whofe minds were turned to theological purfuits. It was dedicated to Leo X. In the courfe of the fame year, his edition of St. Jerome, a favourite author, made its appearance, which he infcribed to his generous patron, archbifhop Warham. Erafmus was ever inimical to that fyftem of war which in his time, as in ours, was but too much in fafhion among the ambitious rulers of mankind; he publifhed, in 1517, a work entitled "Querela Pacis, undique gentium ejectæ profligatæque," which is written with much ftrength of reafoning and true eloquence. By his contemporaries he was charged with maintaining the unlawfulnefs of war on all and every occafion: this, however, was a calumny invented by his enemies, of whom he had many, for, in the work alluded to, he exprefsly fays he is fpeaking only of wars undertaken on trifling and unjuftifiable occafions. "I think," fays he, "very differently of wars, which are ftrictly and purely defenfive, fuch as with an honeft and affectionate zeal for the country, repel the violence of invaders, and at the hazard of life, preferve the public tranquillity." He was aware of the horrors and atrocities of a ftate of warfare, and thought almoft any facrifice might be made by wife princes to prevent it. He undertook to vindicate the caufe of peace, whom he makes the fpeaker on this occafion. But the arguments which he puts into her mouth, and the perfuafive eloquence with which fhe addreffes the fovereign princes of thofe dark times, as they are fometimes called, would fcarcely be borne by the monarchs of Europe in this enlightened age. His defcriptions are vivid, and his reflections but too juft: "Exuruntur vici, vaftantur agri, diripiuntur templa, trucidantur immeriti cives, dum princeps interim otiofus ludit aleam, dum faltitat, dum delectat fe morionibus, dum venatur, dum amat, dum potat. O Brutorum genus jam olim extinctum! O fulmen Jovis aut cæcum aut obtufum." To whom this is particularly applied it does not appear, but the "Querela Pacis" was occafioned by the following remarkable circumftance:

It was a favourite project at this period to affemble a congrefs of kings at Cambray, confifting of the emperor of Germany, the kings of France, England, and the Low Countries; "of which," fays the author, "I am a native. They were to enter into mutual and indiffoluble engagements to preferve peace with each other, and throughout Europe. This momentous bufinefs was very much promoted by William a Ciervia, and by one, who feemed to have been born to advance the happinefs of his country, and of human nature, John Sylvagius, chancellor of Burgundy. But certain perfons, who get nothing by peace, and a great deal by war, threw obftacles in the way which prevented this truly kingly purpofe from being carried into execution. After this great difappointment, I fat down and wrote, by defire of Sylvagius, my Querela Pacis." This work was dedicated to Philip of Burgundy, bifhop of Utrecht, who was likewife a zealous promoter of peace, and who, fo far from being offended with the free fentiments of the book, thanked the author, and even preffed him to accept a living, as a remuneration, which he civilly refufed. Erafmus fought no preferment, though, fays his biographer, he merited the higheft: he fought the happinefs of his fellow creatures, and felt himfelf abundantly rewarded by his own confcience,

and

and their approbation. The bishop, however, in token of his high esteem, sent him a most beautiful ring, set with a sapphire, which his own brother, his predecessor, in the bishopric, had constantly worn, and which he desired Erasmus to wear for his sake.

The commencement of the reformation, under Luther, was a circumstance of considerable importance in the life of Erasmus. He had shewn himself inimical to the superstitions of the times, he had arraigned the principles and practices of the monks, and had done much to undermine the whole system of popery, and to expose the various frauds which had been attached to its observance by avaricious and licentious priests; yet he was not prepared to join the reformers as such, his zeal was not sufficient to enable him to endure persecution: he did not wish to break openly from the church, nor was he quite satisfied with the doctrines of the reformers, and still less was he disposed to coalesce with the rudeness, vulgarity, and contempt of polite literature which characterized some of that class of people. It has also been said that he was very desirous of being noticed by the great, that he had habituated himself to that degree of indulgence, which would render the prospect of poverty and imprisonment absolutely insupportable to his mind. His income likewise arose almost entirely from pensions which he received from crowned heads, prelates, and men of consequence belonging to the Catholic persuasion, which he would unquestionably have lost had he gone over to the opposite side. These are the reasons which have been assigned why Erasmus did not come boldly forward in defence of the reformation; but with these deductions there is enough in his character to challenge the admiration and gratitude of the friends to liberty and the human race. He was ever the undaunted advocate of free enquiry, and perpetually waged war against the ignorance and bigotry that characterized the age in which he lived. On these accounts he was, in the first years of the reformation, highly regarded by Luther, and it was owing to some unadvised, and, probably, unwarranted attacks made upon Erasmus, about the year 1520, by the zealous reformers, that he was driven to enlist among the defenders of the church of Rome.

In the year 1522, he published his "Colloquies," which, though apparently intended for young persons, were generally read, and are supposed to have been very efficacious in promoting the principles of the reformation. As soon as their tendency was discovered, the clergy attempted to stop their sale, but it was then too late; more than twenty thousand copies of them were disposed of in Paris, besides a number of editions which were printed and sold in other places.

In 1524, Erasmus published his treatise, "De Libero Arbitrio," which was an avowed attack upon Luther's opinion concerning predestination, but the author, in his zeal, spoke against reformers in general; Luther replied, and had unquestionably the best of the argument: in some passages he seemed to commiserate the case of his antagonist, and to regret the necessity that he was under of exposing him. "We saw," says he, "that the Lord had not conferred upon you the discernment, the courage, and the resolution to join us in opposing those monsters, and therefore we dared not to exact from you that which greatly surpasses your strength and capacity." He then refers to the motives of worldly interest by which Erasmus had suffered himself to be swayed from the path of rectitude. The controversy increased in violence, and much unjustifiable acrimony proceeded from the pens of the disputants. Under the article REFORMATION we shall have occasion to enter more at large into this subject, and also into the controversy between Erasmus and Melancthon.

Another antagonist with whom our author had to contend was Julius Cæsar Scaliger, who had put himself at the head of those who were so fastidious in the use of pure Latin as to reject every word not to be found in the works of Cicero, and who on that account had assumed the title of "Ciceronians." Erasmus, superior to this pedantry, employed new words for new ideas, and in justification of his conduct published, in 1528, a dialogue entitled "Ciceronianus," in which he attacked the sect both with argument and ridicule. Scaliger wrote against him with all the malignity that human wit and learning could devise, and he was backed in his scurrility by others of the Ciceronians less able in the warfare, but not less inveterate than their master. The nature of this controversy is fairly exhibited in the notes on the life of Erasmus by Bayle.

Erasmus, wearied, perhaps, by disputation, published, in a short time after his "Ciceronianus" had made its appearance, a treatise of much ability and learning, entitled "De Recta Latini Græcique sermonis Pronunciatione." In the year 1529, Erasmus left Basil for Friburg, in order to shew his attachment to the church which had for some years been losing ground in Basil, and so completely had the reformed religion gained an ascendancy there at this period, that all the images were taken from the town-house and other public places and burnt, which was supposed to have been the means of putting an end to the differences among the common people. Erasmus was now advancing in life, and seemed, more than ever, fearful of being thought friendly to the reformation, and to shew his zeal for the opposite system he wrote and published an epistle against some "who falsely call themselves Evangelists," and as they, from his former works, had produced his authority against persecution, he began to maintain that there were certain cases in which they might lawfully be punished capitally as blasphemers and seditious persons. Such were the unworthy steps to which he was led by an anxiety to keep on good terms with his patrons and protectors.

In 1535 he returned to Basil, and so highly was he esteemed by the church of Rome, that there was an intention to give him a place in the college of cardinals; but it was too late for him to accept of the high honour. His health rapidly declined, and on July 12, 1536, he died of a dysentery at the age of sixty-nine. He was buried with great funeral pomp in the cathedral church of Basil, where his tomb still remains. By his will he left legacies to several friends, and the residue of his property he devoted to charitable purposes. In person he was below the middle size, well-shaped, of a fair complexion, with a chearful countenance, a low voice, and agreeable elocution. He had assumed the name of Erasmus in conformity with the pedantic taste then prevailing among men of letters of taking names of Greek or Latin etymology; he translated his name of "Gerard," signifying "Amiable," into the equivalent ones of "Desiderius" in Latin, and "Erasmus" in Greek, making use of both, but the latter was his common and perpetual appellation.

Erasmus was a voluminous writer; and his works were published in nine volumes folio. They consist of numerous translations from the Greek; of grammatical and philological pieces; of poems, declamations, and orations; of a collection of adages and apophthegms; of works in divinity on various topics, moral, didactic, and controversial; of a version of the New Testament, paraphrases of the gospels and the epistles, and commentaries on some other parts of scripture; and of apologies, epistles to correspondents, &c. A new and handsome edition of his works was published in Holland by Le Clerc in eleven volumes folio,

1703.

1703. Dr. Jortin, the biographer of Erafmus, fpeaking of his Latin ftyle, fays, it "is that of a man who had a ftrong memory, a natural eloquence, a lively fancy, and a ready invention, who compofed with great facility and rapidity, and who did not care for the trouble of revifing and correcting; who had fpent all his days in reading, writing, and talking Latin; for he feems to have had no turn for modern languages, and perhaps he had almoft forgotten his mother-tongue. His ftyle, therefore, is always unaffected, eafy, copious, fluent, and clear; but not always perfectly pure and ftrictly claffical."

No one contributed fo much as Erafmus to throw difcredit upon the barbarifm and ignorance of the fchools, or to make literature agreeable, and connect it with good fenfe and folid criticifm. He was a great public benefactor; and therefore he is juftly regarded as one of the principal glories of his age and country. His memory is equally honoured at the place of his birth and of his death. Several of his relics are preferved at the latter place, and at the former, the houfe in which he was born, is marked with an infcription, and his ftatue decorates the great fquare. Jortin's life of Erafmus. Bayle. Complaint of Peace. 1802.

Erasmus, in *Geography*, a mountain of the ifland of Ceylon; 30 miles N.W. of Trincomaly.

ERASTIANS, in *Ecclefiaftical Hiftory*, a religious fect or faction, which arofe in England during the time of the civil wars, thus called from their leader, Thomas Eraftus, a German divine of the fixteenth century, whofe diftinguifhing doctrine was, that the church had no right to difcipline, that is, no regular power to excommunicate, exclude, cenfure, abfolve, decree, or the like.

According to the founder of this fect, the paftoral office was only perfuafive, like a profeffor of the fciences over his ftudents, without any power of the keys annexed. The Lord's fupper and other ordinances of the gofpel were to be free and open to all. The minifter might diffuade the vicious and unqualified from the communion, but might not refufe it, or inflict any kind of cenfure; the punifhment of all offences, either of a civil or religious nature, being referved to the magiftrate. The pretended advantage of this fcheme was, that it avoided erecting *imperium in imperio*, or two different powers in the fame civil government; it effectually deftroyed all that fpiritual jurifdiction and coercive power over the confciences of men, which had been challenged by popes, prelates, prefbyteries, &c. and made the government of the church "a creature of the ftate." Moft of our firft reformers adopted thefe fentiments fo far as to maintain, that no one form of church government is prefcribed in fcripture as a rule for future ages, as Cranmer, Redmayn, Cox, &c. and archbifhop Whitgift, in his controverfy with Cartwright, delivers the fame opinion. The Eraftians formed a party in the Affembly of Divines in 1643, and the chief leaders of it were Dr. Lightfoot, Mr. Colman, Mr. Selden, and Mr. Whitlock; and in the houfe of commons there were, befides Selden and Whitlock, Oliver St. John, efq., fir Thomas Widdrington, John Crew, efq., fir John Hipfley, and others of diftinguifhed reputation. In the affembly, the Eraftians did not except againft the prefbyterian government as a "political inftitution," proper to be eftablifhed by the civil magiftrate, but they were againft the claim of a "divine right." Accordingly the claufe of divine right was loft in the houfe of commons. Neales's Hift. Purit vol. ii. 4to.

ERASTUS, Thomas, in *Biography*, a phyfician, was born, in 1523, at Auggenen, a village in the diftrict of Badenweiller, in Switzerland. He ftudied at Bafil, where he was feized with the plague in 1542, and narrowly efcaped death. He fuffered a long and tedious convalefcence, which, together with his poverty, threw an almoft infurmountable impediment in the way of his ftudies; but he fortunately found a generous protector, who opened the door of the fciences to him, and furnifhed him with the means of travelling to Italy. He took up his refidence at Bologna, where his proficiency in the ftudy of philofophy and medicine was fuch, that he obtained the honour of the degree of doctor of thefe two fciences. Finding himfelf in a fhort time holding a diftinguifhed fituation among the men of learning, he followed the cuftom of the times by changing his name; giving a Greek turn to his original name, which was Lieber, (beloved,) he called himfelf Eraftus. Under this appellation he became a teacher of medicine at Heidelberg, where he obtained confiderable reputation; and in 1581 he was called to fill the medical chair in the univerfity of Bafil. But this honourable fituation he did not long enjoy; he died on the 1ft of January, 1583.

He left many works behind him, of which fome were printed during his life, and others have been publifhed fince his death; their contents, however, are not particularly interefting; the following is a lift of their titles and editions. "Difputationum de Medicina nova Phillippi Paracelfi," p. i. Bafil, 1572, p. ii. ibid. 1572, p. iii. ibid. 1572, p. iv. et ultima, ibid. 1573, all in 4to. In thefe volumes he refutes the doctrines which Paracelfus had previoufly taught at Bafil, and had committed to writing. 2. "De Caufa Morbor. Continente," 4to. 1572. 3. "De Occult. Pharmacor. Poteftatibus," 4to; ibid. 1574; Francofurti, 1611. 4. "Difputat. de Auro Potabili." 4to. Bafil, 1578, 1594. 5. "De Putredine Liber," 4to. ibid. 1580; Lipfiæ, 1590. 6. "Epiftola de Aftrologia Divinatrice," 4to. Bafil, 1580. 7. "De Pinguedinis in Animalibus Generatione et Concretione," 4to. Heidelbergæ, 1580. 8. "Comitis Montani, Vicentini, novi Medicorum cenforis, quinque Librorum de Morbis nuper Editorum Viva Anatome," 4to. Bafil, 1581. 9. "Ad Archangeli Mercenarii Difputationem de Putredine refponfio," 4to. ibid. 1582. 10. "Varia Opufcula Medica," folio, Franc. 1590. See Eloy Dict. Med. Biog. Dict.

ERATO, from ερανω, *I love*, in *Mythology*, the name of one of the nine Mufes who prefided over love-poetry. "By Erato," fays Callimachus in his epigram on the nine Mufes, "the pious hymn was made." To this Mufe fome have afcribed the invention of the lyre and lute; but particularly the pfaltery or long lyre of nine ftrings; and fhe is reprefented with a garland of myrtles and rofes, holding a lyre in one hand, and a bow in the other, and at her fide a Cupid with his torch. In the portraits of Apollo and the Mufes, dug out of Herculaneum, Erato is exhibited holding a plectrum or bow in her right hand, and feeming to play with the fingers of her left. The pfaltery, or lyre, is more than twice the length of that in the hand of Terpfichore. (See Muses.) There is alfo a Nereid of the fame name.

ERATONOS, in *Ancient Geography*, iflands of the Arabic gulf. Pliny defignates their aridity by the epithet *Sitientes*.

ERATOSTHENES, in *Biography*, an eminent Greek mathematician, philofopher, and chronologift, was born at Cyrene in the fecond year of the 126th olympiad, or 275 B. C. He was educated under Arifto, the philofopher of Chios, and Callimachus, the poet; and he himfelf had feveral difciples who were eminent, and among the number was Ariftophanes of Byzantium, one of the moft celebrated grammarians of his time. Such was the fame of Eratofthenes as a man of extenfive erudition, that he was denominated πενταθλος, *i. e.* victorious in five contefts, alluding to to the five prizes of the Olympic games, and expreffing his pre-eminence in all kinds of literary purfuits. He was alfo ftyled the cofmographer and father of chronology, the meafurer of the univerfe, and the fecond Plato. On the invitation of Ptolemy Euergetes, he removed from Athens to Egypt, and fucceeded Zenodotus in the office of librarian to the famous library at Alexandria. This office he retained under three fucceffive princes, difcharging his truft with fingular honour, and acquiring high reputation for literature and fcience by his writings and difcoveries. Availing himfelf of the multitude of hiftorical memoirs, which the library furnifhed, he was both prompted and enabled to determine the dates of many diftinct facts, by laying down certain chronological canons, for which fee CHRONOLOGY. He alfo employed his eminent abilities and learning, with equal fuccefs, in reducing geography to a regular fyftem, and laying its foundation upon clear and folid principles. He likewife firft introduced into his map a regular parallel of latitude, which was a geographical outline traced over certain places, whofe longeft day was obferved to be exactly of the fame length. He began it from the ftraits of Gibraltar, and it thence paffed through the Sicilian fea, and near the fouthern extremities of Peloponnefus, and was continued through the ifland of Rhodes and the bay of Iffus, and then entering Cilicia, and fo croffing the Euphrates and Tigris, was extended to the mountains of India. By means of this line he endeavoured to rectify the errors in the ancient geographical map, fuppofed to be that of Anaximander. In drawing this parallel, he was regulated by obferving when the longeft day confifted of $14\frac{1}{2}$ hours, which Hipparchus afterwards determined to be the latitude of 36°. The running of this parallel through Rhodes was a happy thought of Eratofthenes, becaufe it not only encouraged him to trace upon his map other parallels at certain intervals from his firft, fuch as one through Alexandria, another through Syene, and another through Meroe, but he undertook to trace at right angles to thefe a meridian paffing through Rhodes and Alexandria down to Syene and Meroe. His progreffion this way enlarged his ideas with regard to the fciences of geography and aftronomy, and induced him to attempt a more arduous tafk, which was that of determining the circumference of the globe by an actual meafurement of one of its great circles, making his computation upon the whole by uniting certain accurate obfervations made in the heavens with a correfponding diftance carefully furveyed, and taken upon a meridian of the earth. The fegment of the meridian which he fixed upon for this purpofe, was that between Alexandria and Syene, the diftance of which was meafured, and found to be 5000 ftadia, and the angle of the fhadow upon the fcaphia, or fun-dial, which was obferved at Alexandria, was equal to the 50th part of the circle; for at Syene there was no fhadow from the gnomon at the mid-day of the fummer-folftice; and that this might be more accurately taken, they dug a deep well, which being perpendicular, was completely illuminated at the bottom, when the fun was vertical. The fubftance of this account was taken from Cleomedes, who feems to have extracted it from Eratofthenes's original work, entitled Μετρησεις. (See Fabr. Bell. Græc. vol. ii. p. 477.) And it is publifhed as fuch at the end of the Oxford edition of Aratus in 1672, though under the title of Μετρον της γης περιφερειας. By this account Eratofthenes made the circumference of the earth amount only to 250,000 ftadia, whereas a multitude of original authors, (fuch are Strabo, Geminus, Vitruvius, Macrobius, Pliny, Capella, and Cenforinus,) have uniformly given the numbers to be 252,000. In order to reconcile thefe differences, Dr. Murdoch (Enquiries concerning Meafures of length, prefixed to Bufching's Geography, vol. i.) has ingenioufly fuppofed, that inftead of 7° 12′, the difference of latitude was 7° $8\frac{1}{2}$′, which was the $\frac{1}{50}\frac{2}{5}$th of the circumference, which would bring the calculation to 252,000 ftadia, and that Cleomedes neglected the fmall fractional part of the denominator; but that the principal miftake was in meafuring the diftance, and finding it to be 5000 ftadia. Eratofthenes, by making the circumference to be 250,000 ftadia, allowed 700 ftadia to a degree, which, by the reduction of 8 ftadia to a Roman mile of 5000 feet, amounted to $87\frac{1}{2}$′ Roman miles to each degree. We fhall return from this digreffion, after obferving, that the map of Eratofthenes appears to have contained little more than the ftates of Greece, and the dominions of the fucceffors of Alexander, digefted from preceding furveys. He had feen indeed, and has quoted the voyages of Pytheas into the great Atlantic ocean, which gave him fome faint idea of the weftern parts of Europe: but they were fo imperfect, that they could not be realized into the outline of a chart. Strabo tells us that he was extremely ignorant of Spain, Gaul, Germany, and Britain, as well as of the Gæti and Baftarni; he was equally ignorant of Italy, the coafts of the Adriatic, of Pontus, and of all the countries towards the north. And he mentions in another paffage, that Eratofthenes had made the diftance from Epidamnus, or Dyrrhachium, on the Adriatic, to the bay of Thermæ on the Ægean fea, quite acrofs Epirus, to be only 900 ftadia, when it was really above 2000 ftadia; and in another inftance he had enlarged the diftance from Carthage to Alexandria to be 15,000 ftadia, whereas it amounted to no more than 9000 ftadia.

Eratofthenes alfo obferved the obliquity of the ecliptic, which, in the year 230 B. C. he makes 23° 51′ 20″. (See ECLIPTIC.) In an epiftle to king Ptolemy he gave a folution of the problem for the duplication of the cube; and he invented a convenient method of difcovering the primary numbers, that is, fuch as have no common meafure but unity, which has been called the fieve of Eratofthenes. He wrote alfo numerous treatifes in grammar, aftronomy, hiftory, and geography, together with dialogues on the philofophical fects, and poems. Fragments merely of his different pieces have reached our times, fome of which were publifhed at Oxford in 1672, with brief annotations, in 8vo. Thefe fragments were alfo printed in the Uranologium of Petavius at Paris in 1630, and afterwards at Amfterdam in 1703. The moft valuable remnant of his works is his "Catalogue of the kings of Thebes in Egypt, from Menes, who firft peopled Egypt after the deluge, to the time of the Trojan war." This contains a feries of 38 kings in a direct line of fucceffion, taken not only from the records in the Alexandrian library, but from the facred archives in Diofpolis, or Thebes itfelf, and probably intended for fupplying the defects, and correcting the errors of Manetho's dynafties. This has been ufed by fome of our ableft chronologers as an authority for fettling the Egyptian chronology. Eratofthenes died at the advanced age of 80 or 81, having, as fome authors report, ftarved himfelf to death, becaufe he was unable to bear the depreffion of fpirits occafioned by the decay of his fight. Suidas. Voff. de Hift. Græc. Fab. Bib. Græc. Moreri. Anc. Un. Hift. Gen. Biog.

ERBACH, in *Geography*, a fmall town of Germany, in the circle of Franconia, anciently called Erdtpach, with an old caftle, belonging to the counts of Erbach, who, before the diffolution of the German empire, had two voices at the diet of Ratifbon, in the college of the imperial counts of Franconia. The whole county is about 25 miles in length, and 20 miles in breadth; its population does not exceed the number

number of 30,000 individuals. It is a mountainous country, but tolerably fertile, and producing both corn and wine; of the latter, that of Schonberg, near the Bergftraffe, is reckoned the beft.

ERBAT, a town of Afiatic Turkey, in the province of Diarbekir; 58 miles S.E. from Diarbek.

ERBAZ, a town of Afiatic Turkey, in the province of Natolia; 36 miles W.S.W. from Degnizlu.

ERBITA, in *Ancient Geography*, a town of Sicily, written Herbita by Cicero. It is thought to be the modern *Nicofia*.

ERBLSPACH, or Erlsbach, in *Geography*, a town of Germany, in Lower Bavaria; 34 miles E.S.E. from Ingolftadt.

ERCABUM, in *Ancient Geography*, a town of European Sarmatia. Ptolemy.

ERCE', in *Geography*, a town of France, in the department of the Ille and Vilaine, and diftrict of Bain; 5 miles E. from Bain.

ERCEUS, of ἑρκος, *feptum*, in *Mythology*, the name by which thofe who were appointed to guard the walls of a city invoked Jupiter. This appellation, fometimes written *Herfæus*, was given to Jupiter, becaufe his altars, efpecially in the houfes of princes, ftood under the open air in places inclofed with walls.

ERCHEE, in *Geography*, a town of Perfia, in the province of Adirbeitzan; 60 miles E.N.E. of Tauris.

ERCILLA Y ZUNIGA, Don Alonzo de, in *Biography*, an eminent Spanifh poet, was born at Madrid in 1533. His father, defcended from a noble family, purfued the profeffion of the law, but dying while Alonzo was an infant, the child and his mother were received into the houfehold of Ifabella, wife of Charles V. Alonzo, as foon as his years permitted, was made page to the infant don Philip, whom he attended in his progrefs through the Low Countries, and part of Germany and Italy. He afterwards accompanied the fame prince to England, to celebrate his marriage with queen Mary. During their ftay here intelligence was received of a revolt in Chili, upon which troops were immediately fent off, with whom Ercilla embarked and proceeded to Lima. His duty required him perfonally to engage in a fubfequent war with the Araucanians, whofe courage and love of liberty he admired, and even applauded, though he was under the neceffity of ufing all his efforts in fubduing them. The intervals of warfare he employed in recording, in heroic verfe, the interefting fcenes to which he was witnefs. After he had efcaped the dangers of the expedition, he had nearly loft his life at a tournament exhibited in honour of the acceffion of Philip II. During the fête a difpute arofe between Ercilla and another gentleman; fwords were drawn, and many joined in the conflict, which being conftrued into a plan of mutiny by the governor, he haftily, and without examining into the matter, condemned the principal difputants to be beheaded. Ercilla was led to the fcaffold, and his innocence was demonftrated but juft in time to fave him from an ignominious death. He returned to Spain with his health very much impaired, in his twenty-ninth year; but after a very fhort ftay at home, he commenced a tour through various parts of Europe; but with what particular view has never been afcertained. In 1570 he married, and was made gentleman of the bed-chamber to the emperor Rodolph II. Ten years after this, he was found refiding at Madrid, in retirement and poverty. The king whom he had ferved, and to whom he dedicated his poem "Araucana," made him no requital for his fervices, and little more is known of him, than the mention made by a contemporary of his being engaged, in 1596, in celebrating the victories of the marquis of Santa Cruz, in a poem that has never been publifhed.

The "Araucana" is an hiftorical poem, containing a narrative of real events, interfperfed with fabulous circumftances. It contains 37 cantos, is formed on no regular plan, but is an unconnected feries of adventures. The verfe is faid to be flowing and fpirited, though fometimes it is profaic and infipid. Mr. Hayley, in his Effay on Epic Poetry, has taken pains to make Ercilla known to the Englifh reader, by tranflations of felect parts, and an analyfis of the whole poem. Gen. Biog. Hayley on Epic Poetry.

ERCTA, in *Ancient Geography*, a mountain of Sicily, near mount Erix. Diod. Sic. Polybius.

ERCYNA, a river of Greece, in Bœotia, not far from the cave of Trophonius.

ERDENI-TCHAO, in *Geography*, a town of Chinefe Tartary, in the country of the Eluths; 680 miles N.W of Pekin.

ERDER, a town of Germany, in the circle of Weftphalia, and country of Lippe; 12 miles N.N.E. from Lemgow.

ERDMANSDORF, a town of Germany, in the circle of Upper Saxony, and circle of Erzgeburgh; 5 miles E. of Chemnitz.

EREBENNUS, ἐρεβεννός, a name given by Galen and fome other of the Greek writers, as a diftinctive epithet for the black chamæleon thiftle, which was efteemed poifonous, and was by this word diftinguifhed from the ægleus, or αἰγληις, or white chamæleon, which was an efculent plant, and ufed by fome as an antidote. It has happened, however, that the white chamæleon thiftle has been by fome called a poifon, as well as the black; but this is only owing to a miftake of Pliny, in fuppofing the effects of birdlime to have been attributed to this plant, becaufe of its yielding a vifcous, but fafe gum, at its root. It was called by fome *ixias chamæleon*. See Ixias.

EREBINTHUS, in *Botany*, (ἐρέβινθος, an ancient Greek name for fome kind of vetch or legume), was applied by Mitchel to a fuppofed new genus of his own, which is the *Galega virginiana* of Linnæus. The latter in his Sp. Pl. inaccurately quotes Mich. Gen. which fhould mean Micheli, and profeffor Martyn, under his *Galega*, fp. 4, has Mant. Gen. both which would be unintelligible without an explanation

EREBUS, Ερεβος, from ערב, *night*, in *Mythology*, a term denoting darknefs. According to Hefiod, Chaos engendered Erebus and Night, from whofe mixture was born æther and the day. Ariftophanes, ridiculing fome ancient fyftem of theogony, in his comedy of the Birds, introduces one of his actors as faying, that in the beginning were the Chaos, the black Erebus, and the vaft Tartarus; but as yet there was neither earth, nor air, nor heavens. Night, with her fable wings, laid the firft egg in the womb of Erebus, whence fprung, after fome time, beneficent love, adorned with golden wings. From the union of love with chaos, arofe men and animals. This was alfo the name of part of the inferi among the ancients: they had a peculiar expiation for thofe who were detained in Erebus.

Erebus was properly the gloomy region, and diftinguifhed both from Tartarus, the place of torment, and Elyfium, the region of blifs: according to the account given of it by Virgil, it forms the third grand divifion of the invifible world beyond the Styx, and comprehends feveral particular diftricts, as the limbus infantum, or receptacle for infants; the limbus for thofe who have been put to death without caufe; that for thofe who have deftroyed themfelves; the fields of mourning, full of dark groves and woods, inhabited by those who died for love; and beyond these, an open champaign country for departed warriors. Æn. lib. vi. p. 427. &c.

EREC, or Erech, in *Ancient Geography*, a town of Chaldæa, which is mentioned in the book of Genesis (ch. x. v. 10.) as one of the places in which Nimrod began to establish his kingdom. This was probably the Aracca, placed by Ptolemy in Susiana, on the river Tigris, below its confluence with the Euphrates. Ammianus calls it Arecha. From this city the Arectæan fields, which abound with Naphta, and sometimes take fire, derive their name.

"Ardet Arectæis aut unda per hospita campis."
Tibull.

Erec, a province of Asia, which extended on both sides along the common bed of the Tigris and Euphrates, from their junction to the sea.

ERECT Flowers, in *Botany*, are such as grow upright, without hanging or reclining the head. See Flower.

Erect *leaf*, *erectum folium*. See Leaf.

Erect, in *Fortification*. The defences of a face, in fortification, are said to be erect when the several works bear directly and regularly upon the approaches, in such manner as to tend uniformly towards the capital, from which they are drawn respectively. Thus, when the two bastions which defend a curtain are equal and similar, and the raveline, with all its dependencies, stands evenly upon the line, or capital, of that face, without obliquity, or curve, the whole of such defences are said to be erect. It will be readily understood, that in every regular fortification the whole of the defences will be of this description: and that in all irregular fortifications there will probably be a mixture of erect and of oblique defence. The latter is by no means to be considered a defect; since innumerable cases might occur in which the prolongation, or the curtailment of any particular part, such, for instance, as the face or flank of a bastion, might be indispensably necessary, either to make way for some natural advantage, or to prevent that kind of weakness which might otherwise be entailed by the proximity of some height, whence enfilading might be successfully practised. When, therefore, the two bastions are dissimilar, or when they are unequal, so as to render the flanked angle of either less distant on the capital, if a line of defence were to be drawn upon, and formed from, the two extremities of such unequal bastions, the raveline must either stand a little obliquely, or the bastions must be unequally protected by it. This kind of obliquity is extremely rare, and is often neglected where great accession of strength might otherwise, by its adoption, be given to weak parts: it is peculiarly appropriate to fortresses, of which only one or two faces are understood to be subject to approach.

Erect *Vision*, in *Optics*. See Vision.

Erect, *direct*, and *declining*, &c. *dials*, &c. See Dial.

ERECTHEUS, in *Biography*, is reckoned the 6th king of Athens, from Cecrops its founder, and is supposed to have succeeded his father Pandion about the year 1397 B. C. Some have referred to this reign the arrival of Ceres in Attica, after the rape of her daughter Proserpine, who taught the cultivation of corn, about the year 1383 B. C. and the institution of the Eleusinian mysteries. Erectheus reigned 50 years, and was slain in a battle with the Eleusians.

ERECTHIA, in *Ancient Geography*, a municipal place of Greece, in Attica, belonging to the Egeid tribe, and deriving its name from king Erectheus. It was the native place of the orator Isocrates.

ERECTION, the act of raising or elevating a thing in a right line.

The erecting of a perpendicular on a line given, is a popular problem in geometry. See Perpendicular.

The term erection is also used figuratively; as the erection of a marquisate into a duchy; bishoprics can only be erected by the king.

Erection, in *Physiology*, is the change in the state of the male penis, by which that organ is rendered capable of entering the vagina of the female, for the purposes of sexual intercourse. See Generation.

ERECTOR, in *Anatomy*, a name given to two muscles supposed to possess the power of bringing the organs with which they are connected into an erect state. They are the erector penis of the male, and erector clitoridis of the female subject. See Generation.

ERECTUM, Folium, in *Botany*. See Leaf.

ERECTUS, Caulis, an upright stem. See Caulis, *n.* 6.

EREGEM, in *Geography*, a town of Flanders; 10 miles S.W. of Bruges.

EREGMOS, from ερεικω, *I break*, a word used by the ancients to express a bean decorticated and broken into small pieces, in order to be boiled in ptisans; and also applied indifferently to all the leguminous fruits broken in the same manner.

EREKLI, in *Geography*, a town of Asiatic Turkey, in the province of Caramania; 60 miles E. of Cogni.

EREMEGIKE, a town of Asia, in Thibet; 25 miles S. of Tourfan.

EREMIT. See Hermit.

ERES, or Eris, in *Geography*, a town of Persia, in the province of Schirvan, on the borders of Armenia; 80 miles S.W. of Derbend, and 120 S.E. of Teflis.

ERESIA, in *Botany*, a name given by Plumier to a new American genus, Nov. Gen. 8. t. 25, in honour of the Grecian botanist Theophrastus Eresius; but Linnæus, and all succeeding writers, have, with the greatest possible propriety, called the plant *Theophrasta*, whch see.

ERESMA, in *Geography*, a river of Spain, which runs into the Duero, between Simancas and Tordesillas.

ERESOS, in *Ancient Geography*, a town of the island of Lesbos, which was the native place of Theophrastus.

ERESUS, or Ebusus, a town of the island of Ebusus, founded by a colony of Carthaginians. Its harbour was commodious, its walls very large, and its houses well built.

ERETENUS, a river of Italy, in Venetia, famous, according to Ælian, for its excellent eels, and supposed to be the present Retona.

ERETHISMUS, (from ερεθιζω, to *irritate*, or *excite*). Medical writers extend the general meaning of this term to every kind of irritation which has a tendency to weaken and destroy the vital powers.

In this article we intend to take particular notice of a dangerous affection of the constitution, well known among surgeons by the name of the *mercurial* erethismus.

Mr. Pearson acquaints us, that on his first succeeding to the situation of surgeon to the Lock hospital, he had occasion to remark, that almost every year one, and sometimes two instances of sudden death occurred among the patients of that charity. No cause could be assigned for these events, but the subjects were commonly observed to be men who had either nearly, or completely finished a course of mercury. Messrs. Bromfield and Williams, on being consulted by Mr. Pearson, concerning these extraordinary cases, confessed themselves ignorant of the cause, mode of prevention, and treatment, and explained, that they had never been able to detect any diseased appearances in the bodies of such persons as had died in this sudden and unexpected manner.

Mr.

Mr. Pearſon at length aſcertained, that theſe unfortunate accidents were to be aſcribed to mercury acting as a poiſon on the ſyſtem, quite unconnected with its operation as a remedy; and that its deleterious qualities were neither in proportion to the inflammation in the mouth, nor to the actual quantity of mercury abſorbed into the conſtitution. The diſordered ſtate of the ſyſtem, implied by the mercurial erethiſmus, comes on after a long employment of mercury, and tends to a fatal termination. According to Mr. Pearſon, it is characterized by great depreſſion of ſtrength, a ſenſe of anxiety about the præcordia, irregular action of the heart, frequent ſighing, partial or univerſal trembling, a ſmall, quick, and ſometimes an intermitting pulſe, occaſional vomiting, a pale contracted countenance, a ſenſe of coldneſs; but the tongue is ſeldom furred, and the vital and natural functions are not much diſordered.

Mr. Pearſon obſerves, that when theſe, or the greater part of theſe ſymptoms are preſent, a ſudden and violent exertion of the animal power will ſometimes prove fatal. Walking haſtily acroſs the ward; riſing up ſuddenly in the bed to take food; or ſlightly ſtruggling with ſome of the other patients, are circumſtances noticed by the above gentleman as having commonly preceded the ſudden death of ſuch perſons as have died of the mercurial erethiſmus.

In order to avert the perilous effects of this peculiar affection, Mr. Pearſon ſtates, that the employment of mercury is, at all events, to be diſcontinued, whatever may be the ſtage, extent, or violence of the venereal ſymptoms. Every conſideration muſt yield to the great object of extricating the patient from a ſtate of impending deſtruction; nor would a perſeverance in the uſe of mercury, under theſe circumſtances, be of any avail, in regard even to the ſyphilitic complaints.

The patient ſhould be expoſed to a dry, cool air, without being ſubjected to any more fatigue than can be avoided. Mr. Pearſon contends, that ſitting in a room with a window open is not ſufficient, but that the patient ſhould go into a field or garden, and live as much as poſſible in the open air, till the above ſymptoms have diſappeared. This plan ſhould be conjoined with a generous diet. In this way patients have often been ſufficiently relieved in the ſhort ſpace of ten or fourteen days, to re commence the employment of mercury, and to bear its exhibition effectually, without any bad conſequences.

The gradual approach of the mercurial erethiſmus is commonly indicated (according to Mr. Pearſon's account) by paleneſs of the countenance, a ſtate of general inquietude, and frequent ſighing: the reſpiration becomes quicker, ſometimes accompanied with a ſenſe of conſtriction acroſs the cheſt; the pulſe is ſmall, frequent, and often intermitting, and there is a ſenſe of fluttering about the præcordia. In this early ſtage the further progreſs of the mercurial erethiſmus may be frequently prevented by the exhibition of the camphor mixture with large doſes of the volatile alkali, the employment of mercury being at the ſame time ſuſpended. Alſo, when the ſtomach is not oppreſſed by ſarſaparilla, this medicine is productive of infinite benefit to perſons afflicted with the mercurial erethiſmus. See Pearſon on the "Effects of various Articles of the Materia Medica in the cure of Lues Venerea," edit. 2. p. 155 to 159.

ERETRIA, in *Ancient Geography*, a town of Greece, in the Phthiotide, a country of Theſſaly.

Eretria, a town of the iſland of Eubœa, ſituated on the ſea-coaſt at ſome diſtance to the ſouth-eaſt of Chalcis, oppoſite to the mouth of the Oropus, which, on the continent, ſeparates the limits of Bœotia from thoſe of Attica. This town was probably built by the Athenians, as Strabo ſays, before, but according to Herodotus, after the war of Troy. It was for a long time a conſiderable place, and remained in a flouriſhing ſtate under the reign of Darius, ſon of Hyſtaſpes. It was deſtroyed by the Perſians in the war of Greece, but was afterwards rebuilt, became very rich, and ſubſiſted in the time of Strabo. It was amply furniſhed with pictures, ſtatues, and ſuch ornaments. We cannot trace any remains, except a perſuaſion that it exiſted in a place called by the modern Greeks *Gravelainas*.

Eretria *terra*, *Eretrian earth*, in the *Materia Medica*, the name of a very peculiar kind of alkaline bole, dug in the Negropont, near the ancient Eretria, and once in great uſe as an aſtringent and a ſudorific.

The ancient writers in medicine all mention the Eretrian earth, and Dioſcorides and Galen deſcribe two kinds of it, a grey and white. The grey is what is properly diſtinguiſhed by this name, being an earth of a different kind from all the other boles. The white, though the ancients ſeem not to have obſerved it, yet was plainly, from their own deſcriptions, the ſame with the white bole armenic, though found in a different place. Hill's Hiſt. of Foſſ. p. 5.

The grey or genuine Eretrian earth is a fine and pure greyiſh white earth, moderately heavy, naturally of a ſmooth ſurface, of a friable texture, eaſily crumbling to pieces between the fingers, but not ſtaining the ſkin in handling; it ſticks firmly to the tongue, but melts to a butter-like ſubſtance in the mouth; it burns to a perfect ſnow-white, and effervеſces violently with aqua-fortis. But what abundantly diſtinguiſhes it from all other earths is, that if a little be wetted, and drawn over a plate of braſs or copper, ſo as to mark a line, the mark will in a little time appear blueiſh. This is recorded of it ſo early as in the writings of Dioſcorides, and experiment proves it to be true. It ſeems plainly to be owing to an alkaline quality in the earth; this it plainly manifeſts by its fermenting ſo ſtrongly with acids; and it is as well known that alkalines draw a blue tincture from copper.

The ancients all eſteemed it a great medicine, and were particularly careful in their way of preparing it for uſe, by frequent waſhing. It is now unknown in the ſhops, but its highly alkaline quality, in which it is ſo much ſuperior to all the earths in uſe, might make it worth the bringing into uſe again; and it may ſtill be had in its old place, in almoſt any quantities.

ERETRIAC School, in the *Hiſtory of Philoſophy*. See Eliac *School*.

ERETRUM, in *Ancient Geography*, a town of Italy, in the country of the Sabines, N. E. of Rome, and S. W. of Cures. Strabo preciſely marks its ſituation, when he ſays that it was on the Via Salaris, and that the Via Nomentana terminated there. It was at a ſmall diſtance from the Tiber, near the 18th mile ſtone, according to the tables of Antonine and Peutinger.

EREUATIS, a town of Aſia Minor, in Lycia.

EREUM, a town in the iſland of Sardinia.

EREWASH-Canal, in *Geography*, is the parliamentary name of an important line of canal navigation, which nearly divides the counties of Derby and Nottingham for about twelve miles, of which an account has been given under our article Canal, to this it may be neceſſary to add, that by the act of the 29th George III. for Cromford canal, the tolls on this canal for all articles, except coals and coke, were lowered to one-half of thoſe mentioned in the original act, it being provided that no ſupplies of water to the canal ſhould be taken for the uſe of the Cromford canal, except at thirty feet below the ſummit level of this. Upon this canal the very important experiment was tried, at Ilkerton common, of ſuffering the coal-owners to work their coal under the canal inſtead of paying large ſums in order to have the ſame left, as the act had provided, and a great length has been thus excavated and the ground ſettled, with only a trifling and temporary inconvenience to the canal, in raiſing the banks; on the Nottingham canal the ſame was alſo ſucceſsfully tried, even under the locks, on the recommendation of Mr. Thomas Walker; ſee *Nottingham canal.* A rail-way branch conducts from the head of this canal to Beggarlea and another to Old Brinſley collieries in Nottinghamſhire; and another, conſtructed in 1808, to the new collieries in Cotmanbury-wood in Derbyſhire.

EREZE'E, a ſmall town of France, in the department of the Sambre and Meuſe, chief place of a canton in the diſtrict of Marche, with a population of 640 individuals. Its canton has a territorial extent of 272½ kiliometres, 13 communes, and 4519 inhabitants.

ERFA, a town of the iſland of Corſica; 25 miles N.N.W. of Baſtia.

ERFURT, or Erfort, anciently called *Erpes*, or *Erpisfurt*, a very old town of Germany, in Thuringia, on the river Gera, 60 miles N. by E. of Coburg. N. lat. 51° 6′. It appears to have been founded in the beginning of the fifth century. The emperor Lewis held a diet at Erfurt in the year 852. The emperor Henry I. did the ſame in 935, and Rudolph I. in 1289. The laſt diet of the empire held at Erfurt was that of the year 1566. Erfurt was not an immediate free imperial city, but it enjoyed ſeveral conſiderable lordſhips and immunities, firſt under the protection of the landgraves of Thuringia, then of the princes of Brunſwick, and laſtly, from the year 1483, of the electoral houſe of Saxony: but the archbiſhops of Mentz claiming the ſovereignty over Erfurt, it was at laſt agreed, in 1667, that they ſhould keep a governor in the city, on the expreſs condition that the Proteſtant doctrine and worſhip ſhould be reſpected. The profeſſors' chairs of the univerſity, which had been eſtabliſhed in 1392, were allowed to be filled half with Roman Catholic and half with Proteſtant teachers. In 1754 an academy of ſciences was founded, to which were ſubſequently added a botanical garden, an anatomical theatre, an aſtronomical obſervatory, a riding ſchool, and a ſociety of natural hiſtory. The beſt public libraries are thoſe of the Jeſuits, of the Scottiſh convent, and of the Lutheran miniſtry, which contained ſome valuable ancient manuſcripts of the Hebrew bible.

The moſt remarkable public building at Erfurt is its cathedral church, which is reported to have been built in the year 752. Its celebrated great bell weighs 275 cwt. In more ſuperſtitious times, pilgrims uſed to flock to Erfurt from all parts of Germany on a particular day, to dance the *dance of Death* (den Todtentantz.)

At the peace of Luneville, in 1801, the city of Erfurt, its territory and dependencies, and all the rights of ſovereignty poſſeſſed by the eccleſiaſtical elector of Mentz, or Mayence, were ceded to the king of Pruſſia, as part of the indemnities to which this monarch was entitled for his loſſes on the right ſhore of the Rhine. The population of Erfurt and its territory, together with the Eichsfeld, was, in 1802, reckoned at 121,200 individuals, and in the territory of Erfurt in particular, incluſive of the town, there were 3517 individuals to the German ſquare mile. The city of Erfurt, without the garriſon, contained 16,500 inhabitants.

But Pruſſia having declared war againſt France in 1806, Erfurt was one of the firſt towns which ſurrendered to the French after the unfortunate battle of Jena or Auerſtädt, in October 1806. The fort of Peterſberg, which protects the city, and which had always been conſidered as very ſtrong, did not even attempt a defence. At the peace of Tilſit, in 1807, Pruſſia was ſtripped of all the new acquiſitions and old poſſeſſions beyond the Elbe; and Erfurt, by the conqueror's decree of the 18th of Auguſt, 1807, was to form part of the new kingdom of Weſtphalia. But the French emperor having had a conference with the emperor Alexander I. of Ruſſia at Erfurt in the month of October, 1808, this city was again transferred, by way of compliment, to the Ruſſian emperor's brother-in-law, the preſent duke of Saxe-Weimar, who is a member of the Confederation of the Rhine. There is at Erfurt a conſiderable manufacture of ribbands, which employs above 500 individuals.

ERGALIA, of ἐργον, *opus*, a word uſed by the *Alchemiſts*, to expreſs that part of their treatiſes which explains the inſtruments employed in their operations.

ERGANE, in *Mythology*, the *Inventreſs*, an epithet of Minerva, becauſe to her was aſcribed the invention of ſeveral arts; ſince, beſides that of the art of war, Lucian aſcribes to her that of architecture; the art of ſpinning, of making cloth, tapeſtry, ſilk and woollen ſtuffs, is alſo aſcribed to her by the ancients. She was alſo reckoned the firſt who taught man to plant and cultivate the olive. She is likewiſe honoured with the invention of chariots, and of the uſe of trumpets and the flute, &c.

ERGASIMA, a name given by Dioſcorides and other of the ancients to a very foul and coarſe kind of myrrh.

ERGASTERIUM, a word uſed by the writers in *Chemiſtry*, ſometimes to expreſs the whole elaboratory, and ſometimes that part of a furnace on which the bottom of the retort, copel, or crucible, is to reſt in an operation.

ERGASTINÆ, Εργαστιναι, in *Antiquity*, a ſelect number of virgins employed in weaving Minerva's peplos or robe, which was carried in proceſſion at the Athenian feſtival Panathanæa. See Peplos, and Panathanea.

ERGASTULUM, among the *Ancients*, a houſe of correction, or workhouſe, where ſlaves, by the private authority of their maſters, were confined, and kept at hard labour for ſome offence. It was likewiſe called ſophroniſterium.

ERGATIA, Εργατια, in *Antiquity*, a Laconian feſtival, in honour of Hercules.

ERGAVIA, in *Ancient Geography*, a town of Spain, in the Tarragonenſis. Ptol.

ERGAVICA, a town of Hither Spain, S. of Bilbilis. This appears to have been a conſiderable place when it was taken by Gracchus in his campaign. Several medals were ſtruck here, which repreſented Auguſtus and Tiberius, with an ox upon the reverſe.

ERGENE, in *Geography*, a river of European Turkey, which runs into the Mariza, near Demotica, in Romania.

ERGERS, a river of France, which runs into the Ill, about two miles eaſt from Griſpoltheim, in the department of the Lower Rhine.

ERGETIUM, in *Ancient Geography*, a town of Sicily. Ptol. and Steph. Byz.

ERGINUS, a river of Thrace, in the vicinity of the Athyras, which ran before Sarpedon.

ERGITIUM, a town of Italy, in that part of Magna Græcia called Apulia, ſituated on the Appian way, between Teanum N.W. and Sipontum S. E.

ERGOT, in the *Manege*, is a ſtub, like a piece of ſoft horn, about the bigneſs of a cheſnut, placed behind and below the paſtern joint, and commonly hidden under the tuft of the fetlock. To diſ-ergot, or take it out, is to cleave it to the quick with an inciſion-knife, in order to pull up a bladder full of water that lies covered with the ergot. This operation is ſcarcely practiſed at Paris, but in Holland

land is frequently performed upon all four legs, with intent to prevent watery fores and foul ulcers.

Ergot, in *Agriculture*, is a vegetable difeafe which affects different forts of grain, and other crops, fhewing itfelf, according to the author of Phytologia, by the feeds growing out into large horns, having a black appearance without, as in fea-cale, rye, and in carex. It very often attacks the rye in France, and occafionally in this country in fuch feafons as are very moift; the grain in thefe cafes becoming confiderably elongated, being either ftraight or crooked, containing a black meal along with the white; and is afferted to have the appearance of being pierced or perforated by infects, which are believed by fome to be the caufe of the affection. It has frequently other different appellations, fuch as clavus, or the fpur, and horn feed. No certain remedy or method of preventing it has, we believe, been yet difcovered. See next article.

Ergot, in *Medicine*, a term originally applied, as we have feen, to a peculiar difeafe of corn, efpecially of rye, from the refemblance of the grains thus affected, to the fpur of a cock: and, by metonymy, ufed to denote a difeafe in the human body, occafioned by taking this difeafed, or *ergoted* rye as food.

The earlieft account of this difeafe of rye, and of its pernicious influence on the human body, with which we are acquainted, is contained in a letter from M. Dodart to the editor of the Journal des Savans, publifhed in March, 1676. (See vol. iv. part ii. p. 79.) The facts were communicated a few years before by the phyficians and furgeons of Sologne, in which diftrict the difeafe had been very prevalent. The grains of rye, affected by the ergot, according to M. Dodart, are of a blackifh colour externally, but white within, and when dry, they are harder and of a more compact fubftance than the natural grains, and have no bad tafte. They are confiderably longer than the other grains, fome of them being fourteen or fifteen lines in length, and two in breadth; and feven or eight of them are fometimes feen in one ear. They are obvioufly not foreign fubftances engendered between the grains of rye, M. Dodart adds, but the true grains, furrounded with their proper coats, in which the place of the germ is difcernible. Thefe grains were called *ergots*, *fpurs*, in Sologne; in Gaftinois, where they alfo were known, they were termed *bled cornu*. In various other places this difeafed rye has been called fecale cornutum, or corniculatum, fecale luxurians, clavus fecalinus, mater fecalis, or *mutterkorn*, (by the Germans), &c. It is ftated by Tiffot, on the authority of Haller, that the ergot affects rye only, or two or three other Alpine plants of the grafs-kind. (See Philof. Tranfact. vol. lv. for 1765, p. 110. A minute defcription of the ergot was publifhed by C. N. Langius in 1717, the fubftance of which may be found in the Acta Eruditorum for 1718, p. 309.)

The learned Tiffot, in his letter to fir George Baker, juft referred to, ftates that there are two other difeafes which affect rye and wheat, and which have been confounded with each other, as well as with the ergot, or fecale cornutum, *viz.* the *rubigo*, or mildew, and the *uftilago*, *brulure*, or blight; the former being characterized by the appearance of a reddifh yellow powder, of a glutinous nature, adhering to the ftalk and head of the corn; and the latter by a blacknefs and degeneration of the corn. (See Fontana on this fubject, and fir Jof. Banks on the difeafes of corn.)

The ergot was particularly obferved in rye in wet feafons, and more efpecially when a wet fpring was fucceeded by exceffive heat. M. Dodart remarks that the bread, which was made of ergoted rye, did not differ from ordinary bread in point of tafte; that this rye was moft particularly pernicious when new; but that its effects were not obferved until it had been eaten for a confiderable time. M. Noël affirms that it lofes its deleterious qualities altogether after being kept a few months in fheaf. (See a letter in Quefnay's Traité de la Gangrène, feche, p. 407, Paris, 1749.) And writers in general agree in ftating, that the difeafe, which the ergoted rye induces, is prevalent only at the conclufion of harveft, and ceafes before the commencement of winter; and that it was chiefly obferved among the poor, who were unable to procure wheaten bread in thofe feafons of humidity and fcarcity. (See Muller in Comment. Lipfiæ, anno 1752, p. 634, &c.)

The fymptoms of the ergot in the human body are defcribed fomewhat differently by different writers; but they coincide in reprefenting a dry gangrene, and ultimately death, as the ordinary refults of the difeafe. It commences with a laffitude and debility, but with little interruption to the functions in general. A degree of torpor in the lower extremities is then obferved, accompanied, according to fome of the writers, with a fenfe of prickling, and of the creeping of infects (formicatio) upon the fkin; a flight degree of fwelling, but without inflammation, enfues, often accompanied by the moft excruciating pains, and with a fenfe of burning heat; foon fucceeded by that of extreme cold; the fkin of the feet and legs becomes fhrivelled, and of a dark hue, as if dried in fmoke, afterwards black and deftitute of feeling; in fact the limb dies, or is gangrenous, but in a dry ftate, which has been compared to that of a mummy. By degrees the dead parts feparate from the living, as if they had been deftroyed by cauftic. In this mutilated condition, deprived of one, fometimes of both legs, more rarely of the hands or arms, fome individuals have furvived for months, or even years.

Befides this fpontaneous gangrene of the limbs, another fpecies of difeafe has been afcribed to the ufe of *ergoted* rye by Hoffmann, Tiffot, and fome other writers; but with what juftice or propriety may perhaps admit of a queftion. The difeafe alluded to was a febrile difeafe, faid to be of a contagious and malignant nature, and to be accompanied and principally characterized by various fpafmodic and convulfive fymptoms, by which, or by a general epilepfy, the patients were frequently carried off. This difeafe is faid to have been epidemic in Heffia, Weftphalia, and other parts of Germany, at feveral different periods, in the 16th and 17th centuries; and a defcription of it by the profeffors of the univerfity of Marpurg, in the year 1597, is generally referred to, as the firft complete account of the difeafes. But in that account, of which a tranflation is given by Gregorius Horftius, no allufion whatever is made to the ergot, or fecale cornutum; bad bread is mentioned only among other forts of crude and unwholefome aliment, to which the difeafe (occurring in a time of dearth) is there afcribed. The whole of what is faid refpecting the exciting caufes of that epidemic is contained in the compafs of thefe few lines. "Caufas hujus affectus quod attinet, ex ægrotantium relatione fcire licet, quod externa caufa communiter in alimento, ad nutriendum minus idoneo et improportionato, confiftat, dum pauperes rebus ad vitam neceffariis deftituti, panem impurum et male coctum longo tempore, in fummâ famis urgentiâ, devorant, interdum etiam poma acerba et auftera, fungofque et fimilia deglutientes, fefe eduliis crudis, immaturis, et aftringentibus ingurgitant, de quorum depravatâ concoctione cruditates obortæ, &c." (See Greg. Horft. Opera, vol. ii. lib. viii. obf. xxii.) A fimilar ftatement, refpecting the origin of this epidemic, is given by Sennertus in his chapter, "De febre Malignâ cum Spafmo," probably

upon

upon the authority of the Marpurg profeffors. The difeafe he fuppofed to be excited by a malignant vapour or humour, vellicating the brain and nerves. " Malignus autem ille vapor et humor ortum habuit ex victu pravo, dum, ob annonæ caritatem, panem non bonum, fructus corruptioni obnoxios, fungos, et id genus alia, ad explendam famem, pauperes devorabant. Ex quo victu pravo vitiofos humores in corpore colligi neceffe eft, &c." (Sennert. de Febribus, lib. iv. cap. 16.) The difeafe, therefore, is obvioufly confidered by the original writers as originating from defect of nutritious food, and the ergot is not in any way alluded to. The fymptoms of this fever, which was called by the Germans *die kriebel kranckheit, oder ziehende feuche*, the convulfive peftilence, are thus briefly enumerated by Hoffmann. " The difeafe in its commencement occupies the limbs and the extremities of the hands and feet, in which a fenfe of formication is felt. In fome inftances it begins with ficknefs and vomiting. Then follow violent fpafmodic contractions of the fingers and toes, which at length alfo attack the knees, fhoulders, elbows, and even the face, eyes, and lips, accompanied by an intolerable pain, and fometimes with a fenfe of extreme coldnefs, fometimes with that of a burning heat. Thefe fymptoms return at ftated periods, and fometimes continue for feveral weeks. As the pains diminifh, the patients fall into a ftate of drowfinefs and torpor, often into an alienation of mind, and are affected with giddinefs and deafnefs, the limbs remaining ftiff, and deftitute of the power of motion. In the extremities of the limbs large veficles, filled with ferum, often appear, and fometimes other tumours, which pafs into a gangrenous condition, but by a very flow progrefs, by which ultimately even the bones have been gradually deftroyed. A ftate of general convulfion, or epilepfy, occafionally fupervenes, and proves fatal, efpecially in children." (Hoffmann. Med. Rat. vol. ii. par. ii. cap. 9. § xvi.) A more detailed account of the fymptoms is given by Sennertus, loc. cit. Dr. Cullen has followed Linnæus and Vogel in denominating this difeafe *Raphania;* (See Amœn. Academ. vol. vi.) but queftions whether it be the fame difeafe as the *Necrofis uftilaginea*, by which term Sauvages has defignated the ergot. (See Cullen Nofol. Meth. gen. 52. Sauvage Nofol. Meth. clafs x. gen. 39.) There is, in fact, much confufion in the accounts of authors upon this fubject; and it feems probable that the true effects of the ergoted rye are to be found only in the dry gangrene, and not in the epidemic fevers, which have been afcribed to it.

It was long ago known that corrupted corn was poifonous to the animal body. Galen remarked, that the feeds of colium temulentum mixed with wheat, or the degenerated grain, called black wheat, would produce fever, head-ache, delirium, and gangrenous ulcers. (De Aliment. facultat. lib. i. cap. 37.) Moft of the writers on the fubject, from M. Dodart downwards, have ftated, that the ergoted rye, when given to fowls, hogs, and other animals, as food, produces the fame fymptoms as in man, and deftroys life. More lately the Abbé Teffier made a feries of experiments upon this fubject, and has given a minute defcription of the ergot in rye. He found that by feeding or cramming turkies and other animals with this difeafed rye, he could produce in all of them the dry gangrene and death. (See Memoires de la Soc. Roy. de Medecine for 1776, p. 303. Hift. de l'Acad. des Sciences for 1710. Acta Erudit. Lipf. 170 et 1752. Saviard Obf. Chirurg. The Treatife of M. Teffier, &c.

The dry gangrene occurs from other caufes than the ergoted rye. An account of a whole family confifting of eight perfons, who were feized and mutilated or deftroyed by gangrene of the lower extremities, preceded by pain and fome fwelling, at Wattifham in Suffolk, is given in the Philof. Tranf. vol. lii. part ii. The ftate of the family, three months after the commencement of the difeafe, is thus reprefented: " 1. Mary, the mother, æt. 40. The right foot off at the ancle; the left leg mortified, a mere bone, but not off. 2. Mary, æt. 15. One leg off below the knee; the other perfectly fphacelated; but not yet off. 3. Elizabeth, ætat 13. Both legs off below the knees. 4. Sarah, æt. 10. One foot off at the ancle. 5. Robert, ætat. 8. Both legs off below the knee. 6. Edward, ætat 4. Both feet off at the ancles. 7. An infant, four months old, dead." The father alfo fuffered flightly in the fingers. Although the fymptoms were exactly thofe of the ergot, yet, in this cafe no rye was eaten, nor could any other circumftance in the diet or economy of the family be difcovered, to which the gangrene could be attributed. See Gangrene.

ERIACH, in *Antiquity*, the name of a recompenfe affigned by the Irifh Brehon law, in cafe of murder, to the friends, or to the child or wife of him that was flain, as a kind of compofition between the murderer and his profecutors.

ERIAMBO, in *Geography*, a river of Ruffia, which runs into the Oby; 30 miles above Obdorokoi.

ERIANTHUS, in *Botany*, from ἐριον, *wool*, and ἀνθος, *a flower*, Michaux Fl. Boreali-Amer. v. 1. 54. A genus of graffes eftablifhed by Michaux, in its character very near *Saccharum*, but more naturally allied to *Andropogon*, to which, if the character of that genus were reformed, Michaux himfelf fufpects the prefent might be referred. *Andropogon* indeed feems to require a thorough inveftigation, and probably a divifion into more than two genera.

ERIBANUM, in *Ancient Geography*, a town of Italy, in Campania, upon the Vulturnus. Polybius.

ERIBŒA, a town of Macedonia, in the country of the Parthæans. Ptol.—Alfo, a mountain of Macedonia, in the fame country.—Alfo, a town of Afia, in Bithynia.

ERIBOLUM, the port of Nicomedia, a town of Bithynia.

ERIC, king of Denmark, in *Biography*. There were feveral princes of this name, though but few of them have any claim to notice in this place. Eric the Firft was poffeffed of fo many virtues that he was furnamed the " Good." A mufician, celebrated for his great fkill on the harp, afferted that he could deprive his hearers of their underftanding by the powers of his inftrument. Eric challenged him to the trial, and in the paroxyfm of phrenzy into which the performer threw the monarch, he killed four of his guards. Grieved at what he had done, he made all the recompenfe he was able to the relations of the deceafed, and to do penance for the bloody deed, he determined to undertake a pilgrimage to the Holy Land. His fubjects remonftrated againft his defign, but he was not to be diffuaded from his purpofe, fet out on his journey, and died at the ifle of Cyprus. This event took place in the year 1107.

Eric X., king of Sweden and Norway, as well as of Denmark, the fon of Wratiflaus VII. duke of Pomerania, was declared fucceffor to the crowns of Denmark and Norway in the year 1388, by his great aunt, queen Margaret; and when, in 1396, fhe annexed the crown of Sweden to her dominions, Eric was, by the treaty of the " Union of Calmar," declared fucceffor to that alfo. This celebrated treaty confifted of three articles 1. " That the three kingdoms of Denmark, Sweden, and Norway, fhould thence forward have but one king, who fhould be chofen alternately by each of them, and approved in a general affembly. 2. That the monarch fhould divide his refidence equally between the three

three kingdoms, and appropriate the revenues of each to its particular exigencies. 3. That each kingdom ſhould retain its own laws, cuſtoms, ſenate and privileges; and that the ſubjects of the one ſhould not be elevated to offices of profit or power in another." Theſe conditions ſeemed, at firſt ſight, to have been dictated by wiſdom, but they proved to be the ſource of wars that continued to rage during a whole century between the three kingdoms. On the death of the queen in 1412, Eric ſucceeded without oppoſition to the three united crowns. He had married the daughter of Henry IV. king of England, with whom he had a large portion, and thus might be regarded as one of the moſt potent kings of his time. Eric was ſoon involved in a war with the princes of Holſtein, which for ſome time was carried on with doubtful ſucceſs, but in 1424 the whole of South Jutland, including Sleſwick and Gottorp, was adjudged to the Daniſh crown. This award, which was made by the emperor Sigiſmund, at Buda, determined Eric upon a pilgrimage to the Holy Land. During the expedition, he was made captive, and obliged to pay a large ranſom for his liberty. His abſence from home was attended with other evils. From his acceſſion he had diſpleaſed the Swedes by refuſing to call a general diet for the confirmation of their liberties, which excited much diſcontent, that at length broke out into open rebellion. In 1435 he met the Swediſh diet at Stockholm, and agreed to a full redreſs of grievances. His promiſes, however, were of little avail to his people, who, after enduring much from his miſconduct, depoſed him in 1439, and choſe, in his ſtead, his nephew Chriſtopher of Bavaria. For ten years he made many attempts to regain his ſituation, but without ſucceſs. After this he employed himſelf in compiling a hiſtory of Denmark from the public regiſters, comprizing the period from the commencement of the monarchy to 1288. He afterwards repaired to the iſle of Rugen, where he died in 1459. Eric poſſeſſed quick natural parts, and was a lover of learning; but he was ambitious, deſpotic, irreſolute, and inſincere, qualities which led him into many difficulties, and which rendered his reign truly diſaſtrous. Univer Hiſt.

Eric XIV., king of Sweden, ſon of Guſtavus Vaſa, aſcended the throne of Sweden in 1560, at the age of twenty-ſeven, and was poſſeſſed of all the accompliſhments proper to his elevated ſituation. He ſpoke the modern languages, danced gracefully, ſhewed animation in all his actions, and was eloquent and polite. But he ſuffered himſelf to be hurried away with guſts of paſſion, which ſometimes obliterated every trace of reaſon, and rendered him furious. His father, who had witneſſed theſe fits of rage, had once formed the deſign of excluding him from the throne, and of conferring the crown on his ſecond ſon. For the ſame reaſon he refuſed to permit him to viſit England to pay his court to the princeſs (afterwards queen) Elizabeth: but negotiated the buſineſs by means of his ambaſſador and ſecond ſon John. Eric, however, almoſt immediately after his acceſſion, determined to obtain an interview with Elizabeth, and ſet ſail with a large fleet and ſplendid train, but the veſſels being overtaken by a violent ſtorm, were driven back upon his own coaſt, where he ſuffered ſhipwreck, and for a time relinquiſhed his matrimonial project. He next ſent propoſals of marriage to Mary queen of Scotland, and almoſt before he could obtain any anſwer, ſolicited from the emperor the hand of the princeſs of Lorraine, daughter of Chriſtian II. with whom he was enamoured by the deſcription of ſome of his courtiers. He received a favourable anſwer, but in the mean time he had changed his mind in favour of Elizabeth. His political conduct was as capricious as his amours, and involved him in continual quarrels with his neighbours, and a confederacy was formed againſt him by Muſcovy, Poland, Denmark, and Lubeck. His brother John, who had married Catharine, daughter of the king of Poland, fell under his ſuſpicion, and was driven to an open rupture. John was cited to Stockholm, to vindicate his conduct, and refuſing to appear, an army was ſent into Finland with orders to ſeize him and his wife, and to bring them to the capital. He was immediately thrown into priſon, accompanied by his wife, who voluntarily choſe to ſhare in his ſufferings. It is ſaid that the king went frequently to the priſon with the deſign of murdering his brother, but that on ſeeing him he felt his heart ſo moved with pity, as to prevent him from ſtriking the fatal blow. Sometimes with tears in his eyes he would confeſs the ſanguinary deſign which had prompted his viſit, and added, "I know that the crown of Sweden is intended for you, and I requeſt that, when you are in poſſeſſion of it, you will pardon my errors." This circumſtance ſtrongly diſplays the violence of contending paſſions in the mind of Eric, and has been brought to prove his inſanity.

The early years of his reign were ſpent in wars chiefly with Denmark, carried on with vigour on the part of Eric, though without any permanent advantage. Domeſtic troubles at length withdrew his attention from foreign wars, and his capricious conduct deſtroyed all reſpect for him in the breaſts of his ſubjects. Diſappointed in his matrimonial projects, he entertained a number of concubines, one of whom, a peaſant's daughter, gained ſuch an aſcendancy over him that he married her. He was under the influence of his miniſters and domeſtics of mean rank, who frequently excited his jealouſies of the great families. He entertained a particular hatred of the Stures, an illuſtrious family, deſcended from the ancient regents. Eric had taken one of them into favour, though he had, on a former occaſion, diſgraced him, and made him contemptible in the eyes of the populace. He now ſent him in the quality of embaſſador to Stralſund, but he became once more the object of the king's abhorrence, who conceived that he was conſpiring againſt his life and crown. The king took pains to convince the ſtates that Sture carried on dangerous intrigues at Stralſund, and he ſuborned witneſſes to accuſe him of treaſonable deſigns. An infamous favourite, named Peerſon, perſuaded Eric to extirpate the whole family; ſentence of death was accordingly pronounced againſt thoſe unfortunate men, together with twenty-ſix nobles, who were the pretended accomplices of a conſpiracy laid to their charge. A public trial was afterwards allowed them, in which the Stures were able to vindicate their cauſe ſo completely, and to prove their innocence ſo undeniably, that the king himſelf apologized to them for their detention and long impriſonment: nevertheleſs, in a very ſhort time, he ſtabbed Nils Sture with his own hand. The unfortunate man drew the dagger from his breaſt, and preſented it to the monarch, who, with the moſt ſavage barbarity, ordered his guards to accompliſh that which he had failed to perform himſelf. The reſt of the priſoners were alſo cruelly murdered at the ſame time. No ſooner was this bloody ſcene over than Eric felt the pangs of a wounded conſcience. He grew frantic, and, as if purſued by the avenging furies, fled into the woods, where he wandered for many days like a wild beaſt, refuſing to take food or repoſe. On his return he endeavoured to compenſate for his cruelty, by beſtowing large ſums upon the friends and relations of the victims; and by giving up Peerſon to the hands of juſtice, who was condemned but not executed. Being threatened by the king of Denmark, Eric ſet at liberty his brother John, to whom and to his other brother he propoſed aſſigning lands

in

in Livonia, in lieu of thofe left them by their father Guftavus. Shortly after he formed a defign of putting them to death, and of conciliating the friendfhip of the czar of Mufcovy, by delivering him the wife of duke John, to whom that prince had paid his addreffes before her marriage. His intentions were difcovered in time to defeat the purpofe, and the brothers began to raife forces in their own defence. Eric made a ftand, and an accommodation was effected, but by the treaty he bound himfelf to give up Peerfon, his favourite, who, being put to the torture, confeffed a plot contrived by himfelf and the king, of pillaging Stockholm, burning part of the fhips in the harbour, and proceeding with the reft loaded with fpoil to Narva. The dukes now felt themfelves juftified in breaking the treaty, and they obliged Eric to capitulate in the citadel. He was put under confinement, folemnly depofed by the ftates, and duke John elected in his ftead. His children were declared incapable of fucceffion, and himfelf was condemned to perpetual imprifonment. His keepers were appointed from among the relations of thofe whom he had cruelly maffacred, and who did not fail to fubject him to various infults and indignities, and not unfrequently to the evils of cold and hunger. After nine years imprifonment, he finifhed a wretched life in 1578, in confequence, it was fuppofed, of a dofe of poifon adminiftered by order of his brother John, who dreaded the poffibility of his being liberated, and again fet upon the throne. Eric was not deficient in talents; and he poffeffed great perfonal bravery: under his conduct the Swedifh troops repeatedly diftinguifhed themfelves in contending with and overcoming the Danifh armies, and it has been thought that he would never have fubmitted to the hard conditions which Denmark at length impofed on his fucceffor. (See JOHN.) Univer. Hift.

ERICA, in *Botany*, ερεικη of Diofcorides, the fame name, varioufly corrupted, being applied to the feveral fpecies of this genus among the modern Greeks at prefent, according to Dr. Sibthorp. See Prod. Fl. Græc. 256, 257.—Heath or Ling.—Linn. Gen. 192. Schreb. 258. Willd. Sp. Pl. v. 2. 356. Ait. Hort. Kew. v. 2. 14. Sm. Fl. Brit. 417. Mart. Mill. Dict. v. 2. Juff. 160. Gærtn. t. 63. Tourn. t. 373. Clafs and order, *Octandria Monogynia*. Nat. Ord. *Bicornes*, Linn. *Ericæ*, Juff.

Gen. Ch. *Cal.* Perianth of four ovate-oblong, permanent, upright, often coloured leaves. *Cor.* of one petal, permanent, four-cleft, regular, with an ovate or cylindrical tube, more or lefs inflated. *Stam.* Filaments eight, capillary, equal, inferted into the receptacle; anthers cloven at the fummit, opening by two pores, by which they laterally cohere while young. *Pift.* Germen fuperior, roundifh; ftyle thread-fhaped, ftraight, longer than the ftamens; ftigma capitate, in four or eight lobes. *Peric.* Capfule roundifh, fmaller than the calyx, which covers it, of four cells and four valves. *Seeds* numerous, affixed to the columella.

Eff. Ch. Calyx of four leaves. Corolla four-cleft. Stamens inferted into the receptacle. Anthers with two pores. Capfule fuperior, of four cells. Seeds numerous.

Obf. Some fpecies appear to have a double calyx, but the lowermoft was by Linnæus latterly efteemed rather of the nature of bracteas. The fhape of the corolla is extremely different in different fpecies, its tube being in fome globular, in others ovate, in others again cylindrical and much elongated; fometimes dilated at the orifice, fometimes contracted, in fome inftances curved. The anthers, either included within the tube or projecting beyond it, are in fome fimply cloven at the top, without any appendage at the bafe; in fome this latter part bears a pair of briftles, in others a pair of notched leaflets, termed a creft, which, as Mr. Salifbury remarks, originate rather from the filament than from the anther.

This extenfive and moft elegant genus is confined to Europe and the fouthern part of Africa, the country about the Cape of Good Hope being, of all others, moft abundant in Heaths, whence the green-houfes of Britain are continually fupplied with new fpecies or varieties, to the great profit of nurferymen, fome of whom find it worth while to keep a collector refident there. No *Erica* is found in America, in New Holland, nor fcarcely in the Torrid Zone. The habit of the whole genus is fhrubby, very rarely arborefcent, with fmall, oppofite or whorled, ufually narrow, leaves, and bracteated ftalked flowers, whofe colours partake of all the moft exquifite tints of red, purple, yellow or orange, occafionally variegated with green or white. Some are entirely white, but the anthers are commonly dark brown or purplifh.

It is difficult to guefs at the number of the real fpecies of *Erica*. Willdenow has 137, fome of which are duplicates. Our gardeners reckon about 300, many of which are merely varieties, but there are feveral others only known hitherto in a dried ftate, and probably not a few yet remain to be difcovered in the wilds of fouthern Africa.

The greater part bloffom with us in the fpring, but many at various feafons. They are for the moft part inodorous, though a few of them are delightfully fragrant. They commonly keep well in an herbarium, provided they are dried fuddenly, fo as not to throw off their leaves during the procefs.

Few good figures of this genus, except of the European kinds, are found in the older botanical works, but many appear to great advantage in the more recent works of Ventenat, Wendland, Curtis's Botanical Magazine continued by Dr. Sims, and efpecially in a folio publication by Mr. Andrews, entirely devoted to the fubject, as well as an octavo one, equally ufeful, by the fame artift. The moft fuperb of all, however, are two thin fafciculi, publifhed by Mr. Aiton, of coloured plates by Mr. Frederick Bauer, but unhappily without any defcriptions or even fpecific characters.

In the fcientific definition of the fpecies of *Erica* much yet remains to be done. The labours even of Linnæus and Thunberg are very far from perfection. Mr. Salifbury, who has paid much attention to the fubject, has given an arrangement of 246 fpecies, according to their natural affinities, in the fixth volume of the Linnæan Society's Tranfactions, with often expreffive, if not claffical, fpecific characters, but with an unlicenfed change, and frequent perverfion, of names. This writer includes the Linnæan genus *Blæria*, like Thunberg, under his *Erica*, while he excludes *E. vulgaris* as a genus, by the name of *Calluna*, and feparates a few fpecies (which have an irregular calyx, and flefhy fruit, with three cells and three feeds) into another genus, named, from its large ftigma, *Salaxis*. To him we are indebted for remarking that the corolla of *Erica* is permanent, which is not the cafe in *Andromeda* and *Menziefia*, and that the anthers are united laterally to each other by their pores before they difcharge the pollen. He alfo confiders all true *Ericæ* as having the partitions of the fruit originating from the centre of each valve.

Linnæus and his followers diftribute the fpecies of this genus into three principal fections by the ftructure of the anthers; firft, anthers ariftated or furnifhed with a pair of briftles at their bafe; fecondly, anthers crefted, as above defcribed; thirdly, anthers fimple, or deftitute of any of thofe appendages. The latter are fubdivided into fuch as have the

the anthers included within the corolla, and such as have them projecting beyond its border. All these sections are moreover separated into subordinate ones by the situation of the leaves, whether opposite, or in three, four, or more rows, or scattered, of which last *E. glutinosa* is perhaps the only example. All these characters, however combined, unfortunately prove but artificial, separating species naturally allied to or resembling each other; nor are some of them, derived from the crusted anthers, or number of leaves, constant or invariable, even in the same species. Still, as no natural subdivisions have yet been suggested, we may be glad of artificial and imperfect ones in so vast a genus. Mr. Salisbury, though he disposes the species in order, according to what he conceives to be their natural affinity or resemblance, especially in the form and proportion of the corolla, has not attempted to define or characterize many subdivisions of the genus. As, however, it is very instructive to contemplate the species of such a genus in this light, and as this writer's is the only attempt of the kind, we shall give examples of each of his subdivisions in the order in which he places them. It is necessary to premise that these subdivisions are considered as having in general no peculiar connection, and that one or more species often come between two of them, almost equally distinct from both and from each other. Thus, in the very beginning, *E. scoparia*, (E. coris folio quarta; Clus. Hist. v. 1. 42. f. 3.) ;—and *E. spiculifolia*, (Sm. Fl. Græc. Sib. t. 353. Prod. v. 1. 257.) ; stand as distinct from each other, and from three species immediately following them, among which are *absinthoides* of Linnæus ;—and *setacea*, Andrews, t. 62.—Next come *planifolia*, Linn. (Pluk. t. 347. f. 1.) and *oxycoccifolia* of Mr. Salisbury, agreeing in their ovate dilated leaves, in which they are very unlike their neighbours. Then again *strigosa*, Ait. Hort. Kew. v. 2. 17 ;—and *sicæfolia*, Salisb. (rather *sicifolia*), a new species, each stand separate, as not immediately allied to any other.—We shall, in separate paragraphs, mention one or more species of Mr. Salisbury's subdivisions, noticing likewise the separate anomalous species, and introducing two or three new ones, to the best of our judgment, according to their several affinities. Many still unsettled remain in every collection.

After *sicifolia* follows an assemblage of eight species. Among these is *E. pubescens*, Linn. Sp. Pl. ed. 2. 506, *pallida* of Mr. Salisbury, thus characterized by him.—Leaves three in a whorl. Anthers crested, included. Flowers terminal. Leaves linear. Sides of the calyx doubled back. Corolla two lines long, downy on both sides. Crests short.—Also *E. urceolaris*, Berg. Cap. 107. Ait. and Bau. Ic. t. 16. (*pentaphylla*, Linn.)

Then 13 species with little or no affinity to each other, among which are *arborea* (E. coris folio prima ; Clus. Hist. v. 1. 41.); and *Thunbergii*, Linn. Suppl. 220, Curt. Mag. t. 1214, a most beautiful species, conspicuous for its globose white tube and large deep-orange limb, very rare at present in the gardens.

Next appears a collection of eight, among which is *melanthera* ; another of three, including *capitata* and *bruniades* (Andr. t. 61.); and a third of 18, amongst which are *sexfaria*, Ait. and Bau. Ic. t. 11, with *nigrita* of Linn. and Thunberg, so called from its conspicuous dark anthers, elegantly contrasted with the white corolla and calyx. This last Mr. Salisbury is pleased to denominate *volutæflora*. These three subdivisions he indicates as not so distinct or dissimilar as most.

The following section comprises five new species of Mr. Salisbury's, named by him *fabrilis*, *dianthifolia*, *brevifolia*, *chlamydiflora*, and *selaginifolia*. They have all crested included anthers, and terminal flowers.

His *pannosa*, with a woolly corolla, stands alone.

Then follow 15 species, mostly *Blæria* according to Linnæus, having but four stamens ; see Blæria. Nor can we much object to the union of these two genera, except that in so vast a tribe, we may be glad of even so slight a circumstance as number to make a genus, when there is moreover such a difference in habit as this very arrangement of Mr. Salisbury's implies. If indeed a few species of *Erica*, here and there in the different natural subdivisions, were tetrandrous, nobody would think of separating them for such a reason.

E. nudiflora, Linn. Mant. 2. 229. Sm. Plant. Ic. t. 57, (accompanied by two others) follows. Mr. Salisbury exults in having discovered its bracteas, which escaped Linnæus, Dryander, and the author of the present article, who in this instance readily submits to his correction. They are in the form of two or three excessively minute woolly scales, near the base of each flower-stalk.

The next five, or rather we would say seven, uniting two of Mr. Salisbury's sections, are *herbacea*, Linn. Sp. Pl. 501, Curt. Mag. t. 11, not at all different from *carnea*, Sp. Pl. 504 ; (this, according to Dr. Sibthorp, is the genuine ερεικη of Dioscorides, extremely common every where in Greece);—*mediterranea*, Linn. Mant. 2. 229, Curt. Mag. t. 471 ;—*multiflora*, Sp. Pl. 503, (Garidel. t. 32.), another beautiful native of the south of Europe, long confounded with *vagans* ;—*manipuliflora*, Salisb. (Sm. Fl. Græc. Sibth. t. 352.);—*vagans*, Linn. Mant. 2. 230, (Engl. Bot. t. 3.) common on all the heaths of Cornwall, either with red, flesh-coloured, or white flowers ;—*umbellata*, Linn. Sp. Pl. 501, (Ait. and Bau. Ic. t. 5.) ;—and lastly *nutans*, Wendland. Eric. fasc. 3. 5.—The native country of this last we know not, nor have we seen Wendland's publication. The rest of this very natural assemblage grow in Europe only.

Filiformis and *turgida*, Salisb. we have not ascertained to our satisfaction.

Nine species, very naturally allied, having excessively long anthers, projecting from an elongated tubular corolla, are placed next. Among these are *E. Plukenetii* ; *Petiveri* ; *Banksii*, Andr. t. 26 ; *Sebana*, Dryand. in Ait. and Bau. Ic. t. 10 ; &c. mostly familiar to collectors.

Nine more comprehend *imbricata*, Linn. Sp. Pl. 503 ;—and *flexuosa*, Andr. Eric. t. 33 ;—with *leucanthera*, Linn. Suppl. 223 ;—and *milleflora*, Berg. Cap. 96, which last name is well retained by Mr. Salisbury, in preference to the inaccurate one, *paniculata*, given by Linnæus.

An assemblage of six more contains the beautiful *baccans* Linn. Mant. 2. 233. Curt. Mag. t. 358, a good specimen of the rest.

Five following ones are supposed to be little, if at all, related. Among them are the beautiful *glauca*, Andr. t. 47. Curt. Mag. t. 580 ; in the same section with which the *elegans*, ibid. t. 966, should be inserted. The flowers of the latter are larger, and differently coloured, but they closely agree in structure with those of *glauca*.—*E. Monsoniæ*, Dryand. in Ait. and Bau. Ic. t. 7, (E. Monsoniana ; Linn. Suppl. 223.), one of the most magnificent of all, is placed by Mr. Salisbury, with a sign of incomplete affinity, after *glauca*.—*E. halicacaba*, Linn. Sp. Pl. 507, Ait. and Bau. Ic. t. 2, follows alone. Its corolla is of a pale uniform yellowish green.

Ten species, with a long tubular corolla and short included anthers, are needlessly, we think, divided into three parcels. These are mostly handsome flowers, very frequently to be seen in gardens. Among them are *versicolor*, Andr. t. 12, which

which comprehends as a variety his *coſtata*, t. 46;—*diſcolor* of the ſame author, t. 3;—*cruenta*, Ait. and Bau. Ie. t. 13;—*abietina*, Linn. Sp. Pl. 506, (*E. Patterſonia* of Andr. t. 7, and the gardeners), remarkable for its thick-ſet leaves and crowded golden bloſſoms, as well as its pulpy ſeed-veſſel;—and *concinna*, Ait. Hort. Kew. v. 2. 23, miſtaken by Andrews, t. 64, for *abietina*. For this laſt (*concinna*) Mr. Saliſbury has, in our opinion with advantage, adopted the name *paludoſa* from Hermann, which indicates its place of growth, and conſequently its requiſite treatment in a garden.

E. pyramidalis, Ait. Hort. Kew. v. 3. 491. Curt. Mag. t. 366, with two others unknown to us, conſtitute the next ſubdiviſion.

Then follow 12 fine plants, needleſsly, we again preſume, divided into two parcels. Among them are *tubiflora; curviflora; conſpicua*, Ait. Hort. Kew. v. 2. 22. Ait. and Bau. Ie. t. 12; and *ſordida*, Andr. t. 56; with ſeveral often confounded with theſe, (for it is rather an indiſtinct and perhaps variable tribe,) all which contribute much to adorn our green-houſes, and are in general eaſily cultivated.

E. faſcicularis, Linn. Suppl. 219. Ait. and Bau. Ic. t. 6; and *E. Maſſoni*, Linn. Suppl. 221. Curt. Mag. t. 356; occupy a ſection by themſelves. Theſe are two of the moſt highly prized of the whole genus. The flowers of both are tipped with green.

The 12 next are, in general, ſcarcely leſs ſplendid, witneſs *pharetriformis*, Saliſb. (exſurgens, Andr. t. 13.);—*grandiflora*, Linn. Suppl. 223. Curt. Mag. t. 189;—and *longifolia*, remarkable for its tremulous leaves and the variation of colour in its flowers, inſtances of which are diſplayed in Andrews, t. 8, t. 20, and t. 33; likewiſe in Curt. Mag. t. 402. The deep ſcarlet is juſtly the moſt admired variety.—We cannot but think *pinea*, Andr. t. 57, muſt be a diſtinct ſpecies.

To theſe are nearly allied the next five, comprehending *ſeſſiliſl ra*, Linn. Suppl. 222, (*ſpicata*, Thunb. Diſſ. 43. t. 4. Andr. t. 6);—*alveiflora*, Saliſb. called in the gardens *gelida*, which name aptly expreſſes the cool aſpect of its ſnow-white corolla tipped with pea-green, and ſurely ought to have been retained;—and *mammoſa*, Linn. Mant. 2. 234. Andr. t. 58. (abietina, Schneev. Ic. t. 23.); of which a beautiful ſcarlet variety is moſt common with us, called *ſpecioſa* in Schneevooght, t. 3, and *verticillata* by Andrews, t. 21.

Of Mr. Saliſbury's *brachialis*, a ſolitary ſpecies, we have only ſeen a doubtful ſpecimen.

Four ſpecies follow, among which are *E. Sparmanni*, Linn. Fil. Suppl. 219. Stockh. Tranſ. for 1778. t. 2; and the noble *cerinthoides*, Linn. Sp. Pl. 505. Curt. Mag. t. 220.

E. cernua, Montin Nov. Act. Upſ. v. 2. 292. t. 9. f. 3. Linn. Suppl. 222, ſtands alone; as does Mr. Saliſbury's *doliiformis*, (*mammoſa*, Thunb. Diſſ. de Ericâ, ed. Saliſb. 42. f. 21.)

E. auſtralis, Linn. Mant. 231, not uncommon in gardens;—and *ciliaris*, Linn. Sp. Pl. 503. Curt. Mag. t. 484. follow next. Theſe are both European ſpecies, and are immediately followed by two others, our elegant Engliſh *E. Tetralix*, Curt. Lond. faſc. 1. t. 21. Engl. Bot. t. 1014, (a name changed by Mr. Saliſbury to *botuliformis*, ſauſage-ſhaped);—and his *multicaulis*, the *ſtricta* of Donn and Willdenow, native of Corſica.

Next comes by itſelf our common Britiſh *cinerea*, Curt. Lond. faſc. 1. t. 25. Engl. Bot. t. 1015, more happily, but without any neceſſity, altered to *mutabilus*.

E. regerminans, Linn. Mant. 2. 232, only known in the Linnæan herbarium;—and *pulchella*, Andr. t. 51, occupy two ſeparate ſections.

A very diſtinct and natural aſſemblage of four ſpecies next occurs, in which are *empetrifolia*, Linn. Sp. Pl. 507, known by its hairy corolla;—and *malleolaris*, Saliſb. (*empetrifolia*, Curt. Mag. t. 447.)

The four next ſeem ſcarcely to be ſeparable from them, if we may judge by *viſcaria*, Linn. Mant. 2. 321. Andr. t. 55, the only one of the four with which we are acquainted.

A difficult family of ſeven ſpecies, with a hoary habit, and ſmall turgid downy flowers, is placed next, of which *tardiflora*, Saliſb. (*pubeſcens*, Curt. Mag. t. 480.);—and *hirtiflora*, Curt. Mag. t. 481, are examples. Both are diſtinct from, though nearly allied to, the real *pubeſcens* of Bergius and Linnæus, as well as from his *parviflora*.

A ſomewhat ſimilar tribe, but ſmooth, and with larger more bell-ſhaped flowers, contains ten ſpecies. Amongſt them is *margaritacea*, Ait. Hort. Kew. v. 2. 20. Andr. t. 54, very pretty when laden with its pearly bloſſoms.

E. Bergiana, Linn. Mant. 2. 235, remarkable for its reflexed calyx, with two others, come next, and lead inſenſibly to the following ſection.

This comprehends *pilulifera*, Linn. Sp. Pl. 407;—*obliqua*, Thunb. Diſſ. 44. Ait. and Bau. Ie. t. 3;—and *phyſodes*, Linn. Sp. Pl. 506. Curt. Mag. t. 443; with four more.

E. cernua, Andr. t. 48, ſtands alone, but between it and *phyſodes* we would introduce a new ſpecies, communicated by Mr. G. Hibbert among the reſt of his dried ſpecimens of this genus from the Cape, and by Meſſrs. Lee and Kennedy from their garden, where it firſt bloſſomed in 1808. We would name it

E. roſaria. Leaves in four rows, obtuſe, recurved, toothed. Anthers ſimple, included, with long pores. Corolla ovate, viſcid. The leaves reſemble thoſe of *phyſodes*, but are more diſtant and recurved. Flowers about the ends of the branches, on moſtly axillary, long, viſcid ſtalks, with two or three oblong, pellucid, concave bracteas towards their middle; the flowers droop a little, and are remarkable for their fragrant ſcent, reſembling ottar of roſes. The calyx-leaves are like the bracteas, and about one-third as long as the corolla, which is of a pale ſtraw-colour, ovate, inflated, viſcid, its ſegments obtuſe, crenate, but little ſpreading. Stamens about the length of the calyx; their filaments purple at the ſummit, without any ereſt or appendages; anthers brown, oblong, with pores two-thirds of their length. Germen turbinate, furrowed, ſmooth; ſtyle twice as long as the ſtamens; ſtigma capitate, dark coloured.

E. pulchella, Saliſb. a new ſpecies, ſtands alone, the author being unacquainted with its affinity to any other.

Two others, unknown to us, occupy a ſection with *glutinoſa*, Berg. Cap. 98. Ait. and Bau. Ic. t. 17. (*Andromeda droſeroides*, Linn. Mant. 2. 239.) This is a beautiful plant, with all the habit of an *Erica*, nor any thing but an occaſional luxuriance of number in the parts of the flower to make it an *Andromeda*.

A very ſplendid and diſtinct aſſemblage follows, of ſix ſpecies, diſtinguiſhable by their large flowers, with a long tube, always contracted at its mouth, and more or leſs inflated below. The border is ſpreading and ornamental. Among theſe are *retorta*, Linn. Suppl. 220. Curt. Mag. t. 362, firſt found at the Cape by Maſſon, not by Thunberg;—*ampullacea*, Curt. Mag. t. 303;—and *Aitonia*, Curt. Mag. t. 429. This laſt varies a little in the ſize and hue of its border, but ſo ſtrikingly reſembles the Catalonian Jaſmine, that we long ago named it *jaſminea*, nor is there any occaſion for the uncouth preciſion of *jaſminiflora*.—We have ſtill ſome of this tribe, which appear to be nondeſcripts.

Ten

Ten ſpecies with flowers of a ſomewhat ſimilar form but ſmaller, and more ſlender needle-ſhaped leaves, conſtitute the next parcel. To this belongs *faſtigiata*, Linn. Mant. 66, of which there are ſeveral elegant varieties, named *E. Humea*, &c. in the gardens. Alſo *E. Muſcari*, Andr. t. 1. ſmelling like the Muſky Hyacinth, which it imitates in colour;—and *comoſa*, Linn. Mant. 234, Ait. and Bau. Ic. t. 18.

A tribe more ſplendid in general, of nine ſpecies, ſucceeds. To theſe belong *inflata*, Thunb. Diſſ. 41. t. 2;—*ventricoſa*, ibid. 27. t. 1. Curt. Mag. t. 350;—*lutea*, Linn. Mant. 234. Andr. t. 11;—*articularis*, Linn. Mant. 65. Curt. Mag. t. 423;—and *taxifolia*, Ait. and Bau. Ic. t. 19.

Two ſpecies, indicated as nearly related to the laſt, cloſe Mr. Saliſbury's liſt of 246 in all. Theſe are *tetragona*, Thunb. Diſſ. 14. t. 4;—and *albens*, Linn. Mant. 231. Curt. Mag. t. 440.

We truſt, that thoſe who may have occaſion to deſcribe new heaths in future, will, as far as they are competent, keep the above arrangement in view, as they will find it very inſtructive, however they may differ from Mr. Saliſbury in principles of nomenclature. To this ſubject we have ſcarcely found it neceſſary to advert, except occaſionally, and we rather paſs over in ſilence what we cannot approve. This botaniſt rejects all names of perſons as applied to the ſpecies of any genus. Mr. Dryander once began a more uſeful reformation in ſuch names of *Erica*, making thoſe which commemorate a writer on the ſubject end in *ana*, as *Sebana*; thoſe which apply to a collector only, in the genitive caſe, as *Maſſoni*. The greateſt and moſt correct information is ſtill to be expected from this able botaniſt, in the intended new edition of Mr. Aiton's *Hortus Kewenſis*, where the genus of *Erica* muſt always make a pri cipal figure. S.

Erica, in *Gardening*, comprehends plants of the evergreen, flowery, ſhrubby kind; moſtly exotics; of which the ſpecies moſt in cultivation, according to Martyn, are: the croſs-leaved heath (E. tetralix); the fine-leaved heath (E. cinerea); the double-anthered heath (E. didyma); the tree heath (E. arborea); the Spaniſh heath (E. auſtralis); the many-flowered heath (E. multiflora); the Mediterranean heath (E. Mediterranea); the yellow heath (E. lutea); the purple-ſtalked heath (E. halicacaba); the bladder-flowered heath (E. monſoncana); the mucous heath (E. mucoſa); the hairy-flowered heath (E. urceolaris); the marum-leaved heath (E. marifolia); the bloody-flowered heath (E. cruenta); the ſlender-branched heath (E. rumentacea); the bluſh-flowered heath (E. perſoluta); the three-flowered heath (E. triflora); the arbutus-flowered heath (E. baccans); the ſlender-twigged heath (E. corifolia); the crow berry-leaved heath (E. nipetrifolia); the woolly heath (E. capitata.); the tube-flowered heath (E. tubiflora); the long-tubed yellow heath (E. conſpicua); the honey-wort-flowered heath (E. cerinthioides); the tufted-flowered heath (E. comoſa); the tall downy heath (E. Maſſoni); the ſmooth-twigged pencil-flowered heath (E. Plukenetii); the downy twigged pencil-flowered heath (E. Petiveri); the early-flowered dwarf heath (E. herbacea); and the great flowered heath (E. grandiflora). But there are many other ſpecies equally deſerving of cultivation.

Concerning the firſt of theſe ſpecies, it is obſerved by the editor of Miller's dictionary, that it is not inferior to many of the foreign heaths in the beauty and delicacy of its flowers. It is diſtinguiſhed from the other Britiſh heaths not only by the flowers growing in a kind of pendulous cluſter on the tops of the ſtalks, but by the leaves growing in fours, and forming a ſort of croſs.

The whole of the different ſpecies of heaths which are mentioned above, are plants of conſiderable beauty and elegance, but moſtly tender and delicate in their habits of growth.

Method of Culture.—Theſe very elegant plants muſt be treated in different methods, according to their nature and habits of growth.

The firſt three Britiſh ſorts are capable of being propagated by ſowing the ſeeds either in the places where they are to remain, or in pots filled with peaty earth, in either the autumn or ſpring ſeaſons; but this is a tedious method of practice. The better method is, therefore, to take them up from the places where they grow naturally, in the early autumn, with good balls of earth about their roots, planting them again immediately where they are to grow and remain for ornament.

They are found to ſucceed beſt where the ſoil is of the peaty or moory kind, and where it has not been enriched by manure; and as they protrude their roots chiefly near the top, it ſhould be as little dug about them as poſſible, the ſurface only being kept clean and free from rubbiſh.

And the four following ſorts may be increaſed in the ſame manner as the above; but the beſt practice is by layers, cuttings, or ſlips, which ſhould be laid down or planted out in pots filled with boggy earth either in the early ſpring or the latter end of ſummer, plunging them in a moderate hot-bed, and giving them proper ſhade and water. When they have taken full root, they ſhould be carefully removed with balls of earth about them into ſeparate pots, being replaced in the hot-bed till they become well eſtabliſhed when they will be capable of bearing the open air in mild weather when the ſeaſon is ſuitable.

All the other ſpecies may be increaſed either by cuttings or layers, but moſt of them by the former. The cuttings ſhould be made from the beſt young ſhoots, and be planted in the ſpring ſeaſon in pots filled with a compoſition of light boggy and loamy earth, being placed in the hot-bed, and covered with bell-glaſſes, and duely ſhaded from the ſun, ſlight waterings being given when neceſſary; the layers are beſt laid down in the autumn, being managed in the ſame way as the cuttings. When the plants have become perfectly rooted, they ſhould be removed into ſeparate pots filled with the ſame ſort of mould, being then put in the dry ſtove or green-houſe, where ſome of them require to be conſtantly placed.

But the ninth, twentieth, and twenty-ſixth ſpecies muſt be raiſed by layers, as they have not yet been increaſed by planting their cuttings in the manner directed above.

Where ſeeds are made uſe of in producing theſe plants, they ſhould be ſown in pots filled with the above ſort of earth in the early ſpring, and plunged in the hot-bed of the ſtove. When the plants have acquired a few inches growth, they ſhould be removed into ſingle pots with a little earth about their roots, and be replunged in the hot-bed in the ſtove, being preſerved in it, or the warmeſt part of the green-houſe, during the winter ſeaſon, and whenever the weather is bad.

The firſt three ſorts afford an agreeable variety in the borders and clumps, as they continue long in flower. The four following kinds are likewiſe hardy, and afford variety among other potted plants in the open air during the ſummer months.

All the other ſpecies are more tender, but produce as agreeable an effect among the ſtove and green-houſe collection, from the great beauty and continuance of the flowers in many of the ſorts.

Erica *marina*, *ſea-heath*, a name given by many authors to to a very beautiful zoophyte of the fucus kind, called by Mr. Ray and fome others the fucus ericæ folio.

Erica, in *Ichthyology*, a name given by Gaza and fome others, as the interpretation of the chalchis of Ariftotle, that is, as the name of the common herring.

ERICÆ, in *Botany*, the third natural order in the ninth clafs of the fyftem of Juffieu, fo named from the genus *Erica* which makes a part of it. This order confifts of fuch dicotyledonous monopetalous plants as have perigynous ftamens, and the following diftinguifhing characters. *Calyx* of one leaf, permanent, fometimes fuperior, more frequently inferior and deeply divided. *Corolla* of one petal, fometimes deeply divided, inferted either into the upper part of the calyx, more commonly into its lower part, or into a gland at its bafe; moftly withering and permanent. *Stamens* of a definite number, diftinct, inferted into the fame part, or rarely originating from the lower part of the corolla; anthers moftly with two horns at the bafe. *Germen* fuperior, or rarely inferior; ftyle folitary; ftigma generally fimple. *Fruit* either fuperior or inferior, with many cells and many feeds, either pulpy, or more generally dry with many valves, fixed by their bafes to the central axis, the partitions originating from the middle of each valve. *Seeds* generally minute. *Stem* fhrubby, of a more or lefs elevation, or herbaceous. *Leaves* alternate, or oppofite, or whorled.

This order is in a great meafure analogous to the Linnæan *Bicornes*, exclufive of the *Rhododendra* of Juffieu, which differ from his *Ericæ* chiefly in having the partitions of the capfule formed of the inflexed margins of its valves, and not originating longitudinally from their centre. Ventenat retains the name of *Bicornes* for the *Ericæ*.

The *Ericæ* are divided by Juffieu into two fections, 1. *Germen* fuperior, confifting of *Cyrilla*, Linn. (which being of the fame genus as *Itea*, and having the capfule of the *Rhododendra*, is to be removed thither); *Blæria*; *Erica*; *Andromeda*; *Arbutus*; *Clethra*; *Pyrola*; *Epigæa* (removed by Ventenat to *Rhododendra*); *Epacris* (omitted by Ventenat); *Gaultheria*; and *Broffæa* (likewife omitted by Ventenat, a very uncertain plant).

2. Germen wholly or partly inferior, *Argophyllum*, Forft. and Linn. fil.; *Mæfa*, Forfk; and *Vaccinium*.

A third fection contains two genera allied to *Ericæ*, or fuppofed to be fo, *Empetrum* and *Hudfonia*.

ERICALE, from ηρ, the *fpring*, and καλη, *beautiful*, a name given by Renealm in his Specimen Hift. Plant. 75. t. 68. to the *Gentiana verna*, a moft elegant vernal plant. Linnæus erroneoufly prints it *Ericoila*.

ERICERUM, a name given by Aetius and other authors to a fort of collyrium, ufed in weakneffes of the eyes, in which the herb erica or heath was an ingredient.

ERICEYRA, in *Geography*, a town of Portugal, in the province of Eftremadura, on the fea-coaft; 20 miles N. W. of Lifbon.

ERICHTHONIUS, in *Aftronomy*, a conftellation, the fame as Auriga.

ERICOILA, in *Botany*. See Ericale.

ERICU, a name given in Rheede's Hortus Malabaricus, v. 2. 53. to the *Afclepias gigantea*. It is corrupted from the Sanfcrit name *Roey*.

ERICUSA, in *Ancient Geography*, one of the feven Æolian iflands, now *Alicuda*.

ERIDANUS, in *Aftronomy*, a conftellation of the fouthern hemifphere, in form of a river.

The ftars in the conftellation Eridanus, in Ptolemy's Catalogue, are 34; in Tycho's, 19; in the Britifh Catalogue, 84. See Constellation.

Eridanus, in *Ancient Geography*, a river of Italy, in Cifalpine Gaul, now the Po, which fee. Virgil defcribes it as the largeft river of Italy, calling it the king of rivers:

"Fluviorum rex Eridanus."

—Alfo, a fmall river of Greece, in Attica, which purfuing its courfe to the W. of Athens, united with the Iliffus below that city.—Alfo, a river of Celtica, near the Pyrenées.

ERIE, Fort, in *Geography*, a ftrong fortification in the townfhip of Bertie, Upper Canada, fituated on the N. fhore of lake Erie, at its eaftern extremity, and the W. bank of Niagara river; 27 miles S. by E. from Niagara fort, 18 above the carrying place of the Falls of Niagara, and 45 from fort Chippeway. This is a fmall ftockaded fort, fomewhat fimilar to that at Chippeway; and adjoining it are extenfive ftores as at Chippeway, and about half a dozen miferable little dwellings. It has a barrack for troops and a block houfe; and a company of foldiers is quartered here for the purpofe of tranfporting the public ftores. The lake narrows here into the Detroit ftrait, which carries the waters over the great falls of Niagara. The new fort is projected on a fmall height in the rear of the prefent garrifon. The harbour is capable of accommodating veffels of any fize, which lie oppofite to the fort, at the diftance of about 100 yards from the fhore, expofed to the violence of the wefterly winds; but the anchorage is good, and they ride in perfect fafety. The little fort, with the furrounding huts built on the rocky fhore, the veffels lying off at anchor before it, the rich woods, the diftant hills on the oppofite fide of the lake, and the vaft lake itfelf, extending to the fartheft part of the horizon, altogether form an interefting and beautiful fcene. N. lat. 42° 53′ 17″. W. long. 78° 20′ 30″.

Erie, *Lake*, called alfo *Eric*, *Erige*, or *Erike*, or the lake of the Cat, is a lake of the fourth magnitude in North America, through which runs the line between the United States and Upper Canada. Detroit river on the weft brings the waters of the great lakes with which lake Erie has a communication on the north-weft; and Niagara river on the eaft forms its communication with the waters of lake Ontario and the river St. Lawrence. It is fituated between 41° and 43° N. lat. and between 78° 48′ and 83° W. long. It is of an elliptical form, being about 300 miles in length, and about 90, at the wideft part, in breadth. The depth of water in this lake is not more than 20 fathoms, and in calm weather veffels may fecurely ride at anchor in any part of it; but when ftormy, the anchorage in an open part of the lake is not fafe, the fands at the bottom not being firm, and the anchors being apt to lofe their hold. At this time the water becomes turbid, by the wafhing up of the yellow fand from the bottom of the lake; but in calm weather it is clear, and of a deep greenifh colour. The northern fhore of the lake is very rocky, which is alfo the cafe with the fhores of the iflands, of which there are feveral clufters towards the weftern extremity of the lake; but along moft parts of the fouthern fhore there is a fine gravelly beach. The height of the land bordering the lake is very unequal; in fome places long ranges of fteep mountains rife from the very edge of the water; in others, the fhores are fo flat and fo low, that when the lake is raifed a little above its ufual level, in confequence of a ftrong gale of wind fetting in towards the fhore, the country is deluged for miles. To the very great infularity of the height of the land on both fides of it, is attributed the frequency of ftorms on this lake; the coaft, however, on both fides, is generally favourable for the paffage of batteaux and canoes. A peninfula, called Longpoint, runs upwards of eighteen miles into

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the lake, and being compofed of fand, is convenient for hauling boats upon it, when the lake is too rough for failing and rowing. Towards the fouth fide, however, on both fides of the lake, it would be impoffible to land, on account of the perpendicular height of the rocks. There is a great deficiency of good harbours along the fhores of this lake: on its northern fide there are but two places which afford fhelter to veffels drawing more than feven feet water, *viz.* Long Point, and Point Abineau, and thefe afford only a partial fhelter. On the fouthern fhore, the firft harbour you come to in going from fort Erie is that of Prefqu'tele, which is fituated at the diftance from that fort of about fix miles, and where veffels drawing eight feet water may ride in perfect fafety. Beyond this, about midway between the eaftern and weftern extremities of the lake, there is another harbour, capable of containing fmall veffels at the mouth of Cayahega river, and another at the mouth of Sandufky river, which falls into the lake within the N. W. territory of the States. Britifh fhips feldom ufe thefe harbours, but trade almoft folely between fort Eric and Detroit river, and in cafe of contrary winds, they return to fort Erie, if bound to Detroit river; or to fome of the bays amidft the clufters of iflands fituated towards the weftern extremity of the lake, if bound to fort Erie. The navigation of this lake is very uncertain; and veffels are often detained, at a confiderable expence to paffengers, in fome of the harbours. Lakes Huron and Michigan afford communication with lake Erie, by veffels of eight feet draught. There are portages into the waters of this lake from the Wabafh, Great Miami, Mufkingam, and Alleghany, from two to fixteen miles. The iflands at the weftern end of the lake, of various fizes, lie very clofe to each other, and exhibit a very pleafing fcenery; the largeft of them are not more than fourteen miles in circumference, and many of them are very fmall. The largeft iflands produce a variety of fine timber, amongft which are found oaks, hiccary trees, and red cedars, which latter, being large, are fent for even from the Britifh fettlements on Detroit river, at the diftance of forty miles. Lake Erie has a great variety of fine fifh, fuch as fturgeon, eel, white fifh, trout, perch, &c. Amongft the woods are found racoons and fquirrels, and alfo bears, in the winter feafon, when the lake is frozen between the main land and the iflands. All the iflands are dreadfully infefted with ferpents, and on fome of them rattlefnakes are fo numerous, that in the height of fummer it is dangerous to land. Two kinds of rattlefnakes are found in this part of the country; the one is of a deep brown colour, clouded with yellow, about thirty inches in length, which frequents marfhes and low meadows, and does great mifchief among cattle: the other fort is of a greenifh yellow colour, clouded with brown, and nearly twice the fize of the former. Many different kinds of ferpents, befides rattlefnakes, are found on the iflands in lake Erie. The ponds and marfhes in the interior parts of thefe iflands abound with ducks and other wild fowl, and the fhores fwarm with gulls; among the woods are a few fmall birds, remarkable neither for their fong nor plumage. Weld's Travels, vol. ii.

Erie, a county of Pennfylvania, on the fouth fide of lake Erie, containing 639,400 acres, and 1468 inhabitants. Its chief town is Erie.

ERIEUX, a river of France, which runs into the Rhone, at Beauchaftal.

ERIFFS, a name given to canary birds when about two years old. See Canary *Bird*.

ERIGENA, John Scotus, in *Biography*, who flourifhed in the ninth century, was probably born in Ayrfhire Scotland, though fome writers make him a native of Herefordfhire, in England, and others fuppofe his birth-place to be Ireland. He poffeffed an ardent thirft for literature, and fpared no pains in rendering himfelf accomplifhed in the learning of the Eaft, and from the extent of his erudition he obtained the name of "Scotus the Wife." He ftudied fome years at Athens, and became very converfant in Greek philofophy. Upon his return, he accepted an invitation from Charles the Bald of France, and lived for feveral years in habits of intimacy and familiarity with his royal patron, who affigned to him the direction of the univerfity of Paris. To the fovereign he was not only an inftructor in literature and fcience, but an advifer in the affairs of government. The high rank which he obtained excited much jealoufy, particularly among the bigotted priefts, who accufed him of maintaining heretical opinions. In the year 824, the Greek emperor, Michael the Stammerer, fent to the Weftern emperor, Lewis the Pious, a copy of the treatifes of the fuppofed Dionyfius the Areopagite, which had long been held in great veneration among the Greek Chriftians. Dionyfius was fuppofed to be the firft Chriftian teacher in France, and, on that account, the work in queftion was deemed of great value, and the king, who was unable to read the original Greek, employed Erigena to tranflate it into the Latin language. Unfortunately this was performed without licence from the pope, who, when he found the tranflation eagerly read, infifted that the French king fhould not only banifh Erigena from Paris, but fhould fend him to Rome. Charles refufed to act in this ungenerous manner, neverthelefs, it was deemed advifable, that Erigena fhould leave the capital of France, and in a fhort time after he took refuge in England. This tranflation of Dionyfius's treatifes is faid to have caufed the revival of the knowledge of the Alexandrian Platonifm in the Weft, and to have laid the foundation of the myftical fyftem of theology which afterwards fo generally prevailed. Of the original works of Erigena, the principal was his treatife "On the Divifion of Nature, or the Nature of Things," which was publifhed from the author's MS. by Dr. Thomas Gale, at Oxford, in 1681, under the title of "Joannis Scoti Erigena de Divifione Naturæ, Libri quinque, diu defiderati." Erigena was employed by our great king Alfred in the reftoration of learning at Oxford, where he was appointed profeffor of mathematics and aftronomy. In this fituation he remained only about three years, when fome differences that took place in the univerfity obliged him to retire to the abbey of Malmfbury in Wiltfhire, where he opened a fchool. Here, it is afferted, by moft writers, that he was murdered by his own fcholars, either on account of his harfhnefs and undue feverity; or at the inftigation of the monks, who hated Erigena as being a heretic, and much more learned than themfelves. The particular time and place of his death have been the fubjects of fome difpute. Certain writers contend that his death took place about the year 864 or 866, and others, who are generally followed, make it in 883. Some fay he died in England, and others, among whom is Dr. Henry, think that it happened in France. He was certainly a very extraordinary man for the times in which he lived, and after his deceafe his name was, for a confiderable time, to be found in the lift of the faints of the Romifh church, till it was ftruck out of the calendar, by Baronius, on account of the heterodoxy of his opinions concerning tranfubftantiation. Biog. Brit. Enfield's Hift. Phil.

ERIGENS Penis. See Erector.

ERIGERON, in *Botany*, ἠριγέρων of the ancient Greeks, from ἦρ, *the fpring*, and γέρων, *an old man*, becaufe it is hoary in the fpring. Linn. Gen. 422. Schreb. 553. Willd. Sp.

Pl. v. 3. 1952. Sm. Fl. Brit. 876. Mart. Mill. Dict. v. 2. Juff. 180. Gærtn. t. 170. Clafs and order, *Syngenefia Polygamia-fuperflua.* Nat. Ord. *Compofitæ difcoideæ,* Linn. *Corymbiferæ,* Juff.

Gen. Ch. *Common calyx* oblong, cylindrical, imbricated; fcales awl-fhaped, erect, gradually longer, nearly equal in breadth. *Cor.* compound, radiated; *florets* of the difk all perfect, tubular, funnel-fhaped, with an equal five-cleft limb; thofe of the radius female, ligulate, linear, awl-fhaped, erect, for the moft part entire. *Stam.* (in the tubular florets) Filaments five, capillary, very fhort; anthers forming a cylindrical tube. *Pift.* (in the tubular florets) Germen minute, crowned with hairs longer than its own corolla; ftyle thread-fhaped, the length of the hairs; ftigmas two, oblong, revolute: the female or ligulate florets differ in having their corolla about as long as the hairs, and very flender ftigmas. *Peric.* none, except the clofed permanent calyx. *Seeds,* in the florets of the difk as well as of the radius oblong, fmall. *Down* long, capillary. *Recept.* naked, flat.

Obf. Dillenius obferves that the innermoft or central florets of the difk are generally males. One fpecies has thofe of the radius deftitute of a corolla.

Eff. Ch. Receptacle naked. Down fimple. Florets of the radius linear, very narrow, numerous. Calyx imbricated.

This genus comprehends feveral plants called *Conyza, Virga-aurea, After,* and *Senecio* by former writers, but is a very natural one, characterized by the erect very narrow florets of its radius, ufually coloured blue or white. The lateft edition of Linnæus has 22 fpecies, Willdenow 32. Three are natives of Britain.

1 E. *canadenfe,* Engl. Bot. t. 2019. " Stem hairy, panicled. Leaves lanceolate; the lower ones toothed."—To all appearance perfectly wild in Glamorganfhire, (Mr. Middleton), though fuppofed by Ray to have come over from North America, where it abounds. It is an annual plant, of mean appearance, with innumerable fmall flowers, whofe radius is white or pale red, their difk yellow.

2. E. *acre.* Engl. Bot. t. 1158. Curt. Lond. fafc. 1. t. 60. " Stem racemofe. Stalks moftly fingle-flowered. Leaves lanceolate or tongue-fhaped, feffile."—Common on a dry gravelly or chalky foil, flowering in July and Auguft. The flowers are larger and fewer than in the former; their radius blue. Root biennial.

3. E. *alpinum.* Engl. Bot. t. 464. " Stems almoft fingle-flowered. Calyx flightly hairy. Radius fpreading."—Found in moift parts of the highland mountains of Scotland, flowering in July. This has feldom more than one flower on a ftem, which is much larger than in E. *acre,* with a longifh blue radius, which fpreads more than is confiftent with the generic character, and, perhaps, might authorize the removal of this fpecies to *After,* where Linnæus originally placed its near ally E. *uniflorum,* Fl. Lapp. n. 307. t. 9. f 3.

ERIGONUS, in *Ancient Geography,* a river of Macedonia, which, according to Livy, ran from Illyria through Pæonia into the Axius; called *Erigon* by Strabo and Ptolemy.

ERINACEA, in *Botany,* Tourn. Inft. 646, fee Anthyllis, fp. 15. Tournefort eftablifhed it as a genus, (diftinct from his *Genifta-Spartium,* which confifts of *Ulex* and the prickly *Geniftæ,*) merely becaufe the bufh is all over armed with prominent ftrong fpines, like a hedge-hog.

ERINACEUS, a name given by Dillenius and Micheli to a genus of *Fungi.* Linnæus, perceiving the inconvenience and abfurdity of adopting a generic denomination, already univerfally appropriated to an animal, changed it to *Hydnum.*

Erinaceus, in *Zoology,* a genus of the Feræ order, the hedge-hog of Englifh authors. This tribe is diftinguifhed principally by the teeth. The fore-teeth in the upper jaw are two, and diftant, in the lower two approximate; the tufks in the upper jaw five each fide, in the lower three; grinders four each fide above and beneath; body above covered with fpines.

Species.

Europæus. Ears rounded; noftrils crefted. Linn. Fn. Suec. *Erinaceus auriculis erectis,* Briff. *Echinus terreftris,* Gefn. *Igel,* Knorr. *Heriffon,* Buff. *Common hedge-hog.*

The common hedge-hog, or as it is fometimes called erroneoufly the European hedge-hog, appears to be a native of the temperate parts of Afia, and to be found in Madagafcar as well as Europe. It lives in thickets and bufhes, forming a neft of mofs, grafs, or leaves, of large fize. When difturbed it rolls itfelf up into a globular form, prefenting on every part a formidable armament of fpines, and this is indeed its principal means of defence; upon being immerfed in cold water it expands, and fwims with perfect facility. During the winter it is fuppofed to remain in a ftate of torpidity.

Vegetables of various kinds, as the roots of plants, or fruits, reptiles, fmall birds and infects, conftitute the principal food of this animal; the Calmucs tame and keep it in their dwellings like the cat; and in this refpect they become ufeful, as they deftroy the cockroaches, and other obnoxious infects. They produce from three to five young at a birth. The flefh is very indifferent, yet is fpoken of among the old writers as an article of food, with inftructions for roafting or otherwife preparing it for the table.

The hedge hog is confidered as an inoffenfive animal, notwithftanding the vulgar fuppofition, that it fucks the teats of cattle by night, and occafions ulcerations in thofe tender parts with the irritation of their prickles. The animal has a mufky fmell. Length ten inches.

Inauris. Without external ears. Linn. Seba. *Guiana hedge-hog.*

Length eight inches. Inhabits South America. The head is thick, fhort; fpines cinereous tinged with yellow; hair foft, whitifh chefnut over the eyes; tail fhort; claws long and crooked. Defcribed on the authority of Seba.

Auritus. Ears oval, long. *Auriculis ovalibus longis, naribus criftatus,* Pallas. Nov. C. Pet. *Siberian hedge-hog.*

Inhabits the lower parts of the Volga and Ural and extends from thence to the eaftern parts beyond the lake Baikal. Its form refembles that of the common hedge-hog, but is fmaller, the eyes larger, wifkers difpofed in four rows; the feet longer, more flender; tail fhorter, conic, annulated, and nearly bald. The female is faid to breed twice a year, and to produce from four to feven each time.

Malaccensis. Ears pendulous. Briff. *Hyftrix brachyura,* Linn. *Porcus aculeatus, f. Hyftrix malaccenfis,* Seba. *Malacca hedge-hog.*

Extremely allied in its general appearance to the porcupine, and referred to the hedge-hog tribe chiefly on account of the number and arrangement of the teeth. Its fize is fuppofed to be equal to that of the common porcupine. This animal is faid to inhabit Afia, and to produce the precious ftone called Piedra del Porco, the imaginary virtues of which are fo highly extolled in the old materia medica.

Setosus. Ears fhorter; top and hind head and fhoulders befet with fpines; tail very fhort and fpinous. *Erinaceus*

ceus setosus, Gmel. Schreber. *Tendrac*, Buff. *Petit tendrac de Madagascar*. Sonner. *Asiatic hedge-hog*.

Native of India and Madagascar; length six inches; wallows in the mire, and grunts like a hog, and forms burrows. Remains torpid for six months, during which the hair falls off.

Ecaudatus. No tail; snout very long and acute. Schreber. *Tanrec, et le jeune tanrec*, Buff. *Madagascar hedge-hog*.

Inhabits India and Madagascar. In habit resembles the former, but is larger, measuring in length eight inches. The mouth and eyes are small; ears rounded and longer than in the setosus; the spines black, and covering the whole back and sides; hair yellowish and feet tawny.

The two last mentioned animals are considered by Pennant as the same species, on the presumption that the former is the adult state, the other in a less advanced stage of growth. Dr. Shaw seems inclined to adopt this supposition. There, nevertheless, appears in our mind no plausible reason for such conjecture, unless the descriptions be defective in the most essential particular; for, if one has a tail and the other none, they must be distinct. That the animal described by Buffon had not obtained its full growth is rendered extremely probable by the explanation afforded, but the production of a tail cannot be supposed to depend on the age of the animal. The tanrec feeds on fruits, and remains torpid during about three months of the year.

ERINÆI, in *Ancient Geography*, a people of Asiatic Sarmatia. Ptolemy.

ERINDES, a river of Asia, towards Hyrcania or Sparta, according to Tacitus.

ERINEUS, one of the four cities of Doris, situate on the most northern verge of the kingdom, near the foot of the hills which part Doris from Macedonia.—Also, a port of the sea of the Peloponnesus, in Achaia, between Ægium and the promontory Rhium. Pliny.—Also, a river of Sicily, according to Thucydides, called *Orinos* by Ptolemy.

ERINGO. See Eryngo.

ERINNA, in *Biography*, a Greek poetess, mentioned by different writers as a native of Lesbos, of Teios, of Rhodes, and of Tenos in Laconia, is supposed to have been contemporary with Sappho, about the year 600 B.C. but she is placed by the Chronicle of Eusebius 250 years later. She was celebrated in ancient Greece, and several epigrams were written upon her, one of which speaks of her as inferior to Sappho in lyrics, and superior in hexameters. Some fragments are extant in her name, which are inserted in the "Carmina Novem Poetarum Fœminarum." Antw. 1568. Voss. Poet. Græc.

ERINUS, in *Botany*, a name adopted by Linnæus from Dioscorides, the etymology of which is unknown. Neither is his ερινος the same with the Linnæan plant, but rather, we presume to think, something which has hitherto eluded the sagacity of commentators. His description accords in some points with *Samolus Valerandi*.—Linn. Gen. 318. Schreb. 4:7. Willd. Sp. Pl. v. 3. 332. Mart. Mill. Dict. v. 2. Juss. 100. Gærtn. t. 55.—Class and order, *Didynamia Angiospermia*. Nat. Ord. *Personatæ*, Linn. *Pediculares*, Juss.

Gen. Ch. *Cal.* Perianth in five deep, lanceolate, erect, nearly equal, permanent segments. *Cor.* of one petal, unequal; tube cylindrical, somewhat ovate, the length of the calyx, reflexed; limb flat, in five deep, nearly equal, inversely heart-shaped segments. *Stam.* Filaments four, very short, within the tube of the corolla; two of them (the uppermost) a little longer than the others; anthers small. *Pist.* Germen nearly ovate; style very short; stigma capitate. *Peric.* Capsule ovate, invested with the calyx, of two cells and two valves, the latter cloven half way down when ripe; partition double. *Seeds* numerous, small. *Recept.* compressed.

Ess. Ch. Calyx of five leaves. Limb of the corolla in five, nearly equal, notched segments. Capsule of two cells. Seeds numerous.

Obs. By an unaccountable error in the Ess. Char. in all the editions of Linnæus the upper lip is said to be very short and reflexed, though the whole limb of the corolla is justly described as (nearly) equally five-cleft. Willdenow copies this, though the Hortus Kewensis had corrected it.

E. *alpinus* is the best-known species. "Flowers racemose. Leaves spatulate."—Linn. Sp. Pl. 878. Curt. Mag. t. 310. Native of the alps of Switzerland, and the Pyrenæan mountains, flowering in the middle of summer. It forms tufts, with several dwarf stems, bearing numerous purple flowers, and is a very ornamental plant for rock-work, requiring protection against severe frost and excessive moisture, like most alpine rock plants. It is increased by parting the roots, or by seed.

E. *africanus*. "Flowers axillary, sessile. Leaves lanceolate, slightly toothed."—Linn. Sp. Pl. 878. (Lychnidea villosa, foliis ex alis floriferis, &c.; Burm. Afr. t. 50. f. 1.) Native of the Cape of Good Hope. This has a taller, more branched stem, more oblong leaves, and axillary flowers, of what colour we know not, with a very long slender curved tube. It has not yet appeared in our gardens.

E. capensis. "Flowers spiked. Leaves linear, toothed."—Linn. Mant. 252, excluding Burman's synonym. Gathered by Sparmann in sandy ground at the Cape of Good Hope. This is also a stranger to our gardens. The flowers are said to be yellow and very fragrant. In the dried plant they are black. The tube is an inch and half long; the segments of the limb deeply cloven, the lobes dilated, obtuse and divaricated.

E. *fragrans*. "Leaves lanceolate-oblong, toothed. Segments of the limb undivided."—Ait. H. Kew. v. 2. 357. (Selago Lychnidea; Linn. Sp. Pl. 877. Lychnidea villosa, foliis oblongis, &c. Burm. Afr. t. 49. f. 4.) Native of the Cape, rarely seen in our green-houses. The flowers are yellow or brownish, and fragrant.

E. *tristis*. "Leaves oblong, cut, toothed. Segments of the limb slightly cloven."—Linn Suppl. 287.—Found by Thunberg at the Cape. The flowers are said to be sweet-scented, and of a dull colour.

E. *peruvianus* and *laciniatus* of Linnæus, are both nearly related to *Verbena Aubletia*, and the former at least seems to be the very same species.

ERIOCALIA, from εριον, *wool*, and καλια, *a nest*, in allusion to the singularly woolly involucrum in the midst of which the flowers are seated as in a bird's nest. Sm. Exot. Bot. v. 2. 37. Intr. to Bot. 373. (Actinotus; Labillard. Nov. Holl. 67.) Class and order, *Pentandria Digynia*. Nat. Ord. *Umbellatæ*.

Gen. Ch. *Umbel* simple, of many short rays. *Invol.* of many lanceolate, equal, undivided, coloured leaves, longer than the rays of the umbel, and densely clothed with wool. *Cal.* Perianth superior, in five deep, equal, concave, sometimes coloured, externally hairy, permanent leaves. *Cor.* none. *Stam.* Filaments five, about as long as the calyx, equal, awl-shaped; anthers roundish, of two lobes. *Pist.* Germen inferior, obovate, compressed, furrowed, very hairy; styles two, capillary, spreading, longer than the stamens; stigmas simple. *Peric.* Fruit ovate, obtuse, compressed, furrowed, hairy, crowned with the calyx and styles. *Seed.* solitary?

Ess. Ch. Umbel simple. Involucrum of many lanceolate,

late, equal, woolly, coloured leaves, longer than the umbel. Fruit compressed, hairy. Petals none. Many flowers abortive.

This New Holland genus bears the most striking analogy to the European *Astrantia*, from which it differs in its woolly, not smooth, involucrum, but more essentially in having no petals, and in its hairy, not muricated, fruit. M. Labillardiere had, unknown to us, previously named it *Actinotus*, but that name being already long ago occupied in mineralogy, is untenable in botany.

The only species known are two.

1. E. *major*. Sm. Exot. Bot. v. 2. 37. t. 78. (Actinotus helianthi; Labill. Nov. Holl. 67. t. 92.) "Segments of the leaves bluntish, flat, woolly on both sides. Flower-stalks somewhat corymbose."—Native of the sandy country about Port Jackson, New South Wales, as well as of the west coast of New Holland, flowering in October. The *root* appears to be annual; it is woody and branching. *Stem* solitary, about two feet high, erect, leafy, round, woolly, but little branched except at the upper part, where the long flower-stalks, more or less numerous, grow in a corymbose form. *Leaves* alternate, stalked, three-cleft, lobed and pinnatifid; their segments spreading, linear, entire, flat, a little dilated upward, and bluntish; clothed with dense wool, whiter beneath. *Stipulas* none. *Flowers* terminal, large and ornamental, all over white with a green or rufous tinge. *Involucrum* of eight or ten spreading leaves, each an inch or more in length, peculiarly soft and pliable, like velvet. *Flowers* very numerous, forming a convex compact sort of disk, those of the circumference males. *Calyx* whitish, so as to resemble petals. No aromatic or pungent flavour is perceptible in any part of the plant.

2. *E. minor*. Sm. Exot. Bot. v. 2. 39. t. 79. "Segments of the leaves acute, revolute; smoothish above; silky beneath. Flower-stalks scattered."—Found near Port Jackson, in a sandy or gravelly soil, flowering in March.—Much smaller than the last, and bearing the same analogy to it that *Astrantia minor*, Sm. Exot. Bot. t. 77, does to the *major*, t. 76.—*Root* woody, branched, perhaps perennial. *Stem* a foot or two high, much branched, leafy, round, clothed with close-pressed hairs. *Leaves* on long foot-stalks, divided into three or five deep, spreading, dilated, acute, revolute, pinnatifid or three-cleft lobes; green, smooth, or slightly hairy, above; densely clothed with white silky hairs beneath. *Flowers* on long, solitary, terminal, naked stalks, scarcely a quarter so large as in the other. *Calyx* green, and not coloured. *Involucrum* almost naked underneath; hairy, somewhat silky, white or reddish above. This species is likewise without any peculiar flavour.

ERIOCAULON, from ἐριον, *wool*, and καυλος, *a stem*, because of the woolly or hairy stalk, which however is rarely the case. Linn. Gen. 40. Schreb. 56. Willd. Sp. Pl. v. 1. 485. Sm. Fl. Brit. 1009. Juss. 44. Gærtn. t. 83.—Class and order, *Monoecia Triandria*, Smith. (*Triandria Trigynia*, Linn.) Nat. Ord. *Junci*, Juss.

Gen. Ch. *Common calyx* globose, depressed, imbricated, many-flowered; its scales lanceolate or obovate, obtuse, scariose, equal, permanent; perianth inferior, of two or three obtuse, permanent, muricated leaves. *Male flowers* several, in the middle of the disk. *Cor.* funnel-shaped; tube about as long as the calyx; limb in two deep, obtuse, muricated lobes. *Stam.* Filaments three or four, equal, inserted into the tube of the corolla, and rather longer than the limb; anthers vertical, roundish, of two lobes. *Pist.* Germen obsolete; style capillary, cloven; stigmas blunt. *Female flowers* several, in the circumference, between the calyx-scales. *Cor.* inferior, of two oblong, concave, obtuse petals, muricated at the upper part externally. *Stam.* none. *Pist.* Germen superior, of two or three lobes; style thread-shaped, shorter than the corolla, cloven; stigmas two or three, acute. *Peric.* Capsule roundish, of two or three lobes, with as many cells and valves. *Seeds* solitary.

Eff. Ch. Common calyx of many leaves, many-flowered; perianth superior, of two or three leaves. Male flowers central. Corolla of one petal, cloven. Female fl. in the margin. Corolla of two petals. Stigmas two or three. Capsule of two or three cells. Seeds solitary.

The characters of this genus were so ill defined in the works of Linnæus, that Hudson conceived our British *Eriocaulon*, confounded by Linnæus with his *decangulare*, must be a distinct genus, and he therefore called it *Nasmythia*, in honour of sir James Nasmyth, baronet; see Fl. Angl. ed. 2. 414. As however no genus can be more natural and distinct than *Eriocaulon*, and the fault appears to have been entirely in the descriptions of authors, its characters are now reformed. The above description is made from the only British species, *E. septangulare*, With. 184. Sm. Fl. Brit. 1010. Engl. Bot. t. 733.—"Stalk with seven angles. Leaves sharp-pointed, with an internal network of cells. Male flowers with four stamens." It grows in several lakes in the isle of Skye very abundantly, and was found in September 1801 by Dr. Wade, decorating the edges of all the lakes in Cunnamara, in the county of Galway, Ireland. The *root* is perennial, consisting of abundance of simple, white, shining fibres, composed internally of a series of cells, frequently interrupted by transverse partitions, which is the general structure of the whole herb. *Stalk* a span high, solitary, upright, simple, naked, twisted, with seven angles and as many intermediate furrows, smooth, (so that in this instance the generic name does not well apply), invested with a tubular sheath at the base. *Leaves* numerous, radical, sword-shaped, smooth, taper-pointed, about two inches long. *Head* of flowers terminal, solitary, hemispherical, about three lines broad, prettily variegated with dark purple and white, the calyx and anthers being of the former colour, as well as a few spots on the white corolla. The snow-white club-shaped protuberances, with which the extreme parts of the calyx and corolla are muricated, give the whole an elegant feathery aspect.

Linnæus knew about five species of *Eriocaulon*, but very imperfectly, and he was cautious of adopting Dr. Hope's accurate generic description of the above plant, published in the Philosophical Transactions, v. 59. 243. t. 12, lest it should not accord with every species. As far as subsequent examination of the several exotic ones has gone, it is found to confirm the account here given. Willdenow enumerates eight species in all; Lamarck describes 12 in his Encyclopedie, v. 3. 274—277, and figures 4, rather imperfectly, in his t. 50. This last author is, nevertheless, the best we have on the subject, though Willdenow hesitated to follow him, and Vahl, in his Sp. Pl. v. 2. 210, removes his *E. spadiceum*, perhaps rightly enough, to *Schoenus*.

Authors are very much confused in their accounts of the native countries of several species. The *repens* of Lamarck was gathered by Thierry de Menonville in Hispaniola, not by Commerson in the isle de Bourbon. *E. spadiceum* of the same author was found by Smeathman at Sierra Leone, from whom we have it in plenty, and whom Lamarck rightly quotes; yet Vahl mentions St. Domingo (Hispaniola) a its native country, on the authority of Lamarck's herbarium, without naming Smeathman.

The following 6 species we believe are hitherto entirely nondescript. They will probably appear, with others, more fully illustrated hereafter from the pen of Mr. R. Brown,

Brown, when he has time to resume the study of this genus, of which we believe he has ascertained about 30 species. In the mean while, to secure his specific names and our own thus far, we shall attempt definitions of what we have determined from actual observation.

E. *pygmæum*, Soland. MSS.—Stalks aggregate, five-angled. Leaves and sheaths rough; the latter longest. Head globose. Calyx-scales obovate, pointed.—Native of New Holland. *Herb. Linn. fil.* The *stalks* are about two inches high. *Leaves* about half an inch long, being rather shorter than the sheaths of the stalks, which is unusual. *Heads* brownish.

E. *scariosum*.—Stalks aggregate, five-angled. Leaves and sheaths smooth, of equal length. Head globose. Calyx-scales obovate, acute.—Communicated from New South Wales in 1792, by John White, M. D.—*Stalks* five or six inches high. *Heads* of a silvery white, scarcely so large as a pea, being about twice as big as the former.

E. *stupeum*.—Stalk nearly solitary, five-angled. Leaves and sheaths of equal length, densely woolly at the base. Head hemispherical. Calyx-scales obovate, acute. Gathered by Sonnerat at the Isle de Bourbon. *Stalk* sometimes above a span high. *Leaves* spreading, involute when dry, smooth, or nearly so, but enveloped at their base, as well as the sheath of the stalk, by a dense integument of silky wool. *Head* much like that of *E. septangulare*.

E. *latifolium*.—Stalks somewhat aggregate, cylindrical, furrowed. Leaves smooth, taller than the stems. Head hemispherical. Outer calyx-scales rounded, obtuse; inner lanceolate, acute.—Gathered at Sierra Leone by Dr. Afzelius. The very long and broad flat *leaves*, a span in length, are remarkable. The *sheaths* are also large, about half as long as the stalk. *Head* smaller than in the last, variegated with brown and white.

E. *fistulosum*. Brown MSS.—Stalks aggregate, cylindrical, striated. Leaves smooth, twice as long as the sheaths. Head hemispherical. Inner calyx-scales obovate, pointed.—Native of New Holland.—*Stalks* a span high. *Leaves* about half as long, or more, taper-pointed, smooth, rather turgid. *Heads* small, brownish.

E. *depressum*. Brown MSS.—Stalks aggregate, cylindrical, furrowed. Leaves smooth, as tall as the stalks. Head flattened. Calyx-scales wedge-shaped, obtuse. Native of New Holland. *Stalks* about two inches high. *Heads* hemispherical beneath, nearly flat at the top, dark purplish brown.

We have in our descriptions substituted the word stalk (*scapus* or *pedunculus*) for stem, as being more correct. S.

ERIOCEPHALUS, so named by Dillenius from ἐριον, *wool*, and κεφαλη, *the head*, in allusion to the remarkably woolly appearance, singular in the tribe to which it belongs, which this plant makes when in seed. Linn. Gen. 450. Schreb. 586. Willd. Sp. Pl. v. 3. 2384. Mart. Mill. Dict. v. 2. Juss. 186. Gærtn. t. 168.—Class and order, *Syngenesia Polygamia-necessaria*. Nat. Ord. *Compositæ nucamentaceæ*, Linn. *Corymbiferæ*, Juss.

Gen. Ch. *Common calyx* erect, of ten ovate, equal, cohering scales; the five outermost keeled, the inner ones flat. *Cor.* compound, radiated; the perfect florets doubly numerous, constituting the disk; female ones five, making the radius: that of the perfect florets funnel-shaped, with a five-cleft spreading border; of the radius flat, inversely heart-shaped, with three terminal lobes. *Stam.* in the perfect florets, Filaments five, capillary, very short; anthers united into a cylindrical tube. *Pist.* in the perfect florets, Germen obsolete; style simple; stigma cloven, acute: in the female ones, Germen ovate, naked; style simple; stigma pointed, inflexed. *Peric.* none, except the scarcely altered calyx. *Seeds* in the disk none; in the radius obovate, naked. *Recept.* flat, woolly, and the elongated wool which separates the two rows of calyx-scales, is moreover introduced between the perfect and female florets.

Obs. A small compressed body adheres to the base of each scale of the calyx.

Eff. Ch. Receptacle woolly. Seed-down none. Calyx of ten equal leaves. Florets of the radius five, inversely heart-shaped.

The species are two, both shrubs natives of the Cape of Good Hope, and to be met with, though rarely, in our green-houses.

1. E. *africanus*. Linn. Sp. Pl. 1310. Ait. Hort. Kew. v. 3. 278. Curt. Mag. t. 833. (E. sempervirens, foliis fasciculatis & digitatis; Dill. Elth. v. 1. 132. t. 110. f. 134). "Leaves lobed or undivided. Flowers corymbose."—The *leaves* are fasciculated, fleshy, and nearly cylindrical, hoary and glaucous, mostly undivided, sometimes with two or three lobes or notches. *Flowers* resembling many species of Yarrow, *Achillea*, having broad white radiant florets, and a small purple and yellow disk. The *seeds* are enveloped in the long soft hairs of the receptacle which come forth after the flowering is past. It is propagated by cuttings, and flowers from January to March.

2. E. *racemosus*. Linn. Sp. Pl. 1311. Ait. Hort. Kew. v. 3. 279.—"Leaves linear, flat, undivided. Flowers racemose."—The *leaves* are shorter, flatter, and less fasciculated than in the former. *Flowers* in long clusters or rather spikes. *Wool* of the receptacle very long.—Dr. Sims in Curt. Mag. justly refers Gærtner's synonym to the foregoing species, not to this.

ERIOGONUM, from ἐριον, *wool*, and γονυ, *a joint*, in allusion to the woollinefs of the habit, and the jointed structure of the stem. Michaux Fl. Boreali-Amer. v. 1. 246. Class and order, *Enneandria Trigynia*. Nat. Ord. *Holoraceæ*, Linn. *Polygoneæ*, Juss.

Gen. Ch. *Cal.* Perianth inferior, in six deep, obovate, coloured, spreading segments, of which the three innermost are somewhat the largest. *Cor.* none. *Stam.* Filaments nine, occasionally eight or ten, rather longer than the calyx and inserted into its base, hairy in their lower part; anthers roundish, versatile, incumbent. *Pist.* Germen superior, oblong, triangular, with three furrows; styles three, the length of the stamens; stigmas simple, obtuse. *Peric.* Capsule triangular, membranous, not bursting. *Seed* solitary, triangular, sharp at each end, black; with a snow-white, small, farinaceous albumen, and large flat cotyledons.

Eff. Ch. Calyx inferior, coloured, in six deep segments, permanent. Capsule membranous. Seed solitary, triangular. Stigmas simple.

This genus in its parts of fructification very nearly approaches *Polygonum*, but the above characters are sufficient to distinguish it, and the habit, more especially the absence of stipulas, renders it totally distinct. We are possessed of three species, one of which only has been hitherto mentioned.

1. E. *tomentosum*. Michaux as above, t. 24. (Chrysosplenium? oppositifolium; Walter Fl. Carolin. 140.) Calyx woolly, stem-leaves whorled, sessile.—We have been acquainted with this plant ever since November, 1793, when a root brought by Mr. John Fraser from Carolina, flowered for the first time in his garden at Chelsea. It was drawn by Mr. Sowerby, but the figure remains unpublished. Michaux in the mean while has named and described this genus as above, giving an indifferent plate of the only species known to him, which, he says, grows in the dryest fir woods of Carolina

Carolina and Georgia, and which is the very fame as Mr. Frafer's, in whofe herbarium we have feen a fpecimen from Mr. Walter, who named it, with a mark of doubt, *Chryfofplenium oppofitifolium*, not being furnifhed with fufficient materials to judge how far he was correct or not. Michaux has given a fpecific character, a perilous attempt, and indeed an abfurd one, for a folitary fpecies, as it can only by accident ferve to contraft that fpecies with others as yet unknown. The *Root* is perennial, rather woody, ftem a foot or more in height, erect, round, woolly, rufty-coloured, leafy, branched and forked, many-flowered. *Leaves* nearly entire, fomewhat undulated; green, fcattered with loofe, deciduous, rufty down above; denfely woolly and whitifh, with rufty veins, beneath: the *radical* ones cluftered, obovate, two inches in length, on broadifh woolly footftalks about half as long, fpreading: *ftem-leaves* in numerous rather diftant whorls, three or four in a whorl, feffile, fcarcely an inch long, unequal, pointed. *Stipulas* none. *Bracteas* either terminal or from the forks of the ftem, folitary, feffile, cup-fhaped, bluntly toothed, woolly, containing eight, ten, or more inodorous *flowers* on fimple, flender, woolly *ftalks*, each joined in the middle, and fwelling upwards. Segments of the *calyx* elliptical, broad, obtufe, white at the edge, green clothed with rufty wool at the back. The bafe of the *ftamens*, and fummit of the *flower-ftalks*, are tinged with purple. *Fruit* covered by the clofed internal fegments of the calyx, become contracted at their bafe, and a little undulated.

2. E. *parvifolium*. Calyx naked. Stem-leaves ftalked, alternate, ovate, revolute.—Gathered in California by Mr. Archibald Menzies. The *ftem* is fhrubby, branched, leafy, with a deciduous, nearly fmooth bark. *Leaves* alternate or cluftered, about a quarter of an inch long, ovate, obtufe, revolute, almoft if not quite entire; fmooth and fhining above; denfely clothed with rufty wool beneath. *Footftalks* half as long as the leaves, very woolly, dilated at their bafe, but not quite embracing the ftem. *Flowers* very numerous, in denfe, globular, woolly tufts, one terminating each branch, and furmounted by another, on an elongation of the fame branch, two inches above it. *Flower-ftalks* fmooth. *Calyx* fmooth, or very flightly downy at the back, its fegments oblong, obtufe, keeled, entire, not wavy. We have not feen the radical leaves, nor been able to inveftigate the *bracteas*. The round tufts of very copious flowers, and the ftalked fcattered fmall leaves, at once diftinguifh this fpecies.

3. E. *latifolium*. Calyx naked. Stem-leaves ftalked, alternate, heart-fhaped, undulated. Foot-ftalks embracing the ftem.—Gathered in California by Mr. Menzies, with the laft. *Stem* fhrubby. *Branches* round, woolly, leafy. *Leaves* alternate, two inches long, heart-fhaped, bluntifh, undulated and crifped at the edge; covered with a web of deciduous white down above; very woolly and white beneath. *Footftalks* as long as the leaves, woolly, fheathing the ftem with their dilated bafes. Some leaves are cluftered about the end of each branch. *Flowers* not larger than in E. *parvifolium*, and, as in that fpecies, very numerous in globofe woolly tufts, terminating elongated, naked, woolly branches. Segments of the *calyx* obovate, keeled, fomewhat undulated.

The addition of thefe two fpecies confirms the very natural genus of *Eriogonum*, which in the Linnæan fyftem fhould immediately follow *Rheum*. Probably more fpecies are to be found in the unexplored wilds of North America. Thofe we have defcribed would all certainly bear the climate of Britain, and though not fplendid plants, are worthy of cultivation for their fingularity. Their qualities cannot be fuppofed different from *Polygonum* and *Atraphaxis*. S.

ERIOPHORUM, from ἐριον, *wool*, and φερω, *to bear*, alluding to the woolly or cottony tufts borne by the plant when in feed. Cotton-grafs.—Linn. Gen. 30. Schreb. 41. Willd. Sp. Pl. v. 1. 312. Sm. Fl. Brit. 58. Juff. 27. Gærtn. t. 2. Clafs and order, *Triandria Monogynia*. Nat. Ord. *Calamariæ*, Linn. *Cyperoideæ*, Juff.

Gen. Ch. *Spike*, or rather *Catkin*, imbricated every way: fcales ovate-oblong, flat, flightly inflexed, pointed, membranous, loofe, feparating the flowers. *Cor.* none. *Stam.* Filaments three, capillary, anthers erect, oblong. *Pift.* Germen fuperior, very fmall; ftyle thread-fhaped, the length of the calyx-fcale; ftigmas three, longer than the ftyle, reflexed. *Peric.* none. *Seed* triangular, pointed, furrounded at the bafe with numerous hairs longer than the fpike.

Eff. Ch. Glumes chaffy, imbricated every way. Corolla none. Seed one, invefted with very long hairs.

Six fpecies are defcribed by Willdenow, four of which are found in Britain, *viz. E. vaginatum*, Engl. Bot. t. 873; *polyftachion*, t. 563; *anguftifolium*, t. 564, long confounded with the laft; and *alpinum*, t. 311. The exotic fpecies are, *E. virginicum*, Linn. Sp. Pl. 77; and *cyperinum*, ibid; both natives of North America. The latter has browner and fhorter hairs to the feed than any other, fo as to have nothing of their ftriking appearance. The whole genus grows in a turfy foil, generally in wet places, to which the firft fpecies is an occafional exception, being fometimes found on dry mountainous heaths. Some German botanifts have lately diftinguifhed from the *vaginatum*, one which they name *E. Scheuchzeri*. This is *Eriophorum*, n. 1332 β. Hall. Hift. v. 2. 175. (Juncus alpinus, capitulo tomentofo majori; Scheuchz. Prod. 27. t. 7. f. 2.) It has creeping *roots*, folitary *ftems*, not half fo tall, but much ftouter than thofe of *vaginatum*, with a much lefs remarkable fheath. The *leaves* alfo are very fhort; the hairs of the *feed* very denfe and remarkably delicate. It grows in the moft elevated marfhy paftures of the Alps, or about the boggy borders of Alpine lakes, as mentioned by Scheuchzer, and is undoubtedly a diftinct fpecies.

ERIOPHORUS, Bulbus, the *Woolly Bulb*, βολβος ἐριοφορος of Theophraftus, book vii. chap. 13, who mentions it as "growing on the fhore, and having between its outer coats and the inner part, which is eatable, a woolly fubftance, of which various garments are woven." Pliny obferves, that Theophraftus does not inform us in what country this is practifed. Dodonæus, among the moderns firft inftituted an inquiry into this bulb, Hift. Stirp. 692, giving a figure, communicated by a friend of whofe fidelity he is very unwilling to doubt, of a plant hitherto unfeen by any other mortal. It has fcaly bulbs, more refembling tuberous roots invefted with the permanent bafes of the foliage; long fword-fhaped leaves: and large folitary flowers, unlike every thing known in the vegetable world, being formed of five denfely fhaggy ovate fpreading petals, and a fixth ftanding upright in the place of the ftamens and piftils. This cut has always been judged fictitious, and, if true, it would not anfwer to the defcription of Theophraftus. Dodonæus, moreover, figures the *Scilla hyacinthoides* as one kind of *Bulbus eriophorus*, and refers to Clufius, who, in his Hift. Plant. 173, gives *Scilla peruviana* for another. Both thefe bulbs, and, indeed, fome others, have, in fact, a woollinefs about their upper part when the coats are torn afunder, apparently confifting of their large and tenacious fpiral-coated fap-veffels; but the quantity or quality of this wool is not, in any inftance that has come under our infpection, by any means adequate to the ufes mentioned in Theophraftus.

ERIOSPERMUM, from ἔριον, *wool*, and σπέρμα, *feed*. Jacq. Coll. v. 5. 72. Willd. Sp. Pl. v. 2. 110. Clafs and order, *Hexandria Monogynia*. Nat. Ord. *Coronariæ*, Linn. *Afphodeli*, Juff.

Gen. Ch. *Cal.* none. *Cor.* bell-fhaped, permanent, of fix ovate, equal, keeled petals, three of which are exterior and moft expanded. *Stam.* Filaments fix, fhorter than the corolla, awl-fhaped, uniform, dilated at the bafe, fmooth; anthers incumbent, oval, two-lobed. *Pift.* Germen fuperior; ovate, with fix ribs; ftyle erect, angular, as long as the ftamens; ftigma fimple, obtufe. *Peric.* Capfule of three cells and three valves; partitions from the centre of each valve. *Seeds* feveral, affixed to the lower part of each partition, roundifh, invefted with long prominent woolly hairs.

Eff. Ch. Corolla of fix petals, bell-fhaped, permanent. Filaments broad at the bafe. Capfule of three cells. Seeds invefted with wool.

This genus, than which none can be more natural, either with refpect to character or habit, was eftablifhed by Jacquin in the fifth or fupplemental volume of his Collectanea, upon the *Ornithogalum capenfe* of Linnæus and Thunberg, with two other fpecies. They all agree in their tuberous root; radical, ftalked, folitary, elliptic-oblong, entire, involute leaves; and tall, naked, racemofe, many-flowered ftalks. The flowers are fmall; petals white with reddifh, brown, or greenifh keels.—They are all delineated in Jacquin's Icones Plant. Rarior. v. 2, as follows.

1. E. *latifolium*, t. 420. (Ornithogalum capenfe; Linn. Sp. Pl. 441. Commel. Hort. v. 2. t. 88.) Leaves broadly elliptical, fomewhat heart-fhaped, recurved.—The *leaves* are of a dark fhining green. Partial *flower-ftalks* two inches long. *Petals* with a rofe-coloured rib.

2. E. *lancifolium*, t. 421. Leaves ovato-lanceolate, acute, erect.—The upper fide of the *leaves* is reprefented glaucous by Jacquin, their backs of a grafs green. Partial *flower-ftalks* but an inch long. *Petals* with a brownifh rib.

3. E. *parvifolium*, t. 422. Leaves elliptical, obtufe, erect, flat. The *leaves* of this are glaucous, reticulated, and much fmaller than in either of the former, being but from an inch and half to two inches long. *Petals* with a green rib. *Partial-ftalks* an inch long, fpreading.

All thefe fpecies are natives of the Cape of Good Hope. We fufpect that Bengal and the coaft of Guinea may afford one or two more, but we are not furnifhed with materials fufficient to afcertain them completely.

ERIOSTEMON, from ἔριον, *wool*, and στήμων, *a ftamen*, alluding to the fringed filaments. Sm. Tranf. of Linn. Soc. v. 4. 221. Clafs and order, *Decandria Monogynia*. Nat. Ord. *Rutaceæ*, Juff.

Gen. Ch. *Cal.* Perianth inferior, in five deep fegments, nearly equal, permanent. *Cor.* Petals five, ovate, feffile, regular and equal, fomewhat fpreading, moftly five times as long as the calyx, fometimes rough, inferted under a glandular nectary, which furrounds the bafe of the germen. *Stam.* Filaments 10, awl-fhaped, flattened, clothed or fringed with fine fpreading hairs; anthers on terminal ftalks, roundifh with a fmall point, two-lobed, incumbent, fmooth. *Pift.* Germen of five lobes, fuperior, ftanding on the nectary, each lobe fomewhat ovate, triangular, acute, foon fpreading; ftyle central, from the bafe of the germen, erect, cylindrical, elongated after flowering, fmooth; ftigma capitate, with five notches. *Peric.* Capfules five, connected by their bafe, ovate, compreffed, coriaceous, of two valves, enclofing an elaftic, cartilaginous, bivalve arillus. *Seeds* folitary, kidney-fhaped, brown, fmooth.

Eff. Ch. Calyx in five deep fegments. Petals five, feffile. Stamens flat, fringed. Anthers ftalked, terminal. Style from the bafe of the germen. Capfules five, combined, feated on a glandular nectary. Seeds enclofed in an arillus.

Obf. Some fpecies have a four-cleft flower, with but eight ftamens, and others have five of their 10 ftamens imperfect and abortive.—This genus differs from *Boronia*, Sm. Tracts on Nat. Hift. 287. t. 4—7, in having the anthers upon terminal footftalks, and the ftyle from the bafe of the germen; not to mention the flowers being generally five-cleft and decandrous, and the leaves ufually alternate. From *Corræa* and *Crowea*, fee vol. 10, its differences are evident from the characters there given of thofe genera. We are happy here to mention that the long-defired *Corræa rubra* flowered, for the firft time in Europe, at Meffrs. Lee and Kennedy's, Hammerfmith, in June 1809.

The fpecies of *Erioftemon* in our poffeffion are fix.

1. E. *falicifolia*. Willow-leaved Erioftemon.—Leaves linear-lanceolate, flat, ftraight, naked on both fides. Branches fmooth. Flowers lateral. Gathered near Port Jackfon, New South Wales, by John White, M.D. who communicated dried fpecimens to us in 1791, but it has not yet appeared in the gardens. This is a very handfome flowering fhrub, with numerous, alternate, wand-like, leafy, fmooth, angular *branches*, having indeed much of the habit of *Crowea faligna*. *Leaves* alternate, from one to two inches long, but little fpreading, linear-lanceolate, entire, bluntifh with a fmall point, thick and coriaceous, naked and fmooth on both fides, befprinkled with glandular dots, fcarcely veiny, but marked with an obfolete central rib; their bafe tapering down into a fhort flat *footftalk*. *Stipulas* none. *Flowers* pink, refembling thofe of *Crowea faligna*, on fhort, fimple, folitary, axillary, angular, downy, bracteated ftalks. *Bracteas* imbricated, roundifh, obtufe, concave, pale, downy, fringed. Segments of the *calyx* much refembling the bracteas, about a line long, imbricated at their bafe. *Petals* alternate with them, and five or fix times as long, obovate, fpreading, bluntifh, clothed with fhort, denfe, fcurfy pubefcence, efpecially on the outfide. *Filaments* about one-third as long as the corolla, red, all clothed from the bafe with denfe, white, fpreading hairs, and terminated by a naked, club-fhaped, obtufe, red ftalk, which in the five innermoft alternate ones is much longer, thicker, and more glandular, than in the reft, rendering thofe ftamens confpicuoufly the longeft; anthers at the top of each ftalk, incumbent, uniform, all fertile, ovate, of two cells, burfting longitudinally on their inner fide, tipped with a fmall, pale, reflexed fcale or creft. *Style* fhorter than the ftamens.

2. E. *buxifolia*. Box-leaved Erioftemon.—Leaves elliptical, keeled, revolute, with a recurved point. Branches hairy, round. Flowers lateral.—Gathered near Port Jackfon, by Dr. White. Of this we have two very diftinct varieties, for confidering the Proteus-like nature of the leaves in New Holland plants, in which alone thefe differ, we dare not call them diftinct fpecies. In one the *leaves* are obovate, narrow at the bafe, bluntly crenate and glandular at the edges; in the other they are broadly elliptical, heart-fhaped, and embracing the ftem at their bafe, generally even and entire at their edges, though occafionally furnifhed, in the very fame manner, with blunt glandular teeth. In both the *branches* are round, clothed with fhort prominent hairs. *Leaves* numerous, fcattered, fcarcely half an inch long, coriaceous, nearly fmooth, keeled, with a fharp recurved point, and a thick, flightly revolute, margin. *Flowers* towards the ends of the branches, axillary, folitary. *Stalks* rather fhorter than the leaves, thickened upwards, flightly

ſlightly hairy, with ſeveral minute, crowded, roundiſh, ſmooth *bracteas* a little above their baſe. *Calyx* much reſembling the bracteas. *Petals* whitiſh or roſe-coloured, almoſt as large as in the former, but ſmooth or very ſlightly downy; more ſpreading and recurved. *Filaments* minutely fringed, their terminal ſtalks awl-ſhaped, bearing a few long ſcattered hairs; anthers much like the former but ſhorter, and with a ſhorter broader point. *Germen* ſmooth, with very pointed lobes; ſtyle ſhorter than the ſtamens.

3. E. *ſalſolifolia*. Saltwort-leaved Erioſtemon.—Leaves crowded, linear, obtuſe; flattened above; convex beneath; rough-edged, ſtraight. Flowers terminal.—Gathered by Dr. White near Port Jackſon, with the laſt. It ſeems a more humble ſhrub than either of the foregoing, and has angular *branches*, all over ſcarred where former leaves have ſtood; ſlightly hairy when very young. *Leaves* very numerous, ſomewhat imbricated, half an inch or leſs in length, fleſhy, linear inclining to obovate, obtuſe, flattiſh above, convex beneath, more or leſs rough-edged, and ſometimes otherwiſe pubeſcent, dotted with ſcattered glandular points, which in the dried leaves are prominent tubercles. The baſe tapers down into a very ſhort broad *footſtalk*, articulated with a decurrent prominence of the branch. *Flowers* few, terminal at the top of each branch, on ſhort, ſimple, ſmooth ſtalks, which are minutely bracteated at their baſe. Segments of the *calyx* ſhort, broad and acute. *Petals* recurved, downy, pale red with a darker keel. *Filaments* ſmooth at the baſe, their upper part, and terminal ſtalks, denſely clothed with long, upright, white hairs, almoſt concealing the anthers, which are oblong, with a very minute point or creſt. *Germen* ſmooth, with obtuſe lobes.—The ſtamens in theſe three ſpecies would afford beautiful ſpecific differences, were not thoſe of the leaves more commodious and obvious.

4. E. *uniflora*. Single-flowered Erioſtemon.—Leaves ſcattered, elliptic-lanceolate, ſmooth; paler beneath. Flowers ſolitary, terminal, on ſhort ſtalks. Five of the ſtamens abortive. (Dioſma uniflora; Linn. Sp. Pl. 287. Ait. Hort. Kew. v. 1. 276. Mart. Mill. Dict. v. 2. n. 17. Curt. Mag. t. 273. Schrad. Sert. Hannov. 16. t. 8.)—Native of the Cape of Good Hope, from whence it was ſent to the Kew garden, in 1775, by Mr. F. Maſſon, and is now not unfrequent in collections, being much eſteemed for its beautiful flowers, produced abundantly in the ſpring and early part of ſummer. This is a ſhrub from one to two feet high, much branched, ſtrongly, but not agreeably, aromatic in all its parts. *Branches* leafy, nearly ſmooth. *Leaves* ſcattered, on ſhort, rather hairy, *footſtalks*, elliptic-oblong, often nearly linear, obtuſe, very glandular, paler beneath, very obſcurely crenate, and ſomewhat fringed, varying in length from half an inch to an inch. *Flowers* ſolitary at the end of each branch, but from the number of the ſhort branches they ſometimes appear cymoſe. *Stalks* much ſhorter than the leaves, ſwelling upwards, downy, without bracteas. Segments of the *calyx* near half an inch long, lanceolate, purpliſh, fringed. *Petals* twice as long as the calyx, obovate, pointed, of a ſhining varniſhed white, like porcelain, or often bluſh-coloured above; purpliſh beneath. *Stamens* about the length of the calyx, their filaments all fringed; five of them ſhort, bearing large heart-ſhaped anthers, with greeniſh glandular tips; five much longer and more ſlender, each terminating in a ſmall round ſtalked gland, without any anther, varying in ſize and ſhape. *Germen* globular, clothed with numerous ſtalked nectariferous glands; ſtyle and ſtigma like the other ſpecies. Curtis and Schrader have well deſcribed this plant, but neither of them was ſufficiently acquainted with the real ſpecies of *Dioſma*, now numerous in our gardens, to diſcover that it was generically diſtinct, and that the curious nectary, eſſential to *Dioſma*, was wanting. Schrader endeavours to make his deſcription of that part agree with the generic character, but in vain, and his accuracy would ſoon have diſcovered the truth, had he ſeen a real *Dioſma*. The *Hænkæa* of Schmidt in Uſter's Annals, faſc. 6. 117, to which Schrader refers, agrees in generic characters with *Dioſma barbigera* of Linnæus, and not with our *Erioſtemon*.

5. E. *marginata*. Bordered Erioſtemon.—Leaves ſcattered, lanceolate, paler beneath. Flower-ſtalks axillary, twice as long as the leaves, corymboſe. Five of the ſtamens abortive. (Dioſma marginata; Linn. Suppl. 155.) Native of the Cape of Good Hope, raiſed by Meſſrs. Lee and Kennedy, with whom it flowered in June 1809. It agrees very much in habit with the laſt, but has a more pleaſant ſmell, like ſaſſafras or myrrh, when rubbed, and differs very eſſentially in the great length of its *flower-ſtalks*, which are not terminal, but ſpring from the boſoms of ſeveral of the uppermoſt leaves, and riſing above the ſummit of the branch, make a ſort of corymbus. A pair of lanceolate *bracteas* grow either near the top of each ſtalk, or towards its middle, or in our garden ſpecimens, near the baſe. Their preciſe ſituation ſeems not characteriſtic of any ſpecific difference. The ſegments of the *calyx* vary in breadth, and are often fringed, ſometimes ſmooth. *Petals* moſtly notched at the extremity, but otherwiſe like thoſe of *E. uniflora*, as are alſo the *ſtamens*. The *leaves* vary greatly in length and breadth. Their membranous margin, whence the name is taken, is often very conſpicuous in the dried plant, but we cannot perceive it in the living one, nor even in our garden ſpecimens when dried, ſtill we would not preſume to change a name founded in truth, though not always applicable; otherwiſe *pedunculata* would be a more eligible one. Our remarks on this ſpecies are made from various ſpecimens named and unnamed in the Linnæan herbarium, which vary greatly in the hairineſs or ſmoothneſs of their branches and leaves, as well as the form and breadth of the calyx, but we can find no poſitive ſpecific diſtinction among them. The leaves in ſome are nearly oppoſite, but never conſtantly ſo. We know, from frequent obſervation, that the laſt ſpecies is extremely variable, and are perſuaded that this is ſubject to equal differences. The infloreſcence, however, of each is ſo conſtant, that they can never be confounded together.

6. E. *paradoxa*. Various-leaved Erioſtemon.—Leaves lanceolate, revolute, downy beneath; ſimple, ternate, or pinnate. Flowers lateral, four-cleft. Stamens eight. Sent from Port Jackſon, New South Wales, by Dr. White.—*Stem* ſhrubby, with numerous, oppoſite, round, rough, leafy *branches*. *Leaves* an inch, more or leſs, in length, lanceolate, obtuſe, entire, ſomewhat revolute; ſmooth and naked above; clothed with denſe, white, entangled or ſtarry pubeſcence beneath. In one variety they are ſimple, almoſt perfectly oppoſite, on ſhort footſtalks; in another ſmaller, ternate, ſeſſile on one common winged ſtalk, which is about half the length of the lateral pair; in a third they are as large as in the firſt, and are either ternate or conſiſt of two pair and an odd one, all ſeſſile on a ſimilar, but longer, winged ſtalk. The pinnate and the ternate kinds are unqueſtionably but varieties of each other, nor can we think the firſt a diſtinct ſpecies, however paradoxical our opinion may ſeem. The *flowers* of all are exactly alike. *Flower-ſtalks* copious, axillary, ſolitary, ſhorter than the leaves, ſimple, ſingle-flowered, angular, clothed with ruſty ſtarry ſcales or pubeſcence. *Bracteas* two, towards the middle of each ſtalk, obovate, ruſty, ſmall. *Calyx* downy and ruſty,

 quadrangular

quadrangular at the bafe, its four fegments ovate, broad, keeled. *Petals* four, thrice as long as the calyx, elliptical, keeled, rofe-coloured, fmoothifh above, downy beneath. *Filaments* eight, all nearly equal, rather fhorter than the calyx, red, thick, obtufe, glandular, fringed in their lower part; anthers fhort and roundifh, each on a fhort, flender, white, terminal ftalk, their white tip or creft very minute. *Germen* reddifh, with four blunt lobes.—We have hefitated whether to refer this plant to *Boronia*, with which genus it agrees beft in habit, and number of parts in the fructification, but the infertion of the anthers and of the ftyle have always appeared to us rather like *Eriostemon*. We have never feen it alive. Future obfervations on the living plant may correct our prefent determination. It appears to be one of the pretty tieft fhrubs that New South Wales affords, and would be a welcome acquifition for the Englifh confervatories. S.

ERIOX, or Erox, in *Ichthyology*, a fpecies of Salmo, called by Pennant, Willughby, and Ray the *Grey*. See Salmo.

ERISANA, in *Ancient Geography*, a town of Spain, in Lufitania.

ERISKAY, in *Geography*, one of the weftern iflands of Scotland, feparated from South Vift by a narrow ftrait, called "Erifkay Sound;" about five miles in circumference.

ERISMA, in *Botany*, according to the author of the name, is derived from ερειδω, *to prop*, or *fupport*, and not from εριζω, *to difpute*, or *contend*. Rudge Pl. Guian. 7. Clafs and order, *Monandria Monogynia*. Nat. Ord. uncertain.

Gen. Ch. *Cal.* Perianth of one leaf, permanent, downy on both fides, in four deep unequal fegments, one of which is much the longeft, irregular, obtufe, behind the larger petal; the reft fharper, and half-lanceolate. *Cor.* Petals two, oppofite, unequal, emarginate, the uppermoft united with the calyx betwixt its leffer fegments, broad, roundifh; its bafe ending in a horn-like, blunt *nectary*, the length of the petal, downy externally, like the calyx; the lowermoft thrice as long as the other, and broader, inferted into the receptacle behind the perfect filament. *Stam.* Filaments five; one of them fertile, as long as the upper petal, incurved, inferted into the receptacle; the other four very fhort, abortive; anther arrow-fhaped, narrow. *Pift.* Germen inferior, oblong, of one cell; ftyle thread-fhaped, as long as the filament, afcending; ftigma blunt. *Peric.* unknown. Rudiments of *feeds* two, oblong.

Eff. Ch. Calyx in four deep unequal fegments. Petals two, unequal; the uppermoft united with the calyx, fpurred at its bafe; the lowermoft inferted into the receptacle. Fruit with two feeds.

E. *floribunda*. Rudge t. 1. Native of Guiana. A tree or fhrub with round *branches*, when young clothed with ftarry down of a brown colour. *Leaves* large, nearly oppofite, elliptical or obovate, obtufely pointed, entire, fmooth, with numerous parallel veins. *Stipulas* fmall, deciduous. *Panicles* large, terminal. *Bracteas* in pairs, very unequal, downy, the fmalleft about a line long, the other four lines long, broad and ovate. The *flowers* are very fmall, and concealed by the *bracteas*. Of their colour or properties we have no account.

ERISMATOLITHUS, in *Natural Hiftory*, and *Mineralogy*, is the name of a genus in the animal order of remains (*reliquia*, or relics) of a former race of beings, which inhabited the earth or its waters, and includes the *fulciments* or plant-like fupports which certain animals fabricated for their fupport and habitation, and which are preferved in a foffil ftate. According to Mr. William Martin (Outlines of the Knowledge of extraneous Foffils, p. 193.) the effential characters or diagnoftics of the permanent fpecies in this genus are to be fought in various parts of the *reliquium*, e. g. "In reliquia of cellular fulciments, the ftirp exhibiting the internal form or ftructure of the cells: in reliquia of folid fulciments, the ftirp exhibiting its external form." The temporary fpecies of this genus are to comprife fuch cellular fulciments as do not fhew the ftructure of their cells, and fuch folid imperfect fpecimens as are not reducible to known fpecies. The foffil corals, corallines, fponges, &c. rank under this genus. See Reliquia.

ERISTALIS, the name of a ftone, mentioned by Pliny and the ancients, and of which a very memorable quality is recorded by them, which is, that though it was naturally white, it would occafionally turn red.

ERISTICI, from ερις, *difpute*, in *Botany*, fuch authors as have attempted the ftudy of that fcience in a philofophical way, and have been publicly engaged in difputes about the true foundation of its feveral diftinctions, &c.

ERITHACE, a name given by the ancients to the yellow matter collected on the hinder legs of the bees after their excurfions in fearch of the materials for their hives; we ufually efteem this to be real wax, and the French call it *cire*, brute, or rough-wax; it is certain, however, that though the matter of which wax is to be formed is contained in this fubftance, yet the Dutch and fome other nations have the moft juft idea of it, in calling it *pain des abeilles*, or the food of the bees.

This fubftance is only the farina of flowers, and no experiment has been able to feparate real wax from it. The moft probable opinion concerning it is, that it ferves the bees as food, and that after this it is converted in their bowels into the fubftance called wax.

ERITHALIS, in *Botany*, Εριθαλις is an ancient name of fome plant now unknown, derived from εριθαλης, *highly verdant*, or *beautifully leafy*. Browne adopted it for the prefent genus, and was followed by Jacquin and Linnæus.—Browne Jam. 165. Jacq. Amer. 72. Linn. Gen. 95. Schreb. 130. Willd. Sp. Pl. v. 1. 996. Mart. Mill. Dict. v. 2. Juff. 206. Gærtn. t. 26. Clafs and order, *Pentandria Monogynia*. Nat. Ord. *Rubiaceæ*, Juff.

Gen. Ch. *Cal.* Perianth fuperior, of one leaf, cup-fhaped, with five teeth, permanent. *Cor.* of one petal, deeply five-cleft; tube very fhort; fegments of the limb long, lanceolate, recurved. *Stam.* Filaments five, awl-fhaped, fpreading, fcarcely fo long as the corolla; anthers oblong. *Pift.* Germen inferior, roundifh; ftyle thread-fhaped, compreffed in the upper part, the length of the ftamens; ftigma acute. *Peric.* Berry globofe, crowned with the bafe of the calyx, of ten cells, (fometimes but eight, *Gærtner.*) *Seeds* fmall, folitary, pendulous.

Eff. Ch. Corolla in five deep recurved fegments. Calyx cup-fhaped. Berry inferior, of ten cells. Seeds folitary.

The fpecies are,

1. E. *fruticofa*. Linn. Sp. Pl. 251. (E. odorifera; Jacq. Amer. 72. t. 173. f. 25. E. fruticulofa; Brown. Jam. 165. t. 17. f. 3. Sambucus ligno duro odoratiffimo; Plum. Ic. 247. t. 249. f. 2.)—Leaves obtufe. Flower-ftalks all cymofe, many-flowered.—Native of Jamaica, and other Weft Indian iflands, growing near the fea-fide, and very various in height and luxuriance, according to its fituation. *Stem* fhrubby, with round, fmooth *branches*, leafy towards their extremities. *Leaves* oppofite, ftalked, obovate, entire, about two inches long, various in breadth, obtufe, fmooth and fhining. *Flowers* white, fmelling (according to Jacquin) like the common lilac, growing many together, in long-ftalked, axillary, cymofe panicles, about the ends of the branches, but they are not terminal as Willdenow defcribes them. *Berries* purple, the fize of a pea.—Jacquin

defcribes

defcribes another fpecies or variety, he is doubtful which, with inodorous flowers, whiter berries, and a more humble diffufe ftem, growing on barren maritime rocks in the ifland of Curaçao. This we have never feen.

2. E. *polygama*. Forft. Prod. 17.—Leaves acute. Male flowers cymofe; perfect ones folitary.—Gathered by Forfter in the Society Iflands.—That writer refers to the *Timonius*, Rumph. Amb. v. 3. 216. t. 140, as a narrower-leaved variety of his plant. This is, indeed, to all appearance, an *Erithalis*. Rumphius informs us that it grows in graffy open hilly places in Amboyna, and the neighbouring iflands.

The *ftem* is the height of a man. *Leaves* four or five inches long, and as broad as two fingers, acute at each end. *Flowers* of a dirty white. *Berries* yellowifh-black, eaten by ftarlings and other birds. The *roots* are ufed by the natives to chew, along with a flight mixture of cloves, nutmegs and ginger, in their maritime excurfions, in which they fuffer much from cold and other inconveniencies.

ERITRI, in *Geography*, a town of Afiatic Turkey, in the province of Natolia; 36 miles W. of Smyrna.

ERITZKA, a town of Ruffia, in the government of Irkutfch; 20 miles E. of Kirenfk.

ERIVAN, called *Perfian Armenia*, *Greater Armenia*, and *Eaftern Armenia*, a province of Perfia, about 200 leagues in length, and 60 in breadth. See ARMENIA.

ERIVAN, *Irvan*, or *Irivan*, a city of Afia, and capital of Greater Armenia, or Erivan; fituated in a plain, furrounded with mountains, and watered by two fmall rivers; large, dirty, and ill built, and but indifferently peopled: the ramparts are of earth; the fortrefs is encompaffed with a wall of bricks, in which are a palace for the governor, and 800 houfes, inhabited only by Perfians; the Armenians have fhops there, but muft not remain during the night. The churches are fmall, and half buried in the ground, refembling catacombs; in the town and its environs they reckon 28 convents for devotees of both fexes, but they are poorly endowed.

ERIX, or ERYX, in *Ancient Geography*, a mountain of Sicily, fituated towards the weftern part, near the fea. Solinus fays, that it was confecrated to Venus. Polybius places it between Drepana and Palermo. According to Apollodorus, this mountain derived its name from a fon of Venus, called *Erix*. It is now called "Monte St. Giuliano," or "Monte di Trapani."—Alfo, a town of Sicily, now "Trapani del Monte," fituated on the fummit of mount Eryx, difficult of accefs, and famous for a temple of Venus, called Erycina. Polybius and Strabo mention this town. Minos decorated this temple with fuperb fculpture, and enriched it with fuch noble offerings, as have claimed for him the honour of being its founder. The victims offered themfelves voluntarily at the altar. The moft beautiful women in the world were the prieftefles, and the Roman fenators, laying afide their characteriftic feverity, came hither to indulge in pleafure with the beauteous Sicilian females, perfuaded they fhould thus make their offerings acceptable to the goddefs, and render her propitious. In the time of Strabo the town and temple were much decayed. It is faid that Eryx was deftroyed by Hamilcar, who in the firft Punic war, A. U. C. 493, removed its inhabitants to Drepanum, which he had built not long before. Nothing now remains but a paltry village, and fome foundations of a temple.

ERIZZO, SEBASTIAN, in *Biography*, a noble Venetian, was particularly diftinguifhed for his knowledge of the medallic fcience. He publifhed, in 1559, in Italian, "A Difcourfe upon Ancient Medals," which has been highly efteemed for its erudition. He contended for the difference between the medals and coins of the ancients. Erizzo was the author of a treatife on "Logic;" a tranflation of "Plato's Dialogues;" a difcourfe on "Civil Governments," and fome other pieces. He died in 1585. Gen. Biog.

ERKELENS, or EREKELENS, probably *Herculanum*, in *Geography*, in the days of the Romans, is an ancient town of France, in the department of the Roer, chief place of a canton, in the diftrict of Créveldt, with a population of 1340 individuals. It is at a diftance of about three miles from the river Roer, 15 miles north of Juliers; its ancient fortifications were demolifhed by the French in 1674. The canton contains 48 communes, and 17,853 inhabitants.

ERLA, a fmall town of the kingdom of Saxony, in the circle of the Ertzgebirge, at the foot of the mountain called Rothenberg, remarkable for a rich mine of excellent iron, the beft of the whole of this mountainous diftrict. Its iron works are celebrated for cafting the beft ovens and frying-pans in Saxony; there is alfo a manufactory of cannon-balls. There was anciently a fmall town of the fame name in Ruffia, in the government of Riga, not far from Dorpat; but it is now in ruins.

ERLACH, in French *Cerlier*, a fmall town of Switzerland, in the canton of Berne, at a diftance of about three quarters of an Englifh mile from the upper part of the beautiful lake of Bienne, is fituated on the declivity of the Julimont, or Julius' mountain, for it is proved beyond contradiction that Julius Cæfar eftablifhed upon this hill one of his ftrong entrenched camps. This elevation is alfo called Jolimont, pretty mount, from the beauty of the profpect, which can be no where more varied, or more interefting, on account of the number of picturefque contrafts which it affords. Travellers who wifh to vifit the famous ifland of St. Pierre, in the lake of Bienne, generally take a boat at Erlach. It has an ancient caftle, which gave the title of barons to the illuftrious Swifs family of the Erlachs, who, from the time of the intrepid Ulrich of Erlach, have held fuch a diftinguifhed place in the annals of their country.

ERLANG, or ERLANGEN, a handfome town of Germany, in the circle of Franconia, in that part of the margraviate of Anfpach Baireuth which was called the principality of Culmbach, on the river Rednitz, 18 miles N.W. of Nuremberg, and 30 miles S. of Bamberg. N. lat. 49° 38′. Until the peace of Tilfit, concluded in July 1807, between France and Pruffia, this town, and the whole margraviate of Anfpach Baireuth, belonged to the kings of Pruffia, to whom it had been ceded by the laft margrave, in 1792: but it is now at the difpofal of the French emperor.

Erlang is divided into the old and new town; the latter is alfo called Chriftian Erlang, from the name of its founder, the margrave Chriftian Erneft, who built it in the year 1686 to accommodate feveral families of Proteftant French refugees. The ftreets of both towns are regular and fpacious: there are two handfome fquares, and fome fine churches. The principal manufactures eftablifhed by the French refugees were thofe of hofiery and of hats, which are ftill flourifhing. In 1742 the univerfity of Baireuth was alfo removed to Erlang.

ERLAU, in Latin *Eger*, or *Agria*, a town of Upper Hungary, in the diftrict of Heves, near which there is a fine hot mineral fpring, which is ufed for bathing. It is the fee of a bifhop, and the feat of an univerfity, the buildings of which are very fine: the profeffors are well accommodated, the lecturing rooms very good, and the chapel, library, and public hall extremely elegant. The fee of Erlau is one of the

the richeſt in the kingdom. The town is in general ill built, the only good houſes are thoſe of the canons of the cathedral. There is, however, a Turkiſh tower in good condition. The only remarkable manufactures are thoſe of wax and of leather. The neighbourhood of Erlau is famous for an excellent ſort of Hungary wine, little inferior to the beſt Burgundy.

ERLEBACH, a river of Germany, which riſes in the duchy of Stiria; 6 miles below Ips.

ERLEBACH, a town of Germany, in the circle of the Lower Rhine, and electorate of Mentz, on the Main; 3 miles N.N.W. of Clingenberg.

ERLENBACH, a town of Germany, in the circle of Franconia, and county of Wertheim; 10 miles N.N.E. of Wertheim.

ERMELAND, or ERMLAND, in Latin *Varmia*, one of the four ſubdiviſions of that part of the kingdom of Pruſſia which is called Eaſtern Pruſſia. In ancient times, two-thirds of this country belonged to the biſhops of Ermeland, who were princes of the German empire, and one-third to the chapter of the cathedral church of Frauenburg. The biſhop enjoys ſtill a very conſiderable income.

Ermeland is particularly remarkable for its hemp and flax, and its linen yarn, great quantities of which three articles are annually exported to England in time of peace. The principal towns are Frauenburg, the ſee of the biſhop; Braunſberg, the chief city, which alone exports yarn to nearly the annual amount of two millions of guilders; Heilſberg, Allenſtein, Röſſel, Wormdit, &c.

ERMENEK, a town of Aſiatic Turkey, in the province of Caramania; 63 miles S. of Cogni.

ERMENONVILLE, a ſmall town of France, in the department of the Oiſe, chiefly remarkable for its beautiful park, and a caſtle, which derives ſome celebrity from having belonged to the handſome Gabrielle, miſtreſs of king Henry IV. of France. But Ermenonville is become far more famous in modern times, for having been the laſt retreat of the eloquent and miſanthropic Jean Jaques Rouſſeau, who died here on the 2d of July 1778, and to whom a handſome monument has been erected in a ſmall iſland called the iſland of poplars, which is in the middle of a fine lake. This monument is remarkable for the beautiful ſimplicity of its inſcription.

"Ici repoſe l'homme de la nature et de la vérité."

"Here repoſes the man of nature and of truth."

ERMESIA, a name given to a compoſition uſed among the ancients, and famous for its effects in making people beget handſome children. It conſiſted of honey, myrrh, ſaffron, and palm-wine, all beaten together. This maſs was to be taken mixed in milk. The women took it as well as the men, and many had great faith as to its effects.

ERMIJA, in *Geography*, a town of Spain, in the province of Biſcay; 16 miles E.S.E. of Bilbao.

ERMIL, a town of Ruſſia, in the government of Tamboo; 44 miles S. of Tamboo.

ERMIN, or ERMINE, in *Heraldry*, denotes a white field or fur, powdered or interſperſed with black ſpots, called powdering. See FUR.

It is ſuppoſed to repreſent the ſkin of an animal of the ſame denomination. In effect, there is no animal whoſe ſkin naturally correſponds to the herald's ermin.

The animal is milk white; and ſo far is it from having ſpots, that tradition reports, that it will rather die, or be taken, than ſully its whiteneſs. Whence its ſymbolical uſe.

But white ſkins having for many ages been uſed for the linings of the robes of magiſtrates and great men; the furriers at length, to add to their beauty, uſed to ſew bits of the black tails of thoſe creatures upon the white ſkins to render them the more conſpicuous. Which alteration was introduced into armoury.

The ſable ſpots in ermin are not of any determinate number, but they may be a greater or leſs, at the pleaſure of the painter or furrier

ERMIN, an order of knights, inſtituted in 1450 by Francis I. duke of Bretagne, and formerly ſubſiſting in France. The collar of this order was of gold, compoſed of ears of corn in ſaltier; at the end of which hung the ermin, with this inſcription, *a ma vie*. But the order expired when the dukedom of Bretagne was annexed to the crown of France.

ERMINE', a croſs erminé is a croſs compoſed of four ermine ſpots.

It muſt be obſerved, that the colours in ſuch arms are not to be expreſſed, becauſe neither the croſs nor the arms can be of any colour but a white and black.

Colombiere blazons it quatre queues d'ermine en croix. The editor of Guillim deſcribes it thus; a croſs of four ermines; or, more properly, four ermine ſpots in croſs. It is the coat of Hurſton in Cheſhire.

ERMINE, *timbre of*. See TIMBRE.

ERMINE, in *Zoology*. See MUSTELA *Erminea*.

ERMINES is uſed by ſome Engliſh writers for the reverſe of ermine, *i. e.* for white ſpots on a black field; but on what foundation nobody can tell; for the French, from whom we have our heraldry, have no ſuch term; but call this black powdered with white contre-ermine; as denoting the counter, or reverſe of ermine, which is white powdered with black.

ERMINEUM ANIMAL, *ſtoat*, or *ermine*, the creature whoſe ſkin is the ermine, ſo much eſteemed as a fine fur.

This creature is properly a ſpecies of weaſel, and is called by Mr. Ray, and other authors, muſtela candida, the white weaſel, and by Linnæus muſtela erminea. It is in all reſpects like the common weaſel, and is all over of a pure ſnow white, except the tip of the tail, which is of as beautiful a black, and it has a little yellowiſh grey about the eyes, and a mark or ſpot of the ſame colour on the head, another on the ſhoulders, and a third near the tail. Its colour is, however, very different in degree and elegance, according to the ſeaſon of the year. It is frequent about rivers, and in meadows, in thoſe countries which produce it, and feeds on moles, mice, and other ſmall animals. The ſkins and tails are a very valuable article of commerce in Norway, Lapland, and Ruſſia, and other cold countries, where they are found in prodigious numbers, and regularly change their colour in winter, becoming white. In Siberia, they burrow in the fields, and are taken in traps, baited with fleſh. In Norway they are ſhot with blunt arrows, or taken in traps. The ſtoat is ſometimes found white in Great Britain, and called the white weaſel. See MUSTELA.

ERMINITES ſhould ſeem a diminutive of ermines, and naturally to ſignify little ermines; but it is otherwiſe. Erminites expreſſes a white field powdered with black; only that every ſpot has a little red hair therein.

Some authors uſe the word erminites for a yellow field powdered with black, which the French expreſs much better by, or, ſemée d'ermines de ſable.

ERMINOIS expreſſes an or field, with ſable powdering.

ERMS, in *Geography*, a river of Germany, which runs into the Danube, four miles S. W. of Nurtlingen, in the circle of Swabia.

ERMSLEBEN, a town of Germany, in the circle of Lower

Lower Saxony, and principality of Halberſtadt; 14 miles S. E. of Halberſtadt.

ERNANI, a town of Spain, in the province of Guipulcoa; 5 miles S. of Sebaſtian.

ERNATIA, a town of Aſiatic Turkey, in the province of Natolia; 16 miles N. W. of Satalia.

ERNE, the name of a river in Ireland, which riſes near the boundaries of the counties of Longford and Cavan, and paſſes through loughs Gawnah and Oughter in the latter county. From the laſt of theſe lakes it continues a northern direction till it flows into lough Erne, a little below Belturbet. The ſuperfluous waters of this lake are diſcharged by a rapid current of about ſeven miles, which is alſo called Erne, and which falls into the bay of Donegal, below Ballyſhannon.

ERNE-*Lough*, a lake of the county of Fermanagh, Ireland, which is ſuppoſed to occupy above 45,000 acres. It conſiſts properly of two lakes connected by a broad winding channel of about ſix miles. The upper lake is nine miles long, and from one and a half to five wide; the lower lake extends in length about ten miles, and in breadth from two to eight. Both theſe lakes are full of iſlands, being ſaid to contain from three to four hundred, the number varying according to the ſeaſon, being more numerous in winter than in ſummer, on account of the greater height of the water. Some of theſe iſlands are large and inhabited, and many of them well wooded, ſo that the variety of intereſting proſpects afforded by them and the neighbouring coaſt is aſtoniſhing, and far ſurpaſſes the power of deſcription. A canal to open the navigation from the lough to the ſea has been projected, and would be attended with great advantage to the whole of Fermanagh and Cavan. It is alſo probable that a conſiderable part of the lake might be drained, and notwithſtanding its beauty, it is a pity that ſo many acres ſhould be unprofitable.

ERNEE, a ſmall town of France, in the department of Mayenne, chief place of a canton, in the diſtrict of Mayenne, with a population of 4740 individuals. It is ſituated on the river Ernée, 15 miles W. of Mayenne. The canton contains 6 communes and 15,053 inhabitants, on a territorial extent of 232 kiliometres and a half.

ERNES, in our *Old Writers*, ſignify the looſe ſcattered ears of corn that are left on the ground, after the binding or cocking of it.

It is derived from the old Teutonic *ernde*, harveſt; *ernden*, to cut or mow corn. Hence ern is, in ſome places, to glean.

ERNEST, in *Biography*. See MANSFELD.

ERNEST *Town*, in *Geography*, a townſhip of Upper Canada, in the midland diſtrict, the fineſt above Kingſton, ſheltered from lake Ontario by Amherſt iſland, which lies in its front.

ERNESTI, JOHN AUGUSTUS, in *Biography*, was born in Auguſt, 1707, at Tennſtadt, where his father was ſuperintendant. He ſtudied at Pforta, and ſoon diſplayed uncommon talents; he afterwards applied himſelf to the ſtudy of theology at Leipſic, and took his degree of M. A. in the year 1730. In 1734, having been elected rector of Thomas's ſchool in the room of Geſner, ancient literature, and thoſe branches of knowledge connected with it, became the principal objects of his purſuit. The ſucceſsful application of his talents in this department of knowledge cauſed him to be choſen, in 1742, extraordinary profeſſor of ancient literature, in 1756 he was elected public profeſſor of eloquence, and in 1758, he was made doctor and profeſſor of theology. He died in the year 1781, having, till within the laſt two or three years, been inceſſantly engaged in the laborious diſcharge of his public duties. For twenty years and more he paſſed the greater part of each day in inſtructing others, yet he found ample time for the publication of many original works, and for editing various ancient authors. Among the latter may be mentioned, 1ſt, the Memorabilia of Xenophon, which has been frequently republiſhed in this and other countries. 2d, Ciceronis Opera omnia cum clave, in 6 vols. The Clavis has been publiſhed ſeparately. Erneſti, in preparing this work for the preſs, employed the beſt and oldeſt editions of Cicero, as well as ſeveral MSS.; he examined critically the text of Gruter, corrected in it a great many faults, and in his ſhort notes, he has in various places illuſtrated, and in others reſtored the original. He alſo gave the world new editions with notes of Suetonius, Tacitus, Homer, &c. He publiſhed Ariſtophanis Nubes, cum ſcholiis antiquis et Prefat; Hederici Lexicon, multis vocabulorum millibus auctum; a New Theological Library, in 11 volumes; and "Inſtitutio interpretis Novi Teſtamenti," which has paſſed through ſeveral editions. Alberti of Leyden was ſo much delighted with this, that he called it "The Golden Work." A new edition of it was publiſhed in Holland within a few months after it was printed at Leipzic. The extenſive talents and ſober judgment of Erneſti enabled him not only to embrace every department of literature, but to examine and illuſtrate many of its obſcurities and difficulties. He poſſeſſed a ready and retentive memory, and, above all, an honeſt and upright heart. "Though," ſays his biographer, "the ſerioufneſs of his countenance beſpoke a character hoſtile to every kind of levity, and born for labours that require great vigour and exertion, he was a friend to chearfulneſs, and his company, on account of his eaſy behaviour and good humour, which was often heightened by Ciceronian wit, but confined within the boundaries of virtue and decency, made his converſation much ſought after, and highly agreeable." Gen. Biog.

ERNODEA, in *Botany*, from ἐρνώδης, *branched*, ſo that it ought rather to be written *Hernodea*. Swartz. Prod. 29. Fl. Ind. Occ. v. 1. 223. Schreb. 788. Willd. Sp. Pl. v. 1. 611. Mart. Mill. Dict. v. 2. Sm. Prod. Fl. Græc. Sibth. v. 1. 98. Claſs and order, *Tetrandria Monogynia*. Nat. Ord. *Rubiaceæ*.

Gen. Ch. *Cal.* Perianth ſmall, ſuperior, in four deep, upright, acute, equal, permanent ſegments. *Cor.* of one petal, ſalver-ſhaped; tube elongated, quadrangular; limb in four deep, lanceolate, recurved ſegments. *Stam.* Filaments four, inſerted into the tube towards the middle, awl-ſhaped, longer than the tube; anthers erect. *Piſt.* Germen ſquare, inferior; ſtyle thread-ſhaped, about as long as, or longer than the ſtamens; ſtigma obtuſe, notched. *Peric.* Berry roundiſh, crowned with the calyx, having a furrow at each ſide, and conſiſting of two cells. *Seeds* ſolitary, hemiſpherical, ſtriated.

Eſſ. Ch. Corolla of one petal, ſalver-ſhaped. Calyx in four deep ſegments. Style ſimple. Berry inferior, of two cells. Seeds ſolitary.

1. E. *littoralis*. Swartz. Fl. Ind. Occ. v. 1. 224. t. 4. Vahl. Symb. v. 2. 28. (Thymelæa humilior, foliis acutis atrovirentibus; Sloane Jam. v. 2. 93. t. 189. f. 1, 2.)—Stem ſquare, ſmooth. Leaves nearly ſeſſile, acute, with a ſpinous point. Gathered by Sloane, Browne, and Swartz, in Jamaica. The latter informs us that it grows in gravelly places by the ſhore, or on calcareous rocks. *Root* perennial. *Stems* procumbent, creeping, rather woody, with numerous, long, creeping or pendulous *branches*, which are ſtraight, ſquare, ſmooth, ſomewhat jointed, not much divided, but bearing numerous, alternate, ſhort, leafy, ſimple, lateral branches. *Leaves* crowded, oppoſite, croſſing each other

other in pairs, nearly feffile, about an inch or more in length, elliptic-lanceolate, acute at both ends, entire, very fmooth, ribbed, rigid, of a dark green, tipped with a fpinous point. *Stipulas* united with a ftem between the very fhort footftalks, each crowned with three briftles, the middle one longeft. *Flowers* axillary, folitary, feffile, yellowifh. Many of them, according to Dr. Swartz, have no piftils.

*2. E. *montana*. Sm. Fl. Græc. Sib. v. 2. t. 143, unpublifhed. Prod. n. 343. (Afperula calabrica; Linn. Suppl. 120. Willd. Sp. Pl. v. 1. 577. L'Herit. Stirp. v. 1. 65. t. 32. Rubeola cretica fœtidiffima frutefcens myrtifolia, flore magno fuaverubente; Tourn. Cor. 5.)—Stem round, downy. Leaves ftalked, blunt, pointlefs.—Native of mountainous places in Crete, Sicily, and the fouth of Italy. Much fmaller than the laft, except in its *flowers*, which are larger, clustered about the ends of the branches, and of a fine rofe-colour. The *ftems* are much branched, woody, decumbent. *Leaves* on fhort ftalks, oppofite, about half an inch long, elliptic-lanceolate, bluntifh at both ends, entire, revolute, without any terminal fpine, much more pliable than in the former; dark green above; pale beneath; roughifh occafionally. When bruifed they have a very difagreeable ftercoraceous fmell. *Stipulas* with a fimple lanceolate point. *Branches* more or lefs downy when young.—Authors have greatly differed about the genus of this plant. By the older ones it has been taken for a *Rubia*, a *Valeriana*, a *Thymelæa*, and a *Nerium* or *Oleander*; by modern writers it has been referred to *Afperula*, *Sherardia* and *Pavetta*. We hope to be nearer the truth than our predeceffors; at leaft its technical generic characters agree well with Swartz's *Ernodea*, nor do we find any great difcordance in the habit.—This beautiful plant emulates the *Daphne Cneorum* in colour and general afpect, and would be fcarcely lefs admired in our gardens, to which it is, as yet, a ftranger.

ERNSPACH, in *Geography*, a town of Germany, in the circle of Franconia, and principality of Hohenloe; fix miles N. of Okringen.

ERNSTEIN, a caftellated town of Germany, in the circle of the Lower Rhine, and electorate of Cologne; eight miles E. of Lintz.

ERNSTHOFEN, a town of Germany, in the circle of the Upper Rhine, and principality of Heffe Darmftadt; 10 miles S. of Darmftadt.

ERNSTTHAL, a fmall town of the kingdom of Saxony, in the county of Schonburg, clofe by Hohnftein, at the foot of a mountain called the Pfaffenberg, with a population of about 2000 individuals. It has a few cotton and linen manufactories.—Alfo, a fmall town of Germany, in the duchy of Saxe-Coburg, which has a confiderable glafs manufactory; in the fpace of thirteen weeks, or three calendar months, they make 216,000 glaffes, 1000 of which ufed to be fold, in 1788, for $3\frac{1}{2}$ rix dollars, or not quite twelve fhillings fterling.

ERODINUM, a word ufed by fome of the enthufiaftic writers in alchemy, to fignify the prognoftic, good or bad, of any operation.

ERODIUM, in *Botany*, from ερωδιος, *a heron*, becaufe the fruit refembles the head and beak of that bird. For a fimilar reafon it is called in Englifh Stork's-bill. L'Heritier. Geraniolog. unpublifhed. Ait. Hort. Kew. v. 2. 414. Sm. Fl. Brit. 727. Willd. Sp. Pl. v. 3. 625. Sibth. Oxon. 211. (Geranium; Linn. Gen. 350. Schreb. 458. Juff. 268. Gærtn. t. 79, *mofchatum.*) Clafs and order, *Monadelphia Pentandria*. Nat Ord. *Gruinales*, Linn. *Gerania*, Juff.

Gen. Ch. *Cal.* Perianth inferior, of five ovate, pointed, concave, permanent leaves. *Cor.* Petals five, obovate, fpreading, rather longer than the calyx, generally more or lefs irregular. *Nectary* of five glands between the petals. *Stam.* Filaments 10, awl-fhaped, united by their bafe into a fort of cup; five of them fertile, nearly as long as the petals; the alternate five fhorter and barren; anthers five, oblong, verfatile. *Pift.* Germen fuperior, with five furrows, beaked; ftyle central, awl-fhaped, fpirally furrowed, as long as the ftamens, permanent; ftigmas five, reflexed. *Peric.* Capfules five, aggregate, membranous, obovate, vertical, feparating at their infide, fharp-pointed at their bafe, each tipped at its fummit with a long, linear, flat, pointed, rigid awn, hairy on its infide, and at length fpirally twifted, adhering by its point to the fummit of the ftyle. *Seeds* one or two, erect, ovate-oblong.

Eff. Ch. Calyx of five leaves. Petals five. Nectariferous glands five. Barren filaments five. Fruit beaked, of five aggregate capfules, each tipped with a long fpiral awn, bearded on the infide.

Linnæus in his Genera Plantarum had long ago indicated a divifion of his genus *Geranium* into feveral natural fections, diftinguifhable by characters in their fructification and inflorefcence. The late learned botanift Monf. L'Heritier, purfuing the idea, divided that genus into three, each of them as naturally and diftinctly defined as any in the whole fyftem, and although the convulfions of his country, and his own premature death, prevented his publifhing an elaborate work on the fubject, he had fortunately conferred by letter with the intelligent editors of the Hortus Kewenfis, and with the writer of the prefent article, fo that his intention has been carried into effect, both in that work and the Flora Britannica. Of thefe three genera *Geranium* with its 10 fertile ftamens, regular flower, and recurved naked awns, confifts of what are ufually called European Geraniums, bearing but one or two flowers on a ftalk; *Pelargonium* with its feven fertile ftamens, irregular flower, tubular nectary, and fpiral bearded awns, comprehends what are generally called Cape Geraniums; while the prefent genus is made up of the Linnæan *Gerania cicutaria*.

Three fpecies of *Erodium* are natives of Britain,

1. E. *cicutarium*. Engl. Bot. t. 1768. Hemlock Stork's-bill. (Geranium cicutarium; Linn. Sp. Pl. 951. Curt. Lond. fafc. 1. t. 51.) "Flower-ftalks many-flowered. Leaves pinnate; leaflets feffile, pinnatifid, cut." Common in wafte ground. In fandy places near the fea its petals are generally white, or their ufual rofe-colour is elegantly diverfied with a green fpot on two or three of them. The *herb* is fetid, proftrate and annual, with finely divided leaves.

2. E. *mofchatum*, Engl. Bot. t. 902. Mufky Stork's-bill. (Geranium mofchatum; Linn. Sp. Pl. 951.) "Flower-ftalks many-flowered. Leaves pinnate; leaflets nearly feffile, elliptical, unequally cut." Wild in the mountainous paftures of Yorkfhire and Weftmoreland, but in other places it is ufually the outcaft of gardens, where it has often been cultivated for the fake of the ftrong mufky fcent of its herbage. The *flowers* are fmaller and lefs ornamental than thofe of the preceding; *leaves* larger, paler, and more vifcid.

3. E. *maritimum*, Engl. Bot. t. 646. Sea Stork's-bill. (Geranium maritimum; Linn. Sp. Pl. 951.) "Flower-ftalks barely three-flowered. Leaves heart-fhaped, cut, crenate, rough Stems depreffed." Native of fandy fea-fhores in various places, flowering all fummer long. When brought into a garden it becomes wonderfully luxuriant. The *root* is perennial. *Petals* white or reddifh, for the moft part much fmaller than the calyx leaves.

Willdenow has 34 fpecies of this genus in all. Moft of them

them abound in the warmer countries of Europe, and the northern part of Africa, and feveral are cultivated with us for ornament, as *E. gruinum*; (Geranium creticum; Ger. em. 943), a hardy annual with large blue flowers; *E. hymenodes*; Andr. Repof. t. 413, which requires a greenhoufe, and is perennial. Three fpecies are natives of the Cape of Good Hope, *viz.* the moft beautiful *E. incarnatum*, Ait. H. Kew. v. 2.415. Curt. Mag. t. 261. (Geranium incarnatum; Linn. Suppl. 306.) This is a tender greenhoufe plant, and therefore not very common, but worthy of all attention for the delicate hues, and eye-like pencilling, of its bloffoms. The other two Cape fpecies are *arduinum*, (Geranium arduinum; Linn. Sp. Pl. 952.) very little known to botanifts, and never introduced into the gardens of Europe; and *ribifolium*, Jac. Ic. Rar. v. 3. t. 509.) an inconfpicuous flower, not much likely to excite the attention of cultivators.

ERODIUS, in *Entomology*, a genus of the Coleopterous kind, eftablifhed by Fabricius. Thefe infects are generically diftinguifhed by the following character: the antennæ moniliform; feelers four; jaws horny, truncated, and bifid; lip horny and emarginate. This is the Fabrician definition, to which may be added that the body is roundifh, gibbous, and emarginate; thorax tranfverfe; wing-cafes clofely united, and longer than the abdomen.

Species.

Testudinarius. Black; wing-cafes rough, the fides covered with whitifh duft. Fabr.

An infect of large fize, found at the Cape of Good Hope; the wing-cafes are very gibbous, with fmall raifed dots.

Gibbus. Black; wing-cafes with three raifed lines. Fabr. Remarkable for the gibbofity of its form, and the obtufity of the wing-cafes; it is of moderate fize; and has the anterior fhanks armed with a ftrong tooth in the middle and at the tip. The fpecies inhabits Arabia.

Planus. Black; wing-cafes with a fingle raifed line. Fabr.

Native of the fame country as the former. The anterior fhanks not armed with a fpine.

Minutus. Black; wing-cafes perfectly fmooth. Fabr. Small thorax with two impreffed dots on the back; legs unarmed. Inhabits the eaftern parts of the world.

Muricatus. Gibbous, black; wing-cafes muricate. Fabr.

A fpecies defcribed in the Fabrician Suppl. Ent. from the cabinet of Lund. It is a native of the Cape of Good Hope; in fize and appearance refembles E. gibbus. The head and thorax fmooth.

EROPHEEVO, in *Geography*, a town of Ruffia, in the government of Irkutfch; 60 miles N. of Balaganfkoi.

EROS, of ερως, *love*, in *Mythology*, one of the two chiefs over all the other cupids, being the caufe of love. See Anteros.

EROSION, in books of *Surgery*, we often find this expreffion ufed fynonymoufly with the term ulceration.

Erosion, in *Geology*, according to Mr. Kirwan, (Geol. Eff. 230 and 285,) denotes a folution or melting of the fofter calcareous particles by water, by which he accounts for the formation of the vaft caverns and grottos to be found in the Derbyfhire lime-ftone rocks, and thofe of other countries. M. de Sauffure, in his Agenda (Journal. des Mines, N° 20.) directs the attention of geological travellers to the fides of valleys (§ 12.) to fearch for the veftiges of the erofion of water: by which we might underftand a mechanical fweeping or wafhing away of ftrata, as well as a folution or melting as above.

EROSUM Folium, among *Botanifts*. See Leaf.

EROTESIS, Ερωτησις, in *Rhetoric*, the fame figure with *Interrogation*. Every interrogation or queftion is not figurative; but it becomes figurative, when the fame thing may be expreffed in a direct manner; but the putting it by way of queftion gives it much greater life and fpirit. As when Cicero fays, (in Catal. i. c. 1.) "Cataline, how long will you abufe our patience? Do not you perceive your defigns are difcovered?" He might have faid, "You abufe our patience a long while; you muft be fenfible your defigns are difcovered." But it is evident how much this latter mode of expreffion falls fhort of the force and vehemence of the former. Thus alfo, when Medea fays, "I could fave; and do you afk, if I can deftroy?" Had fhe merely faid, "I could fave, and I can deftroy," the fentence would have been flat, and very unfit to exprefs the rage and fury in which the poet there reprefents her. (Quint. Inft. Orat. l. viii. c. 5.) This figure is fuited to exprefs moft paffions and emotions of the mind, as anger, difdain, fear, defire, &c. It ferves alfo to prefs and bear down an adverfary. This figure likewife diverfifies a difcourfe, and gives it a beautiful variety, by altering the form of expreffion, provided it be neither too frequent, nor continued too long. Befides, the warm and eager manner in which it is expreffed enlivens the hearers, and quickens their attention.

EROTEUM, in *Botany*, perhaps from ερωτάω, *to queftion*, in allufion to its doubtful nature at firft fight, being very like *Thea* till the fruit is inveftigated. Swartz. Prod. 5. The author, however, being himfelf, as it feems, diffatisfied with this name, has, in his Fl. Ind. Occ. v. 1.971, changed it to Freziera, which fee.

EROTIA, Ερωτια, a feftival among the Greeks, in honour of Cupid, being celebrated every fifth year with fports and games.

EROTIANUS, in *Biography*, the author of a gloffary, containing an explanation of all the words ufed in the writings of Hippocrates, lived in the firft century of the Chriftian era, in the reign of Nero, and dedicated his work to Andromachus of Crete, who was phyfician to that emperor. It was printed at Venice, in 1566, in 4to. with the notes of Barth. Euftachius, under the title of "Vocum, quæ apud Hippocratem, collectio, et ejus operum in feptem fectiones diftributio." The gloffary of Erotain was alfo annexed to the edition of Hippocrates, publifhed by Foefius at Geneva, in 1657. Haller. Bibl. Med. Eloy.

EROTIC, derived from ερως, *love*; whence ερωτικος, is applied to any thing which has a relation to the paffion of love.

In *Medicine*, we particularly ufe the phrafe delirium eroticum, for a kind of melancholy contracted through excefs of love.

Though, among the feveral fpecies of pulfes, there be no amorous pulfe, that is, no pulfe peculiar to that paffion; yet we can certainly difcover where the diforder is erotic, by the beating of the pulfe, which, in that cafe, is changeable, unequal, turbulent, and irregular. Speak to the patient of the perfon he loves, and his pulfe inftantly changes, becoming higher and quicker; and the minute you change the converfation, the pulfe is loft again, and is difturbed anew.

EROTIDIA, ερωτιδια, the fame with erotia.

EROTOMANIA, in *Medicine*, a term ufed by fome writers to denote that modification of infanity, of which the paffion of love is the origin, and in which the love of a particular individual conftitutes the predominant idea. Sauvages treats of this form of derangement under the name of *melancholia amatoria*; (fee his Nofol. Meth. Clafs viii. Gen. xix. Spec. 2.) Sennertus under that of *amor* *infanus*, &c. The word is derived from ἔρως, *love*, and μανια, *mania*, madnefs.

This difeafe is diftinguifhed from fatyriafis and nymphomania, if indeed fuch maladies have any exiftence, inafmuch as the patient, fo far from being urged by libidinous defires, contemplates the object of his affection with reverence and diftant admiration, as if fhe were a divinity; he would fpend his days in doing homage to her perfections, and deems food, fleep, and the affairs of the world of little comparative moment. As a remedy for this fpecies of infanity, low and light diet has been recommended. Ovid has advifed the performance of a long journey, during which a conftant change of fcene, and the abfence of all objects, with which the recollection of the individual beloved, might tend to reftore the mind to its ufual condition: conftant occupation of body or mind, "qui vis fanari, res age, tutus eris;" and the admonitions of the wife in regard to the lofs of health, fortune, and character, which muft attend fuch hallucination, have alfo been fuggefted. The former part of the advice may be fometimes beneficial, but thofe who are moft experienced in the treatment of the infane, well know how little benefit is produced by reafoning with madmen. See Melancholy.

EROTYLOS, in *Natural Hiftory*, the name of a ftone, of which we have no defcription left us, but which the ancients are faid to have ufed in divination.

EROTYLUS, in *Entomology*, a genus of Coleoptera in the Fabrician fyftem, allied, and in fome degree confounded, with the two Linnæan genera Chryfomela and Coccinella, and arranged by Gmelin under that of Cryptocephalus. The antennæ are filiform; feelers four and unequal, the anterior longer and hatchet-fhaped; jaws horny and bifid; lip horny, fhort, dilated at the lip, truncated, and fomewhat emarginate; body fuboval. The transformations of thefe infects are unknown, in the perfect ftate they are found generally on flowers. Three of the fpecies are defcribed by Linnæus, the remainder principally by Fabricius.

Species.

Giganteus. Oval, black; wing-cafes with numerous fulvous dots. Fabr. *Chryfomela gigantea*, Linn. *Coccinella gigantea*, Sulz. Native of India.

Cancellatus. Black; wing cafes yellow, reticulated with black. Fabr. Large and roundifh; inhabits Brazil.

Histrio. Deep black; wing-cafes barred with black and yellow, a fcarlet fpot at the bafe and tip. Fabr.

A fpecies of large fize, an inhabitant of Cayenne.

Lugubris. Teftaceous; antennæ and fhanks black. Fabr. Native of America.

Gibbosus. Black; wing-cafes yellowifh with black dots; band in the middle and at the end black. Fabr. *Chryfomela gibb fa*, Linn. *Coccinella*, Gronov.

An infect of confiderable magnitude, the wing-cafes of which are remarkably gibbous, and the thorax impreffed on each fide; it is a native of South America.

6-Fasciatus. Oval, black; wing-cafes with fix waved fulvous bands, the anterior one interrupted. Fabr.

Inhabits Cayenne.

Notatus. Black; wing-cafes with a yellow band in the middle fpotted with black, and marked with red at the bafe. Fabr. Native of South America.

Concatenus. Black; wing-cafes reticulated with yellow and black, and marked with two black bands. Fabr. Mant. Inf. Country unknown; the body large.

5-Punctatus. Oval; wing-cafes black with five red dots. Fabr. Inhabits America.

Punctatissimus. Black; wing-cafes yellow with numerous black dots. Fabr.

Defcribed from the Hunterian cabinet: an American fpecies.

Varius. Black; wing-cafes punctured, fpotted with fulvous in the middle. Fabr. Inhabits Surinam.

Gemmatus. Black; wing-cafes with numerous fulvous dots; thorax variolous. Fabr.

An infect of moderate fize, found in Cayenne.

Macrocheiros. Black; wing-cafes with alternate black and yellow bands; fore legs very long. Fabr.

Native of India.

Abdominalis. Black; wing-cafes yellow with four waved black bands and a diftinct black dot. Fabr.

A Brafilian fpecies, in fize refembling E. fafciatus, and having the abdomen yellow with two lines of black dots.

Fasciatus. Black; wing-cafes with three yellowifh bands. Fabr.

From the Bankfian cabinet: the native place unknown: fize moderate.

Zebra. Yellowifh; head, bafe of the thorax, and three bands on the wing-cafes with the legs black. Fabr. Mant.

Alternans. Black; wing-cafes with two yellow bands, the anterior one dotted with black. Fabr.

Surinamensis. Black; wing-cafes red and immaculate. Fabr. Native of Surinam.

Limbatus. Oblong, black; margin of the thorax and border of the wing-cafes yellow. Fabr.

South American fpecies; head yellowifh with a black frontal fpot; thorax fmooth with a broad finnate lateral margin.

Nebulosus. Black; thorax, and wing-cafes varied with ferruginous. Fabr.

Inhabits the fame country as the preceding.

Dilatatus. Oblong, black; thorax and wing-cafes ferruginous. Fabr.

Native of the Cape of Good Hope. The antennæ are brown, at the bafe ferruginous; wing-cafes fmooth, and much broader than the body.

Morio. Oblong, black, and immaculate. Fabr.

This, and the four following fpecies, are natives of New Holland. Thefe are defcribed by Fabricius from the Bankfian cabinet, and are reprefented in the volume of "Donovan's General Illuftration of Entomology, devoted to the Infects of the Auftralafian regions."

Smaragdulus. Oblong, black; wing-cafes ftriated and green.

Amethystinus. Oblong, black; thorax and wing-cafes blue; refembles the laft; front retufe; wing-cafes with punctured ftriæ.

Bicolor. Oblong, black; bronzed above.

Cupreus. Oblong, black; thorax and wing-cafes coppery.

Rufipes. Oblong, black; legs pitchy. Fabr. Mant. Inhabits Kiel.

Flavipes. Oblong, gloffy green; antennæ and legs yellowifh. Native of Jamaica, in the Bankfian cabinet.

EROWA, the name of a kind of nettle which grows in the mountains at Otaheite in the South Sea, with which the inhabitants make fifhing lines, which ferve to hold the ftrongeft and moft active fifh, and are much ftronger than our filk lines of twice the thicknefs.

ERPACH, in *Geography*. See Erbach.

ERPENIUS, Thomas, in *Biography*, was born at Gorcum, in Holland, in the year 1584. His parents, natives of Bois-le-Duc, were, on account of their converfion to the Proteftant religion, obliged to withdraw from that place, to one more favourable to the rights of private judgment. They provided their fon with a good education in the rudiments of learning, and when they difcovered in him a propenfity pensity for literary pursuits they sent him to Leyden, where he felt so diffident of succeeding in his studies, that for some time he determined to relinquish them. Fortunately his desire for knowledge overcame his modesty, and he applied himself with so much diligence, that he obtained the highest praise of his different tutors, and excited their surprize at his extraordinary progress. He excelled in metaphysics, but his fame with posterity is built on the skill which he acquired in the oriental languages. After availing himself of all the advantages which the university of Leyden afforded, he travelled for farther improvement in foreign countries. In England he became acquainted with Bedell, who was celebrated for his knowledge in Hebrew and rabbinical learning. In France he improved himself in his knowledge of the Arabic tongue; and in Italy he improved his acquaintance with the Hebrew language, by conversing with some learned Jews, and made himself master of the Persian, Turkish, and Ethiopic tongues. After spending several years in foreign countries, Erpenius returned to Holland, where he was elected professor of the oriental languages in the university of Leyden. This was in the year 1612, and very shortly after his appointment he set up a press for the printing of works in the Eastern literature. In the year 1620 he was sent by the States General on different journies into France, to engage Peter du Moulin, or Andrew Rivet, to undertake the theological professorship at Leyden. After this he was appointed oriental interpreter to the States, and was employed to translate the letters addressed to them from Asia and Africa, and to write such as were sent by them to the sovereigns in those parts of the world. He was frequently invited into Spain by the sovereign of that country, to explain certain inscriptions in the Arabic language on the Moorish buildings and monuments in that country, and the emperor of Morocco is said to have been highly pleased with the purity and beauty of his style, and to have exhibited his letters as objects of real curiosity. He died in the year 1624, when he was only 48 years of age. His works are numerous, and have given him a high reputation among the learned. They are enumerated by Moreri, and other biographical writers, and we are informed that he projected an edition of the Koran, with a Latin version and notes, likewise an Arabic grammar and lexicon, which his death prevented him from executing. Gerard-Jean Vossius pronounced over him a funeral oration. Moreri.

ERPIS, or Herpis, in *Ancient Geography*, a town of Africa, in Mauritania Tingitana. Ptolemy.

ERRA, in *Geography*, a town of Portugal, in the province of Estremadura, on a river of the same name; 22 miles S.E. of Santarem.—Also, a river, which runs into the Latas, 12 miles E. of Salvateira, in the province of Estremadura.

ERRABARI, a town of Egypt; 10 miles N.W. of Cairo.

ERRAINE, a town of Egypt; two miles E. of Tahta.

ERRANT, in *Law*, the same with itinerant; the term is attributed to judges who go the circuit; and to bailiffs at large.

Errants, *knight*. See Knight.

ERRATA, a list usually placed at the beginning or end of a book, containing the faults that have escaped in the impression, and, sometimes, even in the composition of the work.

Lindenberg has an express dissertation on typographical errors, "De Erroribus Typographycis;" in which he observes, that there is no book exempt from them, not even the sacred books. He sets himself to enquire into all the causes thereof; and proposes means to prevent them, but he advances nothing on that article but what is either common, or impracticable.

ERRATIC, in *Astronomy*, an epithet applied to the planets, which are called erratic, or wandering stars, in contradistinction to the fixed stars.

Erratic *fevers*, in *Medicine*, a term used to express such fevers as, according to the language of medical writers, observe no regular type, that is, are not determinate either in their attacks, or in their general period. They are thus called by way of distinction from the typic fevers, which are regular in both. See Fever.

Erratic *winds*. See Wind.

ERRHINE, in the *Materia Medica*, from ἐν, *in*, and ῥὶν, *the nose*, is a term applied to those substances which are introduced into the nose, for the purpose of exciting a discharge from the passages. When they excite sneezing, the medicines of this class have been called ptarmica, and sternutatories; and, from the discharge which they occasion, they have been termed apophlegmatica, and, in barbarous Latin, caput-purgia.

Errhines, by stimulating the exhalent vessels and the mucous follicles of the Schneiderian membrane, which lines the internal surface of the nose, and the cavities adjoining it, excite those vessels and follicles to pour out their fluids more copiously than usual. The discharge is sometimes of a mucous, and sometimes of a thinner fluid; it is often attended with sneezing, but sometimes is procured without. This, however, implies no difference in the operation, except as to the stronger or weaker irritation of the medicine employed. For although when sneezing is excited a larger evacuation is often produced, yet the effects of errhines are not altogether proportional to the sensible irritation which they occasion. See Alston, Mat. Med. vol. i sect. 8.

The evacuation produced by these medicines consists not merely in emptying the mucous follicles of the lining membrane of the nose of their contents, but in augmenting the secretion: whence, agreeably to the laws of the circulation, a greater afflux of fluids to those parts is necessarily occasioned, and therefore a diminution of the fluids in the neighbouring vessels. In this way Dr. Cullen explains the fact, that errhines often give relief to rheumatic pains in the neighbouring parts, especially to the tooth-ach, as well as to some forms of head-ach, pains of the ear, and ophthalmia. "How far their effects may extend," he says, "cannot be exactly determined; but it is probable that they may operate more or less on the whole vessels of the head, as even a branch of the carotid passes into the nose: and independent of this, it is not improbable that our errhines may have been of use in preventing apoplexy and palsy; which at least is to be attended to so far, that whenever any approach to these diseases is suspected, the drying up of the mucous discharge should be attended to, and, if possible, restored." Cullen's Mat. Med. vol. ii. p. 436.

The nicotiana, or tobacco, as it is commonly prepared for persons who amuse themselves by snuffing, may be conveniently employed, with people unaccustomed to it, as an errhine; but repetition soon diminishes its power, and renders it useless. It produces a different degree of discharge in different people, even of those who use it habitually; and Dr. Cullen states, from his own experience, "that whenever the discharge has been considerable, the laying aside snuffing, and therefore suspending that discharge, may have very bad effects."

The article most commonly employed as an errhine, is the *Asarum asarabacca*, snuffed up the nose every evening, for a short time, in the quantity of three grains. Quincy observes, ferves, that its pungency is not immediately felt upon taking, but after fome time it makes the nofe run very much. In larger quantities it fometimes brings blood, and even occafions a fwelling of the whole head. This laft effect, however, has been oftener produced by the *Euphorbium*, a ftill more acrid errhine. Dr. Cullen, fpeaking of thefe fevere effects, fays, "I have feen fome inftances of megrims, ophthalmias, and particularly tooth-achs, cured by the violent operation of errhines; but I never thought it fafe to imitate the practice." The *white hellebore*, in very fmall quantity, is alfo an acrid errhine.

ERRIFF, in *Geography*, a province of Africa, in the country of Fez. See RIF.

ERRIPSIS, from ῥιπτω, *I precipitate*, in *Medicine*, is ufed in different fenfes, fometimes for a weaknefs of the whole body, fometimes only of fome one part. When applied to the whole body, it expreffes that utter dejection and proftration of ftrength which makes a man fall down like a dead carcafs; and, when applied to the eyes, it expreffes fuch a debility, as renders it impoffible to keep them open.

ERROAD, in *Geography*, a town of India, in the country of Coimbatore; 39 miles E.S.E. of Damicotta, and 48 N.E. of Coimbatore.

ERROL, a fmall uninhabited town of America on lake Umbagog, on the north-eafternmoft fettled part of Grafton county, in New Hampfhire, incorporated in 1774.

ERROMANGO, an ifland in the Southern Pacific ocean, being one of thofe called the "New Hebrides," 18 leagues from Sandwich ifland, and 24 or 25 leagues in circuit. The middle of it lies in S. lat. 18° 54'. E. long. 169° 19', and it is of a good height. Captain Cook anchored in a bay of this ifland; and he found that although the behaviour of the inhabitants was at firft friendly, their real intentions were very different. They were armed with clubs, fpears, darts, bows and arrows, and feemed determined to employ them in a hoftile manner. On this account it became neceffary for the captain to give orders to his men to fire upon the affailants. At length they were fo terrified as to withdraw and make no farther appearance. Thofe iflanders, it was obferved, feemed to be of a different race from thofe of Mallicollo, and they fpoke a different language. They are of a middle fize, with a good fhape, and tolerable features. Their colour is very dark, and their afpect is not improved by their cuftom of painting their faces, fome with a black, and others with a red pigment. Their hair is curly and crifp, and fomewhat woolly. The few women, who were feen and who appeared to be ugly, wore a kind of petticoat, made either of palm leaves, or of a fimilar plant; but the men, like thofe of Mallicollo, were almoft entirely naked. On account of the treacherous behaviour of the inhabitants of Erromango, captain Cook called a promontory, or peninfula, near which the fkirmifh happened, "Traitor's Head." This is in the N.E. point of the ifland, and is fituated in S. lat. 18° 43', and E. long. 169° 28'.

ERRONAN, or FOOTOONA, the moft eaftern ifland of all the Hebrides, appeared to captain Cook to be about five leagues in circuit, of a confiderable height, and flat at top. On the N.E. fide is a little peak feemingly disjoined from the ifle; but which was thought to be connected by low land. It is diftant in the direction of N. by E. ½ E. 11 leagues from Port Refolution in the ifland of Tanna.

ERROR, a miftake of the mind in giving affent to a thing, or propofition, which is not true. See FALLACY.

Some philofophers define error an act of the mind, whereby things that fhould be joined are feparated; or, things that fhould be feparated, are joined; or a wrong judgment, difagreeing with the things whereon it is paffed.

Error ftands in oppofition to truth, which confifts in an agreement between the propofition and the thing whereof it is affirmed or denied.

However, a bare failure, or non-attainment of truth, does not conftitute error; that being common both to ignorance and doubting.

Error only ftands diftinguifhed from *falfhood*, in that the former is in the mind, and the latter only in the propofition.

The great origin of all error, *i. e.* of believing that to be true which is falfe, is a liberty, or power, in the human mind, of giving its affent to ideas, to propofitions, that are obfcure, as if they were perfpicuous and plain.

Particular caufes of error are, inadvertency, ignorance, impatience, intereft, authority, education, &c. See FAITH, PROBABILITY, OPINION.

Againft all which, there is this one general rule or caution laid down by F. Malebranche and others; *viz.* never to give our full affent to any propofition, unlefs the evidence for it be fo ftrong, as that we can no longer withhold it, without incurring the fecret reproaches of our own reafon.

Mr. Locke reduces the caufes of all our errors to thefe four; *viz.* 1. Want of proofs. 2. Want of ability to ufe them. 3. Want of will to ufe them. And, 4. Wrong meafures of probability.

F. Malebranche confiders five occafional caufes of error, or rather of five different kinds of errors, accommodated to the different manners we have of perceiving things. 1. Errors of fenfe. 2. Of the imagination. 3. Of the underftanding. 4. Of our inclinations. And, 5. Of the paffions. See SENSE, IMAGINATION, UNDERSTANDING, INCLINATION, and PASSION.

ERRORS, *popular.* See POPULAR.

ERROR, in *Law*, generally denotes a fault, or overfight, either in pleading, or in procefs; upon either of which is brought a writ, by way of remedy, called a *writ of error;* in Latin, *de errore corrigendo.*

A writ of error lies for fome fuppofed miftake in the proceedings of a court of record; for, to amend errors in a bafe court, not of record, a writ of "falfe judgment" lies. The writ of error only lies upon matter of law arifing upon the face of the proceedings; fo that no evidence is required to fubftantiate or fupport it; there being no method of reverfing an error in the determination of *facts*, but by an attaint, or a new trial, to correct the miftakes of the former verdict. A writ of error may be brought for notorious miftakes in the judgment or other parts of the record; as where a man is found guilty of perjury, and receives the judgment of felony, or for other lefs palpable errors, fuch as any irregularity, omiffion, or want of form in the procefs of outlawry, or proclamations; the want of a proper *addition* to the defendant's name, according to the ftatute of additions; for not properly naming the fheriff, or other officer of the court, or not duly defcribing where his county or court was held; for laying an offence committed in the time of the late king, to be done againft the peace of the prefent; and for many other fimilar caufes, which (though allowed out of tendernefs to life and liberty) are not much to the credit or advancement of the national juftice. Thefe writs of error to reverfe judgments in cafe of mifdemeanors are not to be allowed of courfe, but on fufficient probable caufe fhewn to the attorney-general; and then they are underftood to be grantable of common right, and "ex debito juftitiæ." But writs of error to reverfe attainders in capital cafes are only allowed "ex gratia;" and not without exprefs warrant under the king's fign manual, or at leaft by the confent of the attorney-general. 1 Vern. 170. 175.

If a writ of error be brought to reverſe any judgment of an inferior court of record, where the damages are leſs than ten pounds; or, if it is brought to reverſe the judgment of any ſuperior court after verdict, he that brings the writ, or that is plaintiff in error, muſt (except in ſome peculiar caſes) find ſubſtantial pledges of proſecution, or bail (ſtat. 3 Jac. I. c. 8. 13 Car. II. c. 2. 16 and 17 Car. II. c. 8. 19 Geo. III. c. 70.): to prevent delays by frivolous pretences to appeal; and for ſecuring payment of coſts and damages, which are now payable by the vanquiſhed party in all, except a few particular inſtances, by virtue of the ſeveral ſtatutes here recited. 3 Hen. VII. c. 10. 13 Car. II. c. 2. 8 and 9 W. III. c. 11. 4 and 5 Ann. c. 16.

A writ of error lies from the inferior courts of record in England into the king's bench, and not into the common-pleas. (Finch. L. 480. Dyer 250.) Alſo from the king's bench in Ireland to the king's bench in England. It likewiſe may be brought from the common pleas at Weſtminſter to the king's bench; and then from the king's bench the cauſe is removable to the houſe of lords. From proceedings on the law ſide of the exchequer a writ of error lies into the court of exchequer chamber, before the lord chancellor, lord treaſurer, and the judges of the court of king's bench and common pleas; and from thence it lies to the houſe of peers. From proceedings in the king's bench in debt, detinue, covenant, account, caſe, ejectment, or treſpaſs, originally begun there by bill (except when the king is party) it lies to the exchequer chamber, before the juſtices of the common pleas, and barons of the exchequer; and from thence alſo to the houſe of lords (ſtat. 27 Eliz. c. 8.); but when the proceedings in the king's bench do not firſt commence therein by bill, but by original writ ſued out of chancery, this takes the caſe out of the general rule laid down by the ſtatute (1 Roll. Rep. 264. 1 Sid. 424. 1 Saund. 346. Carth. 180. Comb. 295.); ſo that the writ of error then lies, without any intermediate ſtage of appeal, directly to the houſe of lords, the dernier reſort for the ultimate deciſion of every civil action. Each court of appeal, in their reſpective ſtages, may, upon hearing the matter of law in which the error is aſſigned, reverſe or affirm the judgment of the inferior courts; but none of them are final, ſave only the houſe of peers, to whoſe judicial deciſions all other tribunals muſt therefore ſubmit, and conform their own. Blackſt. Com. book iii.

Error, *to aſſign.* See Assign.

Errors, *Clerk of the.* See Clerk.

Error *loci*, literally *error of place*, a doctrine of conſiderable importance in the theory of diſeaſes, taught by the celebrated Boerhaave. It was deemed the principal cauſe of thoſe obſtructions to the circulation of the blood, on which inflammation, in all its varieties, was ſuppoſed to depend. "The parts of a fluid," ſays Boerhaave, "become unable to paſs by error of place (per errorem loci), when a corpuſcle ruſhes into the dilated mouth at the baſis of a conical canal, and cannot paſs through the narrow end of it." (Aphoriſm 118.) This doctrine is founded upon theſe three circumſtances; the ſeries of particles, of which the blood is compoſed; the ſeries of progreſſively diminiſhing veſſels; and the conical form of theſe veſſels: and it is thus explained by the comment of Van Swieten.

The largeſt particles in the blood are the red globules, which are to be found naturally in the larger veſſels only. Now the extremities of the arteries carrying red blood, tranſmit the red globules ſingly, according to the obſervations made with microſcopes on the pellucid parts of living animals. The finer parts of the blood are conveyed into the ſmaller lateral veſſels, and the red vein receives the red blood only. The veſſel of the next magnitude receives all the fluids except the red globules, and retaining the larger particles only, (*viz.* the ſerous globules) tranſmits the remaining thinner liquids into the ſtill ſmaller veſſels, that ariſe from the ſerous artery. This law obtains, then, in all the decreaſing ſeries of veſſels. The red arteries can receive and tranſmit all the humours; the ſerous arteries exclude the red part of the blood, but tranſmit the ſerous globules, and every other thinner fluid, and ſo on. Now, ſhould the diameter of a lateral veſſel ariſing from a larger one be by any means increaſed, for example, the aperture of a ſerous artery, which ariſes from a red one, a red globule might be able to enter its orifice when thus dilated; but as a conical canal always grows narrower, it will ſhortly ſtick faſt, and be by no means able to paſs through its extremity, and conſequently will cauſe an obſtruction, as the bulk of the particle to be carried through exceeds the capacity of the tranſmitting veſſel.

This error loci of the fluids was conſidered as the proximate cauſe of inflammation by Boerhaave, and his commentator illuſtrates the dilatation and diſtention of the lymphatic and ſerous veſſels by the red blood in the caſe of inflammations of the eye; in which the veſſels of the ſurface of the eye, which are naturally tranſparent, become red, and viſible, ſometimes even giving a red colour to the whole of the ſurface. See Van Swieten, Comment. ad Aph. 118—378, &c.

ERRUCA, in *Ancient Geography*, a town of Italy, belonging to the Volſii, according to Diodorus Siculus.

ERSE, in *Geography*, a river of Germany, in the circle of Lower Saxony, which runs into the Fuhſe; 8 miles S. of Zelle.

ERSH, in *Agriculture*, is a term ſignifying land in the ſtate of ſtubble after the grain has been taken off. Hence we have pea, bean, and different ſorts of grain erſhes.

Ersh-*Crop*, is ſuch a crop as is grown after ſome of theſe ſorts of ſtubbles have been turned down by the plough.

ERSTEIN, in *Geography*, a ſmall town of France, in the department of the Lower Rhine, chief place of a canton in the diſtrict of Barr, with a population of 2344 individuals. The canton contains 14 communes and 8991 inhabitants, on a territorial extent of $137\frac{1}{2}$ kiliometres.

ERTA, a town of Aſia, in Parthia.

ERTHOLM, a ſmall iſland, about three leagues from the coaſt of Schoonem, and half a league from Bornholm. It belongs to the Danes; and till of late was garriſoned only with 50 men: the force has been ſince augmented to 500. This iſland may be eaſily captured and retained by that power, which, during the interval of naval operations in the Baltic, has the ſuperior fleet.

ERTO del Ferro, a town of Italy, in the kingdom of Naples, and province of Calabria Citra; 10 miles W. of Umbriatico.

ERTZGEBIRGE, or rather Ertzgeburge, (arch-mountainous country,) is the fifth of the ſeven circles into which that part of the kingdom of Saxony, which is called Saxony Proper, or formerly Electoral Saxony, is divided. As late as the tenth century this whole extenſive tract of mountainous country was nothing but an impervious foreſt, called Miriquido, or Miriquidvi, few ſpots of which began to be cleared in 1004. It is bounded to the north by the circles of Miſnia, or Meiſſen and Leipzick, and by the principality of Altenburg, to the weſt by the ſame principality, the circles of Neuſtadt and Voigtland, and the dominions of the princes of Reuſs; to the ſouth and eaſt by the kingdom of Bohemia. Its principal rivers are the Zſchopau, the Flöhe, the Pöhl, the Preſnitz, and the Schwartzwaſſer.

The

The territorial extent of the Ertzgebirge is 121 German ſquare miles, and its population, in 1785, amounted to 405,600 individuals, which gives 3352 $\frac{1}{11}$ inhabitants to the German ſquare mile. It produces corn, potatoes, vegetables of all ſorts, and excellent flax, and has ſeveral manufactories, but chiefly thoſe which work upon minerals and metals.

The circle of the Ertzgebirge is remarkable for its numerous and valuable mines, which, in 1789, employed 12,867 miners, and, in 1788, yielded in ſilver only 50,618 marks. The aggregate of all the metals produced the ſum of 700,64 dollars. Amalgamation, or application of mercury to extract the ſilver from the ore, was firſt introduced in the Saxon mines in the year 1787.

Freyberg is the chief place of the Ertzgebirge, and the firſt town in Europe for the ſtudy of mineralogy. See FREYBERG.

The whole circle of the Ertzgebirge contains 61 towns and 723 villages. It is ſubdivided into 13 diſtricts, *viz.* Freyberg, Auguſtuſburg, Chemnitz, Roſſen, Frauenſtein, Altenberg, Lauterſtein, Wolkenſtein, Annaberg, Grünhayn, Schwartzenberg, Weiſenburg, and Zwickau.

ERTZICA, a town of Aſia Minor, in Cappadocia, commonly called *Arzingham.*

ERUBRUS, a river of Gaul, thought by M. D'Anville to be the Rouver, which runs into the Moſelle, a little below Treves.

ERUCA, in *Zoology.* See CATERPILLAR.

ERUCA *marina griſeo fuſca.* See APHRODITA.

ERUCAGO, in *Botany,* Tourn. Inſt. 232. t. 103, ſee BUNIAS, ſpec. 3.

ERUCTATION, BELCHING, the ſame as ructation.

ERUDITION, denotes learning or knowledge; and chiefly that of hiſtory and antiquity, of languages and of books, which is the reſult of hard ſtudy, and extenſive reading. The Scaligers were men of deep erudition: the writings of M. Launoy, a prieſt of the Oratory, are full of erudition.

Mr. Locke ſays, it is of more uſe to fill the head with reflections than with points of erudition. If the mind be not juſt and right, ignorance is better than erudition, which only produces confuſion and obſcurity. M. Balzac calls a heap of ill choſen erudition the luggage of antiquity.

ERVEDEIRA, in *Geography,* a town of Portugal, in the province of Eſtremadura; 12 miles N.N.W. of Leiria.

ERVILIA, in *Botany,* an ancient name for a kind of vetch or pea. See PISUM OCHRUS, alſo ERVUM.

ERUPA, in *Ancient Geography,* a town of Arabia Deſerta. Ptolemy.

ERUPTION, in general, a burſting forth, or excluſion of ſomething which was before covered, or concealed.

The eruption of volcanos, or burning mountains, is frequently the effect and iſſue of earthquakes. See EARTHQUAKE, VOLCANO, &c. For an account of the eruptions of mount Ætna and Veſuvius, ſee ÆTNA and VESUVIUS.

ERUPTION, in *Medicine,* denotes the appearance of various ſpots and diſcolourations of the ſkin, whether puſtules, pimples, raſhes, &c.: thus, we ſpeak of an eruption of ſmall-pox, or of meaſles; and, by a figure of ſpeech, theſe puſtules, raſhes, &c. are often denominated eruptions, or cutaneous eruptions.

ERUPTION *in Infants.* See INFANTS.

ERUPTIVE DISEASES, a term nearly ſynonymous with CUTANEOUS *Diſeaſes,* (which ſee). Eruptive fevers are theſe febrile diſeaſes which are accompanied by an eruption of ſpots or tumours on the ſkin, by which they are principally characterized: ſuch as ſmall-pox, meaſles, chicken-pox, cow-pox, ſcarlet fever, eryſipelas, ſhingles, &c.

ERVUM, in *Botany,* an ancient Latin name of unknown derivation. Tare. Linn. Gen. 376. Schreb. 498. Willd. Sp. Pl. v. 3. 1112. Sm. Fl. Brit. 775. Juſſ. 360. Claſs and order, *Diadelphia Decandria.* Nat. Ord. *Papilionaceæ,* Linn. *Leguminoſæ,* Juſſ.

Gen. Ch. *Cal.* Perianth of one leaf, tubular, erect, cloven half-way down into five acute ſegments, all of equal breadth, but the lowermoſt is rather the longeſt. *Cor.* papilionaceous, twice as long as the calyx: ſtandard obovate, nearly entire, aſcending, with a broad claw, compreſſed and keeled at the back; wings two, oblong, obtuſe, half-heart-ſhaped, ſhorter than the ſtandard, with narrow claws; keel as long as the wings, of two conjoined compreſſed petals, with ſeparate claws. *Stam.* Filaments in two ſets, one compoſed of nine, the other ſolitary; anthers roundiſh, two-lobed, erect. *Piſt.* Germen ſuperior, oblong, compreſſed, horizontal; ſtyle ſimple, aſcending, forming a right angle with the germen, and about half as long; ſtigma capitate, obtuſe, hairy all over. *Peric.* Legume oblong, obtuſe, compreſſed, rigid, knotty from the prominent ſeeds, of one cell, and two pointed, ſpirally-elaſtic valves. *Seeds* from two to four, occaſionally more, roundiſh, ſomewhat compreſſed.

Eſſ. Ch. Stigma capitate, hairy all over.

The genus *Ervum* in Linnæus is a heterogeneous aſſemblage, difficult to be accounted for. *E. Lens,* the ſpecies from which his generic character ſeems to have been principally taken, is moſt completely a *Cicer,* under which head it ſhould have been deſcribed in our eighth volume. *E. ſolonienſe* is not only a true *Vicia,* but the very ſame plant with *Vicia lathyroides,* Linn. Sp. Pl. 1040. See Engl. Bot. t. 30. *E. monanthos* and *Ervilia,* having the ſtyle hairy on the upper ſide, appear to us to belong to *Lathyrus.* Thus none of the Linnæan *Erva* remain, except our two Britiſh ſpecies, and theſe are not only very peculiar in habit, but according to the analogy of the tribe to which they belong, their ſtigma affords an excellent eſſential character, not to be found in any other *diadelphous* flower. All this was firſt explained in the Flora Britannica, by the author of the preſent article, and Willdenow has adopted it in every point, except that he retains the old erroneous character, "calyx deeply five-cleft," in addition to that derived from the ſtigma, and alſo makes *E. Ervilia* a *Vicia.* He moreover adopts a ſuppoſed new ſpecies from Deſfontaines, making three in all.

1. E. *tetraſpermum.* Smooth-podded Tare. Linn. Sp. Pl. 1039. Curt. Lond. faſc. 1. t. 55. Engl. Bot. t. 1223. Stalks moſtly two-flowered. Pods ſmooth, many-ſeeded.—A troubleſome weed in cultivated land throughout Europe, flowering in June and July. *Root* annual, fibrous. *Stem* weak, climbing, branched, ſquare, hairy. *Leaflets* numerous, alternate, linear-oblong, obtuſe, hairy beneath, their common ſtalk ending in a branched tendril. *Flower-ſtalks* axillary, ſolitary, ſlender, as long as the leaves without their tendril, each bearing two (ſometimes ſolitary,) little drooping flowers of a pale blue veined with dark purple. *Calyx* hairy. *Pods* half an inch long, pendulous, oblong or obovate, ſmooth. *Seeds* four; occaſionally from five to ſeven in a variety found in Huntingdonſhire and at Algiers, which we have in vain tried to make a diſtinct ſpecies.

2. E *vicioides.* Vetch-like Tare Desfont. Atlant. v. 2. 168. t. 198. Willd. Sp. Pl. v. 3. 1112.—Stalks many-flowered. Pods ſilky, two-ſeeded. Leaflets obovate, entire. Gathered by Deſfontaines in hedges at Algiers. It appears to be very nearly related to the following, from which it

chiefly differs in being rather larger, and in having more rounded and not emarginate *leaflets*. Nothing however is more variable than the termination of the leaflets in *Vicia* and its allies. The *pods* are called filky, which is perhaps equally applicable to *E. hirfutum*. All things confidered, we much doubt of the permanency of this fpecies, which we, like Willdenow, adopt entirely from the excellent work of Desfontaines. We tolerate, but cannot approve the mixture of Greek and Latin in the name *vicioides*, which if the fpecies fhould remain, ought to be made *viciæformis*.

3. E. *hirfutum*. Hairy-podded Tare. Linn. Sp. Pl. 1039. Curt. Lond. fafc. 1. t. 54. Engl. Bot. t. 970.—Stalks many-flowered. Pods hairy, two-feeded. Leaflets emarginate.—A pernicious weed in cornfields and paftures throughout Europe. It much refembles the firft fpecies, but the *ftem* is ufually fmoother, the ends of the *leaflets* more abrupt and notched, the *flowers* and *pods* more numerous on each ftalk. The moft effential difference confifts in the fhorter, fomewhat rhomboid, hairy *pods*, with only two feeds.—Mr. Curtis obferves that he has "in wet feafons feen whole fields of corn overpowered and totally deftroyed by this plant, which is ftronger and more prolific than *E. tetrafpermum*." He does not, however, fuggeft any remedy. Thefe weeds are too minute and inconfpicuous when young to be eradicated, and when they have fixed their tendrils upon the crop, they can no longer be feparated without "rooting up alfo the wheat with them." S.

Ervum *Orientale*. See Sophora.

ERVY, in *Geography*, a fmall town of France, in the department of the Aube, chief place of a canton in the diftrict of Troyes, with a population of 1975 individuals. It is 9 miles S. of St. Florentin, and has fome manufactures of linen-cloth. The canton contains 14 communes and 11,199 inhabitants, on a territorial extent of 222½ kiliometres.

ERWASH, a river of England, which rifes in the county of Nottingham, and almoft in its whole courfe feparates that county from Derbyfhire, and falls into the Trent, 4 miles S. W. of Nottingham. See Erewash.

ERWITE, a town of Germany, in the circle of the Lower Rhine, and duchy of Weftphalia; 5 miles S. of Lippftadt.

ERXLEBEN, John Christian Polycarp, in *Biography*, was born in June, 1744, at Quedlingburg, where his father was dean of St. Nicholas's church. He ftudied medicine at Gottingen, where he took the degree of mafter of arts in 1765, and fhortly after gave lectures on natural hiftory and the veterinary fcience. Having publifhed his introductory lectures, he undertook, at the expence of the Hanoverian government, a tour through France, Holland, Denmark, and a great part of Germany, in the courfe of which he acquired much practical knowledge in the veterinary art. On his return he lectured on the feveral fciences connected with natural hiftory, and natural and experimental philofophy. In 1774, and the following years, he was elected a member of moft of the learned focieties on the continent. He died in Auguft, 1777, when he had but juft attained his thirty-third year. Erxleben publifhed many works which were highly efteemed, among thefe are "Principles of Natural Hiftory;" "Principles of Natural Philofophy;" "An Introduction to the Veterinary Art." Gen. Biog.

ERYANNOS, in *Ancient Geography*, a river of Afia Minor, in the Troade, which had its fource in mount Ida.

ERYBIUM, a town of Greece, in the Doride, fituated, according to Diodorus Siculus, at the foot of mount Parnaffus.

ERYCEIRA, Francis de Meneses, *Count of*, in *Biography*, born at Lifbon in 1614, was brought up to the ufe of arms, and obtained fome important offices under government; but in the midft of his ufual occupations he cultivated literature, and publifhed a number of works, particularly hiftories of Tangier and Portugal; and the life of John I. king of Portugal.

Eryceira, Francis-Xavier de Meneses, was grandfon of the preceding, and, like him, united a literary with an active and military life. He was born at Lifbon in 1672, and rofe to eminence in the ftate. He was chofen member of various learned focieties. From his anceftor he inherited a well chofen and extenfive library, to which he made many great additions. He is faid to have been the author of more than a hundred different works, of thefe, however, but few feem entitled to notice. The beft known are, "Memoirs on the Value of the Monies of Portugal," 4to. 1738; "Reflection on Academical Studies;" "Parallels on Illuftrious Men and Women;" and "A Tranflation of the Henriade." He died in the year 1743. Nouv. Dict. Hift.

ERYCINA, in *Mythology*, a furname given to Venus, from Erix, a mountain in Sicily, where fhe had a temple. Venus Erycina had alfo a temple at Rome, which was deemed very ancient even in the time of Thucydides. See Erix.

ERYMANTHUS, in *Ancient Geography*, a mountain or foreft of the Peloponnefus, in Arcadia, E. of a river of the fame name, which had its fource towards the north, on the confines of the Elide and of Arcadia, in mount Lampie. The wood of Erymanthus was full of boars, which made great defolation in the country. Hercules was employed to give chafe to them, which he did with fuch fuccefs, that he flew with his own hands the largeft of them. See Hercules.—Alfo, a town of the Peloponnefus, in Arcadia, called *Phegia* and *Pfophis*, according to Paufanias.

ERYMI, a people of Scythia, on this fide of the Imaus. Ptolemy.

ERYMNÆ, a town of Afia Minor, in Lycia. Steph. Byz.—Alfo, a town of Greece, in Theffaly; placed by Pliny in Magnefia.

ERYNGIUM, in *Botany*, ἠρυγγιον of Diofcorides, the derivation of which is unknown. Eryngo or Sea Holly. Linn. Gen. 127. Schreb. 177. Willd. Sp. Pl. v. 1. 1356. Mart. Mill. Dict. v. 2. Sm. Fl. Brit. 288. Juff. 226. Gærtn. t. 20. Clafs and order, *Pentandria Digynia*. Nat. Ord. *Umbelliferæ*.

Gen. Ch. *Common Receptacle* conical. *Flowers* all fertile, feffile, with fcales between them. *Involucrum* of the whole receptacle of many leaves, flat, fpreading beyond the flowers. *Cal.* Perianth fuperior, of five upright, acute leaves, feffile on the germen, fhorter than the corolla. *Cor.* in the aggregate uniform, roundifh. Petals five, equal, oblong, with a linear longitudinal ftricture, their points bent in, fo as nearly to reach the bafe. *Stam.* Filaments five, capillary, ftraight, projecting far above the corolla; anthers oblong, verfatile. *Pift.* Germen inferior, briftly; ftyles two, thread-fhaped, a little fpreading, fomewhat fhorter than the filaments; ftigmas fimple. *Peric.* Fruit ovate, feparable perpendicularly into two parts. *Seeds* oblong, cylindrical; in fome fpecies remaining fhut up in the cruft of the pericarp, in others deciduous from it.

Eff. Ch. Involucrum of many leaves. Flowers in little denfe heads. Common receptacle conical, fcaly. Seeds briftly.

A moft fingular and very natural genus, having the habit and afpect of a thiftle, the herbage rigid, thorny, either

either more or lefs tinged with vivid blue, or pallid and whitifh; while the fructification is exactly that of an umbelliferous plant, though the inflorefcence is capitate. Willdenow has eleven fpecies, but they and their fynonyms require a thorough inveftigation. Two are natives of Britain, *viz. E. maritimum*, Engl. Bot. t. 718, (in which plate we are forry to remark that the petals are drawn reflexed inftead of inflexed, an error that till now efcaped us.)—This is frequent on fandy fea fhores throughout Europe, flowering in July and Auguft. The long creeping perennial *roots* are aromatic and fomewhat acrid; they are efteemed ftimulant and reftorative, and are fometimes fold candied. The herbage is glaucous variegated with a permanent blue. *Leaves* rounded, plaited, lobed, with fpinous teeth. *Flowers* blue, in denfe terminal heads, encompaffed with a large leafy involucrum. *Scales* of the receptacle three-cleft. The other Britifh fpecies is *E. campeftre*, Engl. Bot. t. 57, found very rarely in England, though common on the continent. Its *leaves* are much more narrowly divided than the firft, and pinnatifid. *Flowers* greenifh-white, with narrow involucral leaves and undivided fcales. This appears to be the true ηρυγγιον of Diofcorides.

Among the exotic kinds *E. amethyftinum*, Linn. Sp. Pl. 337, a native of Styria; *E. alpinum*, ibid. Curt. Mag. t. 922, from the Swifs alps; and *E. planum*, Jacq. Auftr. t. 391; are all hardy perennials, frequently cultivated for ornament. The *alpinum* is indeed peculiarly handfome, on account of its many-leaved, finely divided, blue involucrum.

The following five fpecies are not in Willdenow.

E. *cyaneum*. Sm. Prod. Fl. Græc. Sibth. v. 1. 175. Fl. Græc. v. 3. t. 258. unpublifhed. "Radical leaves in five deep pinnatifid fegments. Stem much branched and divaricated. Involucrum of about five leaves."—Common in Greece and the iflands of the Archipelago. The *root* is perennial *Stem* 12 or 18 inches high, of a fine blue, as well as the involucrums and foliage, many-flowered and divaricated. *Leaves* fmall, in linear, narrow, pinnatifid fegments. Heads of *flowers* fmall, blue, with prominent, confpicuous, white anthers. This moft refembles *E. triquetrum*, Vahl. Symb. v. 2. 46, in habit, but the flowers and involucrum are very different.

E. *multifidum*, ibid. Fl. Græc. v. 3. t. 259.—"Leaves doubly pinnatifid, fomewhat lyrate; radiated at the extremity. Stem corymbofe. Involucrum pinnatifid."—Gathered by Dr. Sibthorp in the Morea. Taller than the laft, with a bright blue *ftem* and *flowers*. The finely pinnatifid *leaves* give it the afpect of an *Echinops*. This is prefumed to be Eryngium creticum erectum, folio multifido, caule et ramis amethyftinis; Tourn. Cor. 23.

E. *parviflorum*, ibid. (E. foliis laciniatis, capitulis florum exiguis et denfe congeftis; Tourn. Cor. 23.) "Leaves bipinnatifid. Stem corymbofe. Involucrum three-cleft or fimple, four times as long as the head." Of this no figure is extant, nor is it known where Dr. Sibthorp gathered the fpecimens found in his herbarium. The *root* is perennial. *Herb* whitifh. *Stem* denfely clothed with leaves, and bearing numerous flowers at the fummit. *Leaves* twice or thrice pinnatifid, their fegments narrow and divaricated. Heads of *flowers* very fmall, with large involucra, generally of five leaves, which are either undivided or three-cleft.

E. *purpuratum*. Leaves all pinnatifid, their lower part fringed with capillary teeth. Stem nearly fimple, with few flowers. Involucrum of about feven undivided leaves.—Gathered near Tangier by the late M. Brouffonet and the Abbè Durand, who feverally fent fpecimens to Dr. Smith. *Root* perennial. *Stems* a fpan high, round, furrowed, leafy, fcarcely branched, but bearing about three dark-blue heads of *flowers*, with very fpinous calyces. *Leaves* all nearly alike, pinnatifid, with decurrent, fometimes lobed, fegments; their lower part clafping the ftem, pectinated, fringed with fine long capillary teeth. Great part of the ftem, and the upper fide of each leaf of the involucrum, are tinged with a rich deep blueifh purple, hardly equalled in any other of the genus.

E. *carthamoides*. Leaves oblong, toothed, undivided, heart-fhaped and clafping the ftem at their bafe. Stem nearly fimple, with few flowers. Involucrum of feveral ovate leaves. Gathered by M. Brouffonet in the neighbourhood of Algiers, flowering in June. *Stem* a foot high, ftrong, round, leafy, fometimes purplifh, fimple, except at the fummit, where it bears from three to five large heads of blueifh *flowers*, whofe involucrum confifts of feveral large, ovate, purplifh, fpinous-toothed leaves, much refembling thofe of a *Carthamus*. The radical and ftem-*leaves* are all fimple, oblong, wavy, with large fpinous teeth, veiny and pale-green.

ERYNGO, in the *Materia Medica*. The root of eryngium is attenuant and deobftruent, and is therefore efteemed a good hepatic, uterine, and nephritic. Its whole virtue, it is to be obferved, confifts in the external or cortical part. Their virtues, however, appear to be but weak; and they are now fcarcely otherwife ufed than as made into a fweetmeat.

The London college directs it to be candied in the following manner: boil the roots till the rind will eafily peel off; when peeled, flice them through the middle, and the pith being taken out, wafh them three or four times in cold water; then for every pound of roots thus prepared, take two pounds of double-refined fugar; diffolve the fugar in water, fet it on a fire, and as foon as it begins to boil, put in the roots, and continue the boiling till they become foft.

Thefe candied roots are an ingredient in artificial affes milk, which is thus made: take of candied eryngo root one ounce, pearl barley half an ounce, liquorice root three drams; boil them in two pints of water to one pint, to which add a pint of new milk from the cow; boil them gently together, then ftrain the liquor for ufe, of which half a pint fhould be drunk three times a day.

ERYNNIS, *q. d.* ερις νȣ, *contentio mentis*, or becaufe, as Paufanias remarks, ἐρινύειν fignifies to fall into a fury, or *Furious*, a name given to Ceres by the Sicilians.

ERYSIBE, in *Botany*, ερυσιβη, *ruft, or the mildew of corn*, from its rufty panicle. Roxb. Pl. Coromand. v. 2. 31. Clafs and order, *Pentandria Monogynia*. Nat. Ord. *Sapotæ*, Juff.

Gen. Ch. *Cal.* Perianth in five deep, roundifh, concave, permanent fegments. *Cor.* of one petal, falver-fhaped, the length of the calyx; tube cylindrical, pervious; limb the length of the tube, in 10 roundifh fegments, fpreading. *Stam.* Filaments five, very fhort, inferted into the lower part of the tube; anthers erect, ovate, fhorter than the tube. *Pift.* Germen fuperior, ovate; ftyle none; ftigma five-lobed. *Peric.* Berry oval, of one cell. *Seed* folitary, large.

Eff. Ch. Corolla falver-fhaped; limb in ten equal fegments. Style none. Stigma five-cleft. Berry fuperior, with one feed.

E. *paniculata*. Roxb. Coromand. t. 159. The only known fpecies, a native of the mountain forefts of India, from whence Dr. Roxburgh fent us fpecimens in 1789. A very large climbing fhrub. *Branches* alternate, leafy, round, clothed when young with copious rufty down. *Leaves* alternate, three or four inches long, fpreading and deflexed,

deflexed, elliptic-oblong, pointed, entire, veiny; smooth and shining above; paler and opaque beneath. *Footstalks* half an inch long, angular, rusty. *Stipulas* none. *Panicles* many-flowered, terminal, erect, much branched, about a span long, their stalks, small oblong scattered bracteas, and the calyx, all densely clothed with rusty down. Tube of the *corolla* greenish; limb yellow, about three lines in diameter. *Berry* the size of a small cherry, black, pulpy, containing one large seed.

Of the uses or qualities of this plant or its fruit we have no account. From its botanical affinity to *Chrysophyllum*, *Achras*, &c. it may certainly be eaten with safety. The flowers are not inelegant.

ERYSIMA, in *Ancient Geography*, a town of Asia, in Cappadocia.

ERYSIMUM, in *Botany*, ερυσιμον of Theophrastus and Dioscorides, about the etymology of which there is much controversy among the learned, but, as often happens in such controversies, nothing satisfactory. Hedge-mustard. Linn. Gen. 339. Schreb. 442. Willd. Sp. Pl. v. 3. 509. Mart. Mill. Dict. v. 2. Sm. Fl. Brit. 706. Juss. 239. Tournef. t. 111. Gærtn. t. 143. Class and order, *Tetradynamia Siliquosa*. Nat. Ord. *Siliquosæ*, Linn. *Cruciferæ*, Juss.

Gen. Ch. *Cal.* Perianth of four ovate-oblong, coloured, parallel, cohering, deciduous leaves. *Cor.* cruciform, of four oblong, flat, very obtuse petals, whose claws are the length of the calyx and erect. Nectary a gland betwixt each of the shorter filaments and the germen. *Stam.* Filaments six, the length of the calyx; of which two opposite ones are shorter than the rest; anthers simple. *Pist.* Germen superior, linear, square, the length of the stamens; style very short; stigma small, capitate, permanent. *Peric.* Pod long, linear, straight, exactly square, of two cells and two valves. *Seeds* numerous, small, roundish.

Eff. Ch. Pod straight, columnar, exactly square. Calyx-leaves cohering. Stigma capitate.

Willdenow has 14 species, of which five are British.

1. E. *officinale*. Linn. Sp. Pl. 922. Curt. Lond. fasc. 5. t. 50. Engl. Bot. t. 735. "Pods close-pressed to the main stalk. Leaves runcinate." Common in waste ground and about hedges. This is usually taken for the ερυσιμον of Dioscorides, whose description, more full than usual with that writer, is very applicable to it. Dr. Sibthorp, however, decidedly considered *Sisymbium polyceratium* as the plant Dioscorides meant, and this, perhaps, will be found to accord still better with his description, which compares the horn-like pods to fænugreek. See its figure in Matthiolus, Ed. Valgr. fol. v. 1. 524. The ερυσιμον of Theophrastus is supposed to be a still different plant, as he reckons it among the various kinds of grain.

In this and similar cases, therefore, though the Linnæan generic name is adopted from ancient writers, it does not follow that their plant is of the same genus, which matter is frequently impossible to be ascertained. It is sufficient that such names are established by common consent amongst systematical botanists, from whom they acquire a new stamp of authority; nor ought they to be changed, whatever new light may be thrown upon them by future commentators. We study by the arrangements of Linnæus or Jussieu, not by those of Theophrastus or Dioscorides. It is only in case any species requires to be separated from an established genus, that we are glad to recur to its ancient appellation for a generic name; as in the cases of *Cyamus*, Sm. Exot Bot. v. 1. 59. t. 31, 32 (see CYAMUS); and *Nuphar*, Prod. Fl. Græc. v. 1. 361.

2. E. *Barbarea*. Linn. Sp. Pl. 922. Engl. Bot. t. 443. "Lower leaves lyrate; their terminal lobe rounded: upper ones obovate, toothed."—Common in waste ground, either dry or wet, flowering most in the spring. Its numerous *flowers* of a full yellow, often seen double in gardens, and its dark shining broad *leaves* easily distinguish it. The whole plant has a nauseous, bitter, slimy flavour.

3. E. *præcox*. Sm. Fl. Brit. 707. Engl. Bot. t. 1129. "Lower leaves lyrate: upper ones pinnatifid, their segments linear, oblong, and entire."—Found in Devonshire by the Rev. Dr. Beeke. The narrow lobes of the *stem-leaves*, smaller *flowers*, and much longer *pods*, distinguish this from the last, with which we believe Linnæus confounded it. The distinction is highly important, as we are convinced the present is the very same with the American Cress, as it is called, or rather Winter Cress, of the gardens, an agreeable and wholesome pungent herb for sallads, &c.

4. E. *Alliaria*. Linn. Sp. Pl. 922. Curt. Lond. fasc. 2. t. 48. Engl. Bot. t. 796. "Leaves heart-shaped."—Common under hedges in the spring, and known by its broad toothed *leaves*, white *flowers*, and strong scent of garlick when bruised.

5. E. *cheiranthoides*. Linn. Sp. Pl. 923. Engl. Bot. t. 942. Jacq. Austr. t. 23.—"Leaves lanceolate, slightly toothed. Pods erect. Flower-stalks when in fruit spreading."—Not rare in Osier-grounds, Turnip fields, and other cultivated ground, where the soil is gravelly or sandy, flowering in July. This resembles the yellow stock or wall-flower in habit and *leaves*, but the small *flowers* and square *pods* at once distinguish it.

The exotic species are not quite so well ascertained as ours. Ehrhart and Roth have taken pains to elucidate them, and the result is given by Willdenow. We know not that any of them is worthy of the attention of the cultivator except for botanical curiosity.—They are all either annual or biennial, perfectly hardy in our climate, and bear narrow lanceolate leaves, with small yellow flowers. As weeds their copious seeds render them rather troublesome.

ERYSIPELAS, from ερυω, *to draw*, and πελας, *near*, from the disposition of the affection to draw the adjacent parts into the same state; or from ερυθρος, *red*, and μελας, *black*, a dark red.) The generality of surgical authors have considered erysipelas as a species of inflammation, and every reflection induces us to entertain the same opinion, notwithstanding the opposite sentiment of one of the lecturers on surgery in this metropolis. The immortal Celsus has observed: "notæ verò inflammationis sunt quatuor; rubor, et tumor, cum calore et dolore," lib. 3. cap. 10. According to this definition, erysipelas is certainly an inflammation, although the degree of swelling is not so great, nor the pain exactly of the same kind, as in cases of phlegmon, or common inflammation.

With many distinguished surgical authors, we regard erysipelas as a particular kind of inflammation, most frequently affecting the small vessels on the surface of the body. It is, as Mr. Hunter describes, more commonly a cutaneous inflammation, than one situated in deeper parts; although it is probable, that, in some constitutions, every inflammation, wherever it exists, will be of this kind. However, there can be no doubt of the fact laid down by this accurate observer, *viz.* that the skin appears to be the most susceptible of erysipelas, because this affection will spread over a prodigious extent of the surface of the body, while (at least, in common instances) the cellular membrane underneath remains free from disorder. (See Hunter on Inflammation, p. 270.)

Mr. Hunter taught surgeons, that one of the uses of the adhesions, adhefions, which form in cafes of common inflammation, is to circumfcribe and bound the matter, in the event of fuppuration taking place. Now, in eryfipelas, the extravafation in the place affected is not fo confiderable as in phlegmon, nor is it of that kind, which produces adhefions among the inflamed parts. Indeed, fince eryfipelas feldom ends in fuppuration, fuch adhefions, according to Mr. Hunter's view of the fubject, would in general be unneceffary. Perhaps, alfo, the circumftance of there being no adhefions in eryfipelatous cafes, may account for the terrible diffufion of mifchief, which always happens, when abfceffes do occafionally take place. Then, we know, that the matter makes its way extenfively through the cellular fubftance, in every direction under the fkin, under fafciæ, and between the mufcles, producing, wherever it goes, what has been often named a gangrenous fuppuration. When eryfipelas is of an unmixed kind, it has not the dark red colour which common inflammations have, but a lighter red, with a yellow tinge, which is particularly obfervable towards the termination of the diforder. The fwelling which occurs is unattended with any remarkable induration, and forms a very inconfiderable prominence. The fkin of the inflamed part has a fhining appearance, and, on being touched with the finger, turns white at the fpot where the preffure is made; but the bright red colour immediately afterwards returns. The pain is ufually of a burning, fhooting defcription, and the patient frequently complains of a fort of itching, which is found to be particularly annoying. The fwelling, which happens in cafes of eryfipelas, is not only not fo hard and elevated as that which arifes in examples of phlegmonous inflammation, it is at the fame time not fo clearly circumfcribed.

Another remarkable feature of eryfipelas, is the manner in which this inflammation often changes its fituation, by getting well on one fide, while it is fpreading in fome other direction. The great celerity with which the affection fpreads, and the large furface which it in a very little while covers, may alfo be fet down among its moft ftriking peculiarities.

When the affection is intimately dependent on the ftate of the conftitution, we very often fee all the local fymptoms recede in one place, and the difeafe make its attack in fome other part of the body. Such inftances are not unfrequently mentioned by writers as *metaftafes*, juft as if it were a real fact, that, when the eryfipelatous fymptoms get well on one leg, and the other leg becomes affected in a fimilar way, thefe events happen, in confequence of the firft identical difeafe actually moving from one limb to the other. From this abfurd doctrine originates all the cant about the danger of ufing fuch applications as are likely to repel the inflammation. The truth is, that the fecond attack of the eryfipelas is not at all connected with the termination of the firft; but arifes from fome different, and probably inexplicable caufe, juft as encyfted tumours will often form, one after another, in various parts of the body, as regularly as they are cut out. In this latter inftance, no one is abfurd enough even to fufpect that the growth of one tumour is the effect of a previous one being cured.

In true eryfipelas, there is no throbbing of the part affected, as in cafes of phlegmon; and when eryfipelatous inflammation runs along the fkin, the affection has a determinate edge, and does not lofe itfelf gradually and infenfibly in the furrounding parts, as common inflammation does.

The alteration which the fkin undergoes in eryfipelas confifts in its feeling at the part affected lefs pliable than in the natural ftate, and a little thickened.

Such are the ordinary local fymptoms of eryfipelas. They are fubject, however, to fome variety, depending on the mildnefs or violence of the attack, and on the circumftance of the diforder being either fimple, or complicated with another affection; for inftance, œdema, phlegmon, &c.

With refpect to violence, eryfipelas may be very properly divided into three degrees. In the firft, or mildeft form of the complaint, the eryfipelas makes its appearance, without any preceding illnefs, or with only a flight indifpofition of fhort duration, and confifting of laffitude, difturbed fleep, lofs of appetite, &c. Thefe complaints very foon go off, when the eryfipelas comes out, which happens in about a couple of days. For two days more the local fymptoms remain the fame, and then the eryfipelas turns pale and yellow, gradually difappearing altogether, with a detachment of the cuticle. During the whole courfe of the diforder there is no fever of any confequence; but a little while before the rednefs occurs the pulfe is fometimes rather difturbed.

In the fecond, or more fevere degree of the diforder, the patient is troubled, about two days before the eryfipelas makes its appearance, with an unufual proftration of ftrength, heavinefs in all his limbs, head-ach, lofs of appetite, naufea, and even actual vomiting, complaints in the ftomach, &c. Befides thefe inconveniencies, the patient is affected with a fever, and all its ufual fymptoms. After a couple of days, commonly on the third day from the commencement of all indifpofition, the eryfipelas comes out, attended with a gentle fweat, and a moderate increafe in the fecretion of urine, after which circumftances the fever, with all its attendant fymptoms, goes off. The reft of the progrefs of the cafe is fimilar to what we have related, as happening in the firft, or mildeft attack of eryfipelas.

In the third, or moft violent degree of the diforder, particularly in thofe cafes in which eryfipelas makes its attack on the face, the patient is affected with fevere febrile fymptoms, head-ach, lofs of fleep, delirium, ficknefs, &c. Thefe complaints do not diminifh, as in the milder cafes of eryfipelas, when the local rednefs, heat, &c. take place on the third day; but continue with unabated vehemence, until the eryfipelas itfelf fubfides. The laft defirable event commonly happens, according to Richter, on the eleventh day, accompanied with an increafe in the fecretions from the fkin and kidnies.

The moft dangerous cafes of eryfipelas are thofe in which the face is affected. Of this form of the diforder, the celebrated Cullen has left us a matchlefs defcription, which we think is highly deferving of infertion in this Cyclopædia. The eryfipelas of the face, (fays this interefting author,) comes on with a cold fhivering, and other fymptoms of pyrexia. The hot ftage of this is frequently attended with a confufion of head and fome degree of delirium; and almoft always with drowfinefs, or perhaps coma. The pulfe is always frequent, and commonly full and hard.

When thefe fymptoms have continued for one, two, or at moft three days, there appears on fome part of the face a rednefs, fuch as that of erythema. This rednefs at firft is of no great extent; but, gradually fpreads from the part it firft occupied, to other parts of the face, commonly till it has affected the whole; and frequently from the face it fpreads over the hairy fcalp, or defcends on fome part of the neck. As the rednefs fpreads it commonly difappears, or, at leaft decreafes in the parts it had before occupied. All the parts upon which the rednefs appears are at the fame time affected with fome fwelling, which continues for fome time after the rednefs has abated. The whole face becomes confiderably turgid; and the eye-lids are often fo much fwelled, as entirely to fhut up the eyes.

To

To continue Dr. Cullen's account: when the rednefs and fwelling have proceeded for fome time, there commonly arife, fooner or later, blifters of a larger or fmaller fize on feveral parts of the face; thefe contain a thin yellowifh, or almoft a colourlefs liquor, which fooner or later runs out. The furface of the fkin in the bliftered places fometimes becomes livid and blackifh, but this livor feldom goes deeper than the furface, or difcovers any degree of gangrene affecting the fkin. On the parts of the face not affected with blifters the cuticle fuffers, towards the end of the difeafe, a confiderable defquamation.

Sometimes the tumours of the eye-lids end in a fuppuration.

The inflammation coming upon the face does not produce any remiffion of the fever which had before prevailed; and fometimes the fever increafes with the increafing and fpreading inflammation.

The inflammation ufually continues for eight or ten days; and, for the fame time, the fever and fymptoms attending it alfo continue.

In the progrefs of the inflammation, the delirium and coma attending it fometimes go on increafing, and the patient dies apoplectic, on the feventh, ninth, or eleventh day of the difeafe. In fuch cafes, it has been commonly fuppofed that the difeafe is tranflated from the external to the internal parts. But, Dr. Cullen obferves, that he never met with any inftance in which it did not appear to him, that the affection of the brain was merely a communication of the external affection, as this continued increafing at the fame time with the internal.

When the fatal event does not take place, the inflammation, after having affected a part, commonly the whole of the face, and, perhaps, the other external parts of the head, ceafes. With the inflammation the fever alfo ceafes; and, (fays Cullen,) without any evident crifis, the patient returns to his ordinary ftate of health.

The fame diftinguifhed writer reprefents the difeafe as being not commonly contagious; but he conceived it poffible that it might fometimes be communicated from one perfon to another; and, he adds, that perfons who have once laboured under the diforder are liable to returns of it.

According to Cullen, the event of the difeafe may be forefeen from the ftate of the fymptoms which denote more or lefs affection of the brain. If neither delirium nor coma comes on, the difeafe is feldom attended with any danger; but when thefe fymptoms appear early in the difeafe, and are in a confiderable degree, the utmoft danger is to be apprehended.

We have already remarked that, in cafes of eryfipelas, fuppuration does not frequently happen; but that when it does, owing to the matter not being confined by the adhefive inflammation, very bad confequences follow. Wherever the matter fpreads, it occafions under the fkin an extenfive floughing of the fafciæ, tendons, and cellular fubftance, all which kind of mifchief may take place, while the fkin itfelf, which is very vafcular and highly organized, remains unimpaired in its texture. This combination of fuppuration and mortification is more likely to happen when the eryfipelatous inflammation extends to a greater depth than common, fo as to affect the cellular membrane. In this ftate, as Mr. Hunter has well defcribed, air, matter, and floughs, are all produced together under the fkin, and, on handling the part, a ftrange feel is communicated, neither like that of a fluctuation, or a crepitation. Mr. John Pearfon very whimfically, we will not fay unaptly, compares the fenfation with that excited by a quagmire or morafs. Frequently, the practitioner may obferve in fome opening, made either by ulceration or the lancet, a fmall black floughy point, and, on taking hold of it with a pair of forceps, and drawing it out, he finds, to his great furprife, that a whole mortified tendon, of confiderable length, follows his inftrument.

Eryfipelas is to be met with more frequently in fummer than winter, and more commonly in hofpitals than other places. Wounds of the head, oftener than any other kind of accident, give rife to the diforder.

Eryfipelas has fometimes been obferved on the fkin of new-born infants. Several inftances of this kind are mentioned in the Medical Communications, as having occurred in the Britifh Lying-in-Hofpital. In one of thefe examples, the child was born with its whole face fwelled and inflamed, the left fide being affected with a true eryfipelas. There was alfo an inflammation on the legs, feet, and left hand. On each tibia, there appeared an oblong flough, of a dark brown colour, almoft livid; the one on the left leg was exceedingly large. The cure was attempted by employing embrocations, emollient poultices, and fomentations, and applying camphorated fpirit of wine. This child appears to have fwallowed the decoction of bark with great eafe, as it took four ounces of it every day from the very time of birth. In three days the fwelling of the face and other parts had confiderably fubfided; but, on the third day, a vefication began to form on the left cheek, and another juft above the eye-brow, on the fame fide. Thefe vefications increafed in number and fize, efpecially on the legs, where they extended over the whole limb. Some confectio cardiaca was added to the decoction of bark, and pledgets, dipped in oil of turpentine, were put on all the parts affected, previoufly to the application of the poultice. The vefications began to break on the fixth day, and a fanies to iffue from them; yellow floughs alfo now made their appearance in different parts. The child feemed much debilitated, and, for the laft three or four days, had taken eight ounces of the decoction of bark, with one dram of the confectio cardiaca every twenty-four hours. The pledgets, applied to the fores, were dipped in a digeftive ointment, with oil of turpentine, and fome cataplafm e cymino. Under this mode of treatment, the floughs were foon detached, and the child recovered, though not without the lofs of the little finger, two joints of the ring finger, and one of the middle one.

The diftemper, which we have juft been defcribing, for fome time proved extremely fatal, none of the infants recovering who were attacked. However, bark is ftated to have acted quite as a fpecific remedy for the difeafe, as foon as it was tried, and almoft all the children are faid to have got well who took this medicine. Mortification always took place in fuch fubjects as died; and the danger was regularly obferved to be the greateft in the inftances in which the genitals were the parts firft attacked. The difeafe was alfo noticed to affect the children of weakly women, and of fuch as were addicted to drinking fpirits.

To return, however, to our account of the common forms of eryfipelas, we have to apprife the reader, that the term "St. Anthony's fire," which is fo frequently mentioned by all forts of perfons, is ftrictly applied by medical writers and practitioners to that fpecies of the affection in which veficles arife upon the furface of the fkin; while other inftances, not accompanied with vefications, are named *fimple* eryfipelas.

The divifion of the fubject, however, cannot be properly comprehended under thefe two varieties; and the generality of authors have found it neceffary to obferve other diftinctions.

Mr.

Mr. Pearſon, in his Principles of Surgery, has noticed the following ſpecies of the complaint:

1. The acute eryſipelas.
2. The œdematoſe eryſipelas.
3. The malignant, or gangrenous eryſipelas.

Each of theſe ſpecies may be an idiopathic, or ſymptomatic diſeaſe.

Mr. Pearſon remarks, that the acute eryſipelas is moſt commonly ſeen in thoſe of a ſanguine and choleric temperament; it is generally ſudden in its attack, and uſually affects the face. Febrile ſymptoms are often preſent immediately after the acceſſion of the diſeaſe; but they gradually diminiſh as the eryſipelas becomes more diſtinctly formed. Conſiderable heat, and great uneaſineſs, take place in the part affected; the ſkin is alſo of a brighter ſcarlet colour than in the other ſpecies. If puſtules appear, they are diſtinct; but ſometimes there are no veſications on the ſurface.

Suppuration very rarely occurs in this kind of eryſipelas, and the violence of the diſeaſe commonly ſubſides in three or four days; the part then grows yellowiſh, and throws off furfuraceous ſcales. The diſeaſe terminates about the tenth day. A tenderneſs of the hairy ſcalp will often continue for a conſiderable time after the diſeaſe has diſappeared.

The acute eryſipelas, as we have already obſerved, is ſometimes an idiopathic affection; frequently it is ſymptomatic, or, in other words, the conſequence of a wound, eſpecially one of the head. Perſons who have once been attacked with the acute eryſipelas, in a ſpontaneous manner, are particularly liable to ſuffer again from future attacks of the ſame diſorder.

Mr. Pearſon ſtates, that the œdematoſe eryſipelas is not, in general, ſo ſudden in its attack, nor ſo ſevere on its acceſſion, as the acute eryſipelas. The diſeaſe increaſes gradually, is more diffuſed, and is attended with leſs burning pain. If febrile ſymptoms ſhould ariſe, they never run high, nor are they of long duration; moſt commonly the ſtrength is depreſſed, attended with a ſoft, frequent, perhaps, irregular pulſe. In this ſpecies of eryſipelas no conſtitutional relief is derived from the appearance of the local affection: on the contrary, the danger increaſes with the progreſs of the external diſeaſe.

When the face is the ſeat of the œdematoſe eryſipelas the whole countenance has a bloated appearance. The red colour of the ſkin is mingled with yellow or brown, and the complaint is attended with ſhiverings, vomiting, and more or leſs diſturbance of the functions of the brain. Mr. Pearſon further remarks, that the veſications are often ſmall and numerous, and, that when they have been expoſed for a few days to the air, the countenance becomes covered with a dark-coloured cruſt, very much reſembling the appearance which ariſes in the confluent ſmall-pox. Though the face is very much ſwelled, it is not firm to the touch, and eaſily yields to preſſure.

The œdematoſe eryſipelas is deemed highly dangerous. Patients often die, in a delirious or comatoſe ſtate, about the ſeventh day, ſometimes a little later.

It is common to ſee many people afflicted with this ſpecies of eryſipelas about the ſame time. Mr. Pearſon informs us, that, in hoſpitals, he has ſeen ſeveral perſons ſucceſſively attacked with the complaint in the ſame ward. Some conjectures have been entertained of the diſorder being contagious.

All ages and conſtitutions may be affected with the œdematoſe eryſipelas. However, ſubjects weakened by age, or intemperance, are moſt frequently attacked. Dropſical patients, children, and new-born infants, are alſo ſeen affected with the complaint.

According to Mr. Pearſon, the œdematoſe eryſipelas, when ſymptomatic, is much leſs dangerous than when idiopathic; but, ſays this author, whenever the face is conſiderably affected, the diſeaſe is always to be regarded as a ſerious one, whatever be the remote cauſe. On the limbs it is ſeldom dangerous, or very afflicting, unleſs treated in an improper way. Mr. Pearſon mentions his having ſeen the œdematoſe eryſipelas make its firſt appearance upon the face, and, by a gradual and regular progreſſion, proceed downward to the extremities, ſucceſſively appearing upon an inferior portion of the body, as it diſappeared from a ſuperior part. Each renewed acceſſion of the complaint was leſs and leſs ſevere, as it receded to a greater diſtance from the part that was primarily affected.

The malignant, or gangrenous eryſipelas, makes its firſt appearance ſomewhat like the œdematoſe form of the diſorder. Its progreſs, however, is much quicker. Phlyctenæ, with a livid baſe, ſoon occur on the ſkin, together with gangrenous ſymptoms. The diſeaſe, at a very early period, becomes attended with a ſtate of the conſtitution, reſembling that which exiſts in putrid fevers.

The gangrenous eryſipelas moſtly occurs on the face, neck, breaſt, and ſhoulders: the danger of the diſeaſe depends very much on the ſtate of the conſtitution.

When an eryſipelatous inflammation, particularly one of the legs has been cured, a degree of œdema will frequently continue about the lower part of the limb for ſome time afterwards.

Eryſipelatous inflammation differs from phlegmon in the following reſpects. The ſwelling is leſs prominent; and is never diſtinctly circumſcribed. The ſkin often has the appearance of being ſcorched, or burnt. The redneſs is quite circumſcribed, has a very determinate edge, is frequently tinged with yellow, and, on being touched with the end of the finger, a white ſpot is produced for a ſhort time in the place where the preſſure was made. The pain is not of the lancinating, throbbing kind, which attends phlegmonous inflammation; but is ſuch as cauſes a ſenſation of a great heat and burning in the part, together with a violent degree of itching. The part affected does not preſent the feel of, what ſurgeons underſtand by, tenſion; but only ſeems to the touch as if the ſkin were a little thickened. Except in the acute eryſipelas, there is no hardneſs of the pulſe, as in caſes of phlegmon, and inſtead of being attended, as the latter affection, with rather an increaſe of ſtrength, eryſipelas is almoſt always accompanied with more or leſs debility.

With reſpect to the cauſes of eryſipelas our knowledge is very imperfect, and every obſervation on this ſubject muſt be received with doubt. We do not mean to ſtate, that the remote cauſes are not very often ſufficiently obvious. We frequently have occaſion to remark, in the practice of ſurgery, that certain punctured wounds, and injuries of the external parts of the head give riſe to eryſipelas. Indeed, we may ſtate, as a general remark, that the ſame claſs of irritations, termed *remote* cauſes, which in one conſtitution would occaſion phlegmonous inflammation, in another would excite eryſipelas. What is far more difficult of inveſtigation, is the cauſe why eryſipelas ſhould take place rather than common inflammation; in other words, the exact particularity, to which the origin of eryſipelatous inflammation is to be aſcribed, is involved in much more obſcurity. Sometimes even the remote cauſe cannot be diſcovered, the affection having the appearance of originating in a ſpontaneous manner.

It

It was one of the ancient doctrines, eftablifhed by Galen, and maintained down to the prefent time, that what is underftood by a bilous habit is particularly fubject to eryfipelatous inflammation. Many parts of the writings of the celebrated Pott, the experienced Richter, and other noted modern writers, evince their belief in this opinion.

Weak and irritable conftitutions appear to us to be moft fubject to eryfipelas; while ftrong, plethoric perfons moft frequently undergo common phlegmonous inflammation. We think, that there is every reafon to believe, that, in general, eryfipelas is intimately dependant on the ftate of the conftitution, or on fome peculiarity of temperament. This opinion is fomewhat confirmed by the fact, that while perfons, who lead drunken, intemperate lives, are particularly often afflicted with eryfipelatous inflammation, in confequence of local injuries, other people, who lead more regular lives, generally have phlegmonous inflammation after fimilar injuries.

It muft be admitted, however, that eryfipelas occafionally makes its appearance in conftitutions with which we can find no evident fault. Indeed, Hunter feems to have confiderable reafon for his inference, that the affection may, in fome inftances, be altogether independent of conftitutional caufes, fince it is the common courfe of the difeafe to be actually getting well on one fide as faft as it is fpreading on another.

If we can fometimes affign particular circumftances, which operate as caufes conducive to eryfipelas, it is all that we can hope to do. To trace the proximate caufe in every example which prefents itfelf, is far beyond our pretenfions; neither do we believe that it is to be done by the powers of human refearch. We might adopt the language of Cullen, and talk of eryfipelas depending "on a matter generated within the body, and thrown out, in confequence of fever, upon the furface of the body." We might alfo join Mr. Pearfon in reprefenting eryfipelas as being fometimes the "critical termination of another difeafe, fuch as obftructed menftruation, quartan ague, fupprcffed fuppuration, fpafmodic and convulfive difeafes." However, we fhould fhew juft as much devotion for truth, were we to offer any other wild, vague fuppofitions, unfupported by rational evidence.

Lefs afpiring in our attempts, we fhall only aim at pointing out circumftances which feem to act as caufes, conducive to the diforder, in fome inftances. If many women of temperate lives, and young children, are occafionally affected with eryfipelas, as they undoubtedly are, the fact only proves, that there are other caufes befides intemperance which may be concerned in giving rife to the complaint. The fources of the difeafe muft, we believe, on fome occafions, be regarded as among the myfterious and inacceffible fecrets of nature. When drunkennefs and other kinds of intemperance are affigned as caufes conducive to eryfipelas, it is not meant that they are exclufively fo. There are, probably, hundreds of other caufes in exiftence, though we may not be able to detect them.

With regard to women of temperate regular lives, and to children being occafionally affected with eryfipelatous inflammation, the fact cannot be called in queftion. But, ftill, no experienced man will contend that fuch fubjects are attacked with eryfipelas, on meeting with local injuries, half fo frequently as perfons with conftitutions impaired by any kind of intemperance, habits, or modes of life.

Richter and fome other writers, have defcribed eryfipelas as depending very much on a fuppreffed ftate of the perfpiration; but we are inclined to think that they have afcribed the importance of a caufe to a mere effect of the fever, with which eryfipelas is connected.

Treatment of the acute, or phlegmonous eryfipelas.—This fpecies of the difeafe being commonly attended with a full, and frequently a hard pulfe; the blood drawn fhewing upon its furface the buffy coat to be feen in all inflammatory complaints; and laftly, the fwelling of the eyelids, frequently ending in fuppuration; there can be no doubt, that the affection fhould be treated very much in the fame manner as phlegmonous inflammation. Blood-letting, cooling purgatives, and every part of the antiphlogiftic regimen, are advifed by Cullen, who affirms, that his experience had confirmed the fitnefs of this method of cure.

The evacuations of blood-letting and purging are to be employed, more or lefs, according to the urgency of the fymptoms, particularly the febrile ones, and thofe which mark an affection of the brain.

Although Mr. Pearfon mentions general and topical bleeding as being indicated in the treatment of the acute eryfipelas, yet he obferves, that cafes very rarely occur in large towns where bleeding is at all admiffible, and a repetition of the operation can very feldom be proper.

Profeffor Richter ftrongly praifes the good effect of emetics on eryfipelas; but fome other writers, probably in a ftrain of ignorance, or prejudice, reprefent fuch medicines as having fometimes occafioned fatal confequences.

Another indication is to promote a gentle degree of perfpiration. For this purpofe, we may exhibit fmall dofes of the antimonium tartarifatum, or the pulvis ipecacuanha comp., æther vitriolicum; faline draughts with volatile alkali, &c.

Opium and camphor are alfo proper remedies for allaying irritation.

Whoever has been in the habit of confulting the writings of feveral celebrated medical authors, will perceive that they place great reliance in bark, as a medicine tending very powerfully to check and cure eryfipelatous inflammations. When we mention Mr. John Hunter among fuch authors, our readers will be inclined, perhaps, to fufpect that there muft be fome foundation for the repute into which this medicine has rifen for the complaints under confideration. However, we muft confefs our own belief, that bark gained credit for its good effects on eryfipelas entirely in confequence of the general enthufiafm which once depicted it as a cure for almoft every difeafe of the human frame. The fentiment is corroborated, if not confirmed, by the fact, that the beft modern practitioners feem now to confider bark no longer of eminent fervice in cafes of acute eryfipelas.

With refpect to local applications, in thefe inftances, feveral kinds have been ufed by different practitioners. Cold aftringent lotions, oily fubftances, rubefacients, farinaceous, or earthy powders, and emollient poultices, have all been tried. As far as our experience extends, the lotio aquæ lithargyri acetati is as good an application as can be made to a part affected with the acute fpecies of eryfipelas. However, it becomes us to apprife the reader, that the majority of medical writers beftow the greateft praife on the employment of dry mealy powders, fuch as flour, ftarch, &c. for topical remedies, with which the inflamed part is to be covered.

Mr. Pearfon, ftrangely enough, fpeaks in favour of rubefacients, as if the fkin were not already reddened enough by the difeafe; but referves his higheft recommendations for mild warm poultices. Let the furgeon, however, confider the ill confequences and terrible mifchief which always occur when fuppuration fupervenes, and let him beware of the injudicious plan of promoting the latter event.

Treatment of the œdematofe eryfipelas.—In this cafe topical bleeding may be practifed; but venefection is hardly ever allowable. The bowels ſhould be kept open with ſaline purgatives of the mildeſt deſcription, and a gentle perſpiration ought to be excited, by means of ſmall doſes of tartariſed antimony, the pulvis ipecacuanha comp., &c. For the purpoſe of appeaſing pain and irritation, the practitioner may preſcribe camphor, opium, æther, &c.

When the patient's conſtitution is in a debilitated condition, tonics are indicated, together with the moſt nouriſhing food. Bark, wine, porter, brandy, the confectio aromatica, may now be found of the utmoſt ſervice.

Treatment of the malignant or gangrenous eryſipelas.—Little need be ſaid here on this ſubject, as the mode of treatment is the ſame as that of mortification in general. See GANGRENE.

The grand objects are; to ſupport the patient's ſtrength; to cover the parts affected with emollient poultices; to foment them two or three times a day with a decoction of poppy-heads; to make depending openings for the eſcape of the matter and ſloughs; and remove the dead parts, as ſoon as it can be done without occaſioning the leaſt irritation and pain.

We have frequently ſeen the gangrenous miſchief ſo extenſive in theſe caſes, that amputation of the limb was the only means of ſaving the patient from deſtruction. See Richter's Anfangſgründe der Wundarzneykunſt. Band i. Von der Roſe. Pearſon's Principles of Surgery. Cullen's Firſt Lines of the Practice of Phyſic. Cooper's Firſt Lines of the Practice of Surgery.

ERYSIPHE, in *Agriculture*, a term applied by ſome to that vegetable diſeaſe generally known by the name of mildew. See MILDEW.

ERYSTHIA, in *Ancient Geography*, a town of the iſland of Cyprus. Steph. Byz.

ERYTHEIA, an iſland of Iberia, in the ocean. According to Strabo, it was ſeparated from the continent by a large ſtrait of a ſtadium, or, according to Pliny, of 100 paces. It was near Gades. Its name was derived from the Phœnicians, who, having inhabited the banks of the Erythrean ſea, came to ſettle here. It was alſo called *Aprodiſias*, or the iſle of Venus, and the iſle of Juno. See GADES.

ERYTHE'MA, in *Surgery*, (from ερυθος, *red.*) The celebrated Cullen diſtinguiſhed two claſſes of eryſipelatous inflammations. When the diſeaſe was an affection of the ſkin alone, and very little of the whole ſyſtem, or when the affection of the ſyſtem was only ſymptomatical of the external inflammation, he called the diſeaſe *erythema;* but when the external inflammation was an exanthema, and ſymptomatical of an affection of the whole ſyſtem, he named the diſeaſe *eryſipelas*, which ſee.

"An Erythema, Roſe, or St. Anthony's Fire, (ſays Dr. Cullen) is an inflammatory affection of the ſkin, with hardly any evident ſwelling; of a mixed, and not very bright red colour, readily diſappearing upon preſſure, but quickly returning again; the redneſs of no regular circumſcription, but ſpreading unequally, and continuing almoſt conſtantly to ſpread upon the neighbouring part; with a pain like to that from burning; producing bliſters, ſometimes of a ſmall, ſometimes of a larger ſize, and always ending in a deſquamation of the ſcarf-ſkin, ſometimes in gangrene."

We need not enlarge on the ſubject of erythema, in the ſenſe of an eryſipelas not originating from a conſtitutional affection, as every uſeful information, concerning eryſipelatous inflammations in general, is to be found in the article ERYSIPELAS.

The chief object which we have in view in the preſent part of this work is to deſcribe a particular affection of the ſkin, named, in conſequence of its being occaſioned by the uſe of mercury, the *mercurial erythema*, or *eczema*.

It was perhaps, for the firſt time, diſtinctly noticed and deſcribed by Mr. Benjamin Bell in his Treatiſe on the Venereal Diſeaſe. "It is not an uncommon effect of mercury (ſays this author) to excite an eruption upon the ſurface of the body. In ſome, this appears as a miliary raſh, ſomewhat reſembling meaſles; while in others it is conſiderably elevated, and ſeems to be produced by a ſerous effuſion between the cutis and ſcarf-ſkin. In ſome the eruption is partial, being confined to particular ſpots; while in others it prevails generally over the whole body.

"This eruption, or efflorescence, is not attended with pain; but the heat and itchineſs which accompany it are, in ſome inſtances, ſo diſtreſsful, that it keeps the patient at all times very uneaſy, and deprives him entirely of reſt.

"The remedies, (obſerves Mr. B. Bell) which I have found to anſwer the beſt, are the internal uſe of opiates, conjoined with the application of flour or ſtarch-powder to the parts affected. The ſkin is kept ſufficiently cool and eaſy by one or the other of theſe powders being from time to time freely applied to the eruption; and, by a proper exhibition of opiates we ſecure reſt during the night. In ſome inſtances, however, we are obliged to avoid the uſe of opiates; for although they may anſwer the purpoſe of procuring ſleep, they tend evidently to increaſe the heat and itchineſs of the eruption. We find, indeed, that, in ſome conſtitutions, opium excites an uneaſy itchy ſenſation over the whole body, even where an eruption has previouſly taken place: and it is, perhaps, with ſuch patients only, that it cannot be employed in the treatment of this eruption.

"The eruption to which I allude, (adds Mr. Bell,) appears to ariſe entirely from the effect of mercury upon the ſyſtem; but it does not ſeem to depend upon any particular preparation of the remedy. It takes place indiſcrimately from all of them; and not more readily from unction than from thoſe preparations that are uſed internally." See a Treatiſe on Gonorrhæa Virulenta and Lues Venerea; by B. Bell, vol. ii. p. 228.

Since this gentleman publiſhed the foregoing work, the mercurial erythema has excited conſiderable attention, and ſeveral writers, *viz.* Drs. Moriarty, M'Mullin, and Spens, and Meſſrs. Alley and Pearſon, have endeavoured to render our knowledge of the ſubject more extenſive.

Dr. M'Mullin judiciouſly obſerves, that eruptions of various kinds are very common ſymptoms of ſyphilis, but a very unuſual effect of mercury. Hence, until the real nature of the mercurial erythema was aſcertained, whenever the affection occurred in patients undergoing a mercurial courſe for ſyphilitic complaints, it was naturally enough conſidered as an anomalous form of lues venerea. The mercury was conſequently puſhed to a greater extent, in proportion to the violence of the ſymptoms, and from the cauſe of the diſeaſe being thus unconſciouſly applied for its removal, it could not fail to be aggravated, and hurried on to a fatal termination. At length, the obſervation of this fact, and of another truth, that a ſimilar eruption did ſometimes appear in patients who were uſing mercury for other complaints, and in whom no ſuſpicion of ſyphilis could be entertained, led to the important diſcovery that the eruption was entirely an effect of mercury, and not at all connected with the original diſeaſe.

Dr. M'Mullin imputes the firſt explanation of the nature of the mercurial erythema to Drs. Moriarty and Spens, and Mr. George Alley, all which writers publiſhed in the courſe of the ſame year, *viz.* 1804. However, the paſſage which we have quoted above, from Mr. B. Bell's work on the

the venereal difeafe, clearly evinces that though the above gentlemen have undoubtedly great merit in having increaf.d our information concerning the difeafe, yet the latter writer had noticed the affection before them. Indeed, Dr. Spens has had the liberality to make this acknowledgment himfelf.

According to Dr. M'Mullin, the different appearances which this difeafe affumes, from its feverity and duration, may be beft underftood by defcribing it as confifting of three diftinct ftages. The firft ftage, fays this gentleman, commences with languor, laffitude, and cold fhiverings. Thefe fymptoms are fucceeded by increafed temperature of the body, quick pulfe, naufea, head-ach, and thirft. The patient is troubled with a dry cough, and complains of difficult refpiration, anxiety, and fenfe of ftricture about the præcordia. The tongue is ufually moift, and covered with a white glutinous flime. It fometimes appears clean and of a bright red colour in the centre, while the margins remain foul. The fkin feels unufually hot and itchy, with a fenfe of prickling, not unlike the fenfation experienced from the application of nettles. The belly is generally coftive; but a diarrhœa is often produced by very flight caufes.

To continue Dr. M'Mullin's defcription: on the firft, or fecond day, an eruption moft commonly appears, the colour of which is either dark or bright red. The papulæ are at firft diftinct and elevated, very much like thofe which occur in rubeola. Sometimes, but not often, the eruption appears like urticaria, and in fuch inftances the difeafe is obferved to be very mild. The papulæ very fpeedily run together in fuch a manner as to form a fuffufed rednefs, which difappears on preffure. In moft cafes, it firft begins on the fcrotum, infide of the thighs, fore-arm, or where mercurial frictions have been made, and the fkin of the parts affected becomes confiderably fwollen. Inftances have alfo been feen in which an eruption of a purplifh colour, and accompanied by papulæ, has fuddenly diffufed itfelf over the whole body. (See Moriarty on Lepra Mercurialis.) Dr. M'Mullin remarks, however, that the latter form of the affection may be confidered as uncommon. In every inftance which Dr. M'Mullin has feen the eruption was at firft confined to a few places, and thence gradually extended, until the different portions of the eruption had united. The papulæ were alfo rough to the feel. But, in fuch cafes as refemble urticaria, many minute veficles, interfperfed among the papulæ, and containing a ferous fluid, make their appearance from the very firft. Contrary to what happens in moft difeafes, accompanied with cutaneous affections, the febrile fymptoms are much aggravated, and continue to increafe, after the eruption is complete. The pulfe in general beats from 120 to 130 in a minute, the thirft continues urgent, and the patient, who is extremely reftlefs, feldom enjoys quiet fleep. Dr. M'Mullin further informs us, that when the eruption has continued in this manner, for a certain period, the cuticle begins to peel off in thin, whitifh, fcurfy exfoliations, not unlike thofe obferved in rubeola. This defquamation firft begins where the eruption made its earlieft appearance. and in this order fpreads to other parts. About this period the fauces become fore, the tongue fwells, and the eyes appear fomewhat inflamed.

The duration of this ftage is very various; fometimes it continues from ten to fourteen days, and in other cafes it terminates in half that time. When the difeafe has appeared in its mildeft form, the patient recovers immediately after this defquamation, a new cuticle having formed underneath. When the difeafe is fevere, however, he has only experienced the fmalleft part of his fufferings, and the fkin now affumes a new appearance, which Dr. M'Mullin has confidered as the fecond ftage.

This author reprefents the fkin as appearing at this period as if ftudded with innumerable minute veficles, which are filled with a pellucid fluid. Thefe veficles (he obferves) may be expected, if the patient, at the clofe of the firft ftage, fhould complain of increafed itching, and a fenfe of a burning heat in the parts, from which the cuticular exfoliations have fallen. The veficles fometimes remain for a day or two; but in general they are burft immediately after their formation, by the patient rubbing the parts, in order to relieve the troublefome itching which he fuffers. A ferous acrimonious fluid is difcharged. which poffeffes fo difagreeable an odour, that it induces naufea in the patient himfelf, and thofe who approach his bed-fide. The fmell is faid to be fo peculiar, that it can be eafily recognifed by any perfon who has once perceived it. Dr. M'Mullin ftates, that this fluid is poured out moft copioufly from the fcrotum, groin, infide of the thighs, or wherever the fkin forms folds, and febaceous glands are moft numerous. The ferous difcharge from the veficles forms, with the cuticle, incruftations, which Dr. M'Mullin regards as the criterion of the third or laft ftage.

The fame writer obferves, that the crufts are generally very large, and when detached retain the figure of the parts from which they have fallen. Their colour is in general reddifh, but it fometimes appears dark and dirty. Dr. M'Mullin conceives, that this period of the difeafe might be termed, with much propriety, the ftage of *decruftation*, in order to diftinguifh it more fully from the *defquamation*, which has been already noticed. When the ftage of decruftation appears, the fauces become more affected, the eyes intolerant of light, and the tarfi tender, inflamed, and fometimes turned inward. The crufts formed on the face, as in other parts of the body, before falling off, break fo as to leave cracks and fiffures, which horridly deform the countenance; and in confequence of the great fwelling of the face the eye-lids are alfo completely clofed. The back and hairy fcalp are faid to be the parts moft backward in becoming affected, and, according to Dr. M'Mullin's account, they even fometimes efcape entirely in very fevere cafes.

In this ftage of the mercurial erythema the patient is under the neceffity of avoiding every kind of motion, on account of the pain which it occafions, and which he compares with fuch a fenfation as one may fancy would be produced by a cracking of the flefh. The crufts alfo fall off in fuch abundance, that the bed feems as if ftrewed with the cones of hops.

While the eruption is only making its appearance in one place, it may have attained its moft advanced form in another part, fo that all the different ftages of the difeafe may be prefent at one time, in the fame individual.

Typhus prevails throughout the whole courfe of the complaint; but, what is curious, the appetite continues in moft cafes unimpaired, and fometimes is even voracious.

Dr. M'Mullin alfo remarks, that when the catarrhal fymptoms have continued during the progrefs of the complaint, they are particularly aggravated in the advanced ftage of the cafe. The anxiety and pain in the breaft are likewife ftated to be very fevere, attended with cough and bloody expectoration, the patient invariably feeling languid and dejected. The pulfe becomes frequent, feeble, and irregular; the tongue black and parched; and, at length, diarrhœa, delirium, convulfions, gangrene of the furface of the body, and death, enfue.

The

The mild form of the diſeaſe only goes through the firſt ſtage, and ends, as we have already deſcribed, in a ſlight deſquamation, after a few days. When the affection is ſevere, however, it is often protracted more than two months, every ſtage of the eruption continuing proportionably longer; and when, in this manner, it has run its courſe, it repeatedly breaks out on the new ſurface, and paſſes through the ſame ſtages.

For the preceding hiſtory of the ſymptoms of the mercurial erythema, we feel ourſelves highly indebted to Dr. M'Mullin. See Edinburgh Medical and Surgical Journal, vol. ii. p. 25, &c.

With the exception of one caſe, which Dr. Rutter has inſerted in the eighteenth number of the journal juſt now mentioned, we have no inſtance recorded, in which the preſent diſorder originated, without the patient being under the influence of mercury. Whether Dr. Rutter's example is to be conſidered as the ſame identical diſeaſe as the one which we have been deſcribing, we ſhall not undertake to inveſtigate. We ſhall only obſerve, that ſince it is very poſſible to miſtake other complaints for the real mercurial erythema, we do not conſider one ſolitary fact, reſting on the judgment of an individual, who might differ in opinion concerning the nature of the diſeaſe, with the next medical practitioner conſulted, a ſufficient ground for implicitly believing, that ſuch a diſeaſe as the mercurial erythema can be produced quite independently of the uſe of mercury.

In certain habits, every preparation of mercury, and every form of employing this medicine, ſeem capable of bringing on the diſeaſe. As the complaint was firſt taken notice of in patients who were afflicted with ſyphilis, it was ſuppoſed to be an anomalous form of the venereal diſeaſe. But, at laſt, the repeated appearance of the eruption in perſons exempt from all ſuſpicion of having any ſyphilitic ſymptoms, made ſurgeons convinced, that what is now commonly named the mercurial erythema had nothing venereal in its nature. However, ſince few out of the great number of patients, continually employing mercury, are afflicted with this erythema, medical writers have attempted a further explanation of the difficult ſubject of cauſes, by ſtating, that the mercurial erythema only takes place in ſuch patients as have a certain undeſcribable peculiarity of conſtitution. The contemplative reader will at once perceive, that this is a vague and an unphiloſophical mode of accounting for the production of the diſeaſe, as the ſame ſorry kind of explanation may be generally adopted in regard to every diſorder, the immediate cauſe of which is totally unknown. Is it not a greater mark of prudence and good ſenſe to confeſs our ignorance, under theſe circumſtances, than to offer ſtatements, wiſhing them to be conſidered as explanatory, while they do not convey any information whatever on the ſubject?

It has been ſuppoſed by ſome, among whom is Dr. Gregory of Edinburgh, that the application of cold to the body, while under the influence of mercury, is abſolutely eſſential to the production of the diſorder under conſideration.

Notwithſtanding there can be no reaſonable doubt that the mercurial erythema is commonly excited by the uſe of mercury in ſome form or another, yet it appears from what Mr. Pearſon has ſtated, that the diſeaſe is not always exaſperated by a perſeverance in the employment of the medicine. On ſome particular occaſions, when this gentleman judged it to be of great moment to continue the mercurial frictions, the eruption neither ſpread univerſally, nor was it materially increaſed. The patients, however, did not get rid of the raſh till the mercury was diſcontinued.

We have already noticed the opinion of Dr. Gregory and ſome other practitioners, that expoſure of the body to cold, at a time when the ſyſtem is under the influence of mercury, is abſolutely neceſſary for the production of the mercurial erythema. Mr. Pearſon ſeems to entertain a very different ſentiment; for, he obſerves, that he is not aware of any other cauſe, than the action of mercury on a particular kind of conſtitution being concerned. He acquaints us, that he has ſeen this cutaneous diſeaſe occur in private practice as well as the Lock hoſpital, where the ſtricteſt attention has been paid to the temperature of the apartment, to regimen, and to perſonal cleanlineſs. He has had no reaſon to believe that any one ſeaſon of the year is more conducive to the diſeaſe than another; and he ſtates that free expoſure to the air, either in winter or ſummer, has not the leaſt perceptible effect in exciting the eruption.

Mr. Pearſon, as a general rule, recommends the employment of mercury to be immediately left off on the firſt appearance of the eruption; and though he ſeems to admit that the affection may be relieved by remedies, yet he is doubtful whether any plan of treatment has the power of interrupting its regular courſe, or abridging its duration. Mr. Pearſon would by no means wiſh to inſinuate, however, that the patient may not derive conſiderable benefit from medical aſſiſtance; his ſufferings (he owns) may be greatly mitigated; many inconveniences may be remedied; his ſtrength may be ſupported; and, in ſhort, (ſays Mr. Pearſon,) he may be ſo conducted through the diſeaſe, that his general ſtate of health ſhall not ſuffer any material or permanent injury.

It is not enough to diſcontinue the employment of mercury. In large hoſpitals, and particularly ſuch as are appropriated to venereal caſes, the patient ſhould be immediately removed from thoſe wards which may have their atmoſphere vitiated by the breathing of perſons charged in general with mercury.

In the early ſtage of the mercurial erythema, Mr. Pearſon recommends ſmall doſes, of antimonial powder, with ſaline draughts, or elſe the ammonia acetata. A gentle purgative ſhould be given every three or four days, and opium is proper for appeaſing the pain and irritation, and procuring ſleep. Sometimes, ſays Mr. Pearſon, opium mixed with camphor, or Hoffman's anodyne liquor, will have a better effect than when adminiſtered alone. When the diſcharge is no longer ichorous, and the tumefaction is ſubſiding, the ſame ſurgeon preſcribes the liberal exhibition of ſarſaparilla and bark. He has alſo thought, that the general ſenſe of uneaſineſs has been leſſened by the vitriolic acid, which proves at the ſame time grateful and refreſhing.

The diet ſhould be of a light and nouriſhing quality; but no fermenting liquors can be prudently allowed till the deſquamation of the cuticle is ſomewhat advanced.

In order to diminiſh the pain ariſing from the irritation of the ſkin, the warm bath may be uſed as often as the patient's ſtrength will permit. His linen and ſheets, which are ſoon rendered hard and ſtiff by the diſcharge, ſhould be very frequently changed. Mr. Pearſon is alſo in the habit of covering every part, where excoriations occur, with a ſoft mild cerate, made of litharge plaſter, yellow wax, and olive oil. This application is to be thickly ſpread on rollers, by which means it may be conveniently put wherever it is needed. The dreſſing ſhould be changed twice a day.

Dr. M'Mullin has noticed, that, though in the early ſtage of the mercurial erythema, diaphoretics are indicated, yet the bowels are ſo irritable, that ſuch medicines can ſcarcely be employed. For the ſame reaſon, he recommends

mends us to be very cautious in giving mineral acids, ripe fruits, &c. This gentleman approves of the patient being kept in rather a warm temperature, and in a place where he can derive the advantage of a quick circulation of air. The bowels being weak, Dr. M'Mullin advifes us only to employ the mildeft purgatives, when medicines of this clafs are required.

With regard to the topical treatment, the latter gentleman fays, that folutions of fulphate of zinc, and acetite of lead, fulphur ointment, and the decoction of oak-bark, have all been tried, but without any particular good, and he feems to prefer fprinkling the parts with powdered ftarch. To allay the cough and forenefs of the fauces, he advifes mucilaginous mixtures, containing a fmall proportion of opium.

When the incruftations become general, the fever always affumes more of the typhoid type. In this ftage bark has been ufually prefcribed, with a view of fupporting the ftrength; but Dr. M'Mullin remarks, that this medicine can never be given in fufficient quantity, owing to its affecting the ftomach, or occafioning diarrhœa. In fome inftances, he obferves, the cold infufion, conjoined with aromatics, has been beft retained, and a little opium may be added to the dofes. Opium, which this gentleman defcribes as improper in the firft ftage, may now be taken without any rifk of unpleafant confequences. He ftates, that wine is the beft remedy in this ftage of the difeafe. Porter and diluted fpirit are alfo proper, and the thirft muft be affuaged with whey, light broths, and nourifhing drinks of every kind. Owing to there being now a large extent of the fkin in an excoriated ftate, the patient cannot at this time generally bear warm bathing, which often brings on a ftate of fyncope, and all that can be done is to wafh the parts, in the moft tender manner, with tepid water.

For the ophthalmia tarfi, the unguentum zinci vitriolati is recommended, and the linimentum aquæ calcis is faid to relieve moft effectually the pain which makes the patient feel as if his flefh were cracking.

We fhall conclude this article with advifing the reader, who wifhes to be perfectly acquainted with the fubject of mercurial erythema, to confult B. Bell's Treatife on Gonorrhœa Virulenta and Lues Venerea, vol. ii. p. 228. Pearfon on the Effects of various Articles in the Cure of Lues Venerea. Edit. 2. p. 166. An Effay on a Peculiar Eruptive Difeafe arifing from the Exhibition of Mercury, by G. Alley, Dublin, 1804. A Defcription of the Mercurial Lepra, by Dr. Moriarty, Dublin, 1804. Hiftory of Three Cafes of Erythema Mercuriale, by Dr. Spens, in Edinb. Med. and Surgical Journal, vol. i. p. 7. Effay on Erythema Mercuriale, by Dr. M'Mullin, in Edinb. Med. and Surgical Journal, vol. ii. p. 25. Cafe of Erythema not occafioned by Mercury, by John Rutter, M. D. in Edinb. Med. and Surgical Journal. vol. v. p. 143.

ERYTHRÆ, in *Ancient Geography*, a town of Greece, in Bœotia. Pliny. It was fituated near mount Citheron, according to Euripides. Some authors place it in the territory of Platæa, to the eaft of this town.—Alfo, a town of Greece, in Theffaly, fituated upon the river Erypæus, according to Strabo.—Alfo, a town of Greece, in Œtolia, near Eupalium.—Alfo, a town in the ifle of Cyprus, called Paphos.—Alfo, one of the twelve towns of Afia Minor, in Ionia, according to Pliny Strabo fays, that it gave name to the Erythræan Sibyl. He fays alfo, that it had a port, called Cyffus, in which were four ifles called Hippi. This town was built by Nilæus, the fon of Codrus. In the town was a temple of Hercules, one of the moft ftately edifices in all Afia. Erythræ took part, on all occafions, with the Romans, who rewarded its fidelity with ample privileges, and confiderably enlarged its territory. It is now a village, named Erethri.—Alfo, a town of Africa, in Libya.

ERYTHRÆA, in *Botany*, ερυθραια, *red*, a name given by Renealm to the *Chironia Centaurium*, (Gentiana *Centaurium* of Linnæus), on account of its red colour, unufual in the Gentian tribe. This writer controverts the univerfally received opinion of its being the κενταυριον μικρον of Diofcorides, becaufe the latter is faid to prefer watery fituations. But neither this, nor indeed any other of his arguments, is of much weight; for the *Chironia Centaurium* often occurs in low and wet places, and according to Dr. Sibthorp is very frequent throughout Greece. *Chironia fpicata*, which Diofcorides would hardly diftinguifh from it always grows in marfhy fpots, and is found on the coafts of Greece, as may alfo *Chironia pulchella*, though fcarcely diftinguifhed by any body from the common kind when Dr. Sibthorp vifited that country, and therefore not noted by him.

ERYTHRÆAN Sea, in *Ancient Geography*, is the ancient name of the *Red Sea*. Indeed, the ancients gave this name to the whole expanfe of water that extends from the coaft of Ethiopia to the ifland of Taprobana. This appellation was probably derived from Edom or Efau, whofe defcendants were called Idumæans, and inhabited the northern part of Arabia. The Idumæans navigated upon the Red fea and the Perfian gulf, and alfo upon the Indian fea, and the oriental name Idumæan fignified red. Whence the fea of the Idumæans was called the Red fea, and the Erythræan fea.

Erythræan *Sibyl*. See Sibyl.

ERYTHREAN, an appellation given to Hercules, from a temple which he had at Erythres, in Arcadia.

ERYTHRINA, in *Botany*, from ερυθρος, *red*, on account of the fcarlet flowers, whence alfo it is called Coral-tree. Linn. Gen. 365. Schreb. 486. Willd. Sp. Pl. v. 3. 912. Mart. Mill. Dict. v. 2. Juff. 356. (Corallodendron; Tournef. t. 446.) Clafs and order, *Diadelphia Decandria*. Nat. Ord. *Papilionaceæ*, Linn. *Leguminofæ*, Juff.

Gen. Ch. *Cal.* Perianth of one leaf, entire, tubular; its margin more or lefs two-lobed; its bafe on the lower fide furnifhed with a honey-bearing pore. *Cor.* papilionaceous, generally of five petals; ftandard much the longeft, lanceolate, afcending, its fides bent downwards; wings minute, fomewhat ovate, fcarcely longer than the calyx, and hardly reaching beyond the claw of the ftandard; keel ftraightifh, ufually about the length of the wings, fometimes longer, of two petals either feparate or united, notched at the end. *Stam.* Filaments ten, unequal, united below into a tube, flit at the upper edge, a little incurved, half as long as the ftandard, one of them occafionally feparate; anthers ten, oblong. *Pift.* Germen fuperior, ftalked, awl-fhaped, tapering into an awl-fhaped ftyle, as long as the ftamens; ftigma terminal, fimple. *Peric.* Legume very long, protuberant from the feeds, pointed, of one cell. *Seeds* feveral, kidney-fhaped.

Eff. Ch. Calyx two-lobed, ftandard much longer than the keel. Wings minute. Legume cylindrical, with many convex feeds.

Obf. *E. herbacea* has the tenth ftamen feparate; which is alfo the cafe with *E. Crifta-galli*, whofe keel moreover has its petals united into one, and is much longer than in the generality of the fpecies.

The fpecies of this fplendid genus are, for the moft part, natives of very hot climates in the Eaft or Weft Indies, and amount in Willdenow, who has paid particular attention to them, and defcribed two new ones, to twelve.

E. *herbacea*, Linn. Sp. Pl. 992. Trew. Ehret. t. 58. found in in Carolina, will ſupport our winters in a green-houſe, nor does its ſtem always die down to the root. The *flowers* form long and very handſome ſpikes, being of a moſt vivid though deep ſcarlet, with purpliſh ſtalks and calyx. *Seeds* ſcarlet with a black eye.

E. *Corallodendrum*, Linn. Sp. Pl. 992, brought from the Weſt Indies, requires a ſtove. It has an arboreſcent prickly *ſtem*, with *flowers* much like the former.

E. *mitis*, Jacq. Hort. Schoenbr. v. 2. 47. t. 216, is another ſimilar ſpecies in its *flowers*, but deſtitute of prickles. It was ſent to the Imperial garden from the Caraccas.

E. *Criſta-galli*, Linn. Mant. 99. Sm. Exot. Bot. v. 2. 69. t. 95, is perhaps one of the moſt ſtately of the whole. This is ſaid to be a native of Braſil, but was raiſed in the Liverpool garden from ſeeds brought from the Eaſt Indies, probably from the garden at Calcutta. It was in 1805 but a ſlender prickly ſhrub about ſix feet high, with ternate prickly-ribbed *leaves*. *Flowers* in large terminal cluſters, of a rich unpoliſhed deep ſcarlet, their ſtandards much broader, and keels much longer, than is uſual in this genus; the wings very ſmall and three-lobed, of a greeniſh white. Tenth *filament* ſeparate to the very baſe.

E. *ſpecioſa*, Andr. Repoſ. t. 443, a plant we have never ſeen, flowered in the garden of A. B. Lambert, eſq., and though ſuppoſed to be a native of South America, is ſaid to be perfectly hardy, and to ſtrike very freely from cuttings. Whether it be comprehended under any of Willdenow's ſpecies, we are not at all certain. The *ſtem* is prickly, thick and ſtrong. *Leaflets* very broad, with prickly ribs. *Flowers* ſcarlet, in very denſe ſpikes. *Wings* half as long as the ſtandard, which is narrow like the firſt ſpecies; keel not half ſo long as the wings. If theſe circumſtances are conſtant, the generic character will require correction.

ERYTHRINUS, in *Ichthyology*, a ſpecies of Sparus and alſo of Salmo, which ſee reſpectively.

ERYTHROCEANEUS, in *Ornithology*, the red and blue maccaw, with a wedge-like tail, and the ſides of the head naked and rough. See Psittacus.

ERYTHRODANUM, in the *Materia Medica*, a name by which ſome authors have called the rubia tinctorum, or madder.

ERYTHROIDES, in *Anatomy*, from ερυθρος, *red*, and ειδος, *form*, a name given by ſome anatomiſts to the firſt proper covering of the teſticles. It is not now admitted that theſe bodies are covered by any thing except the fibres of the cremaſter and cellular ſubſtance of the ſcrotum, to which, perhaps, the above-mentioned name may have been applied.

ERYTHRONIUM, in *Botany*, from ερυθρος, *red*, in alluſion either to the colour of the flower, or to the more unuſual blood-like ſtain in the leaves. Dog's-tooth Violet. Linn. Gen. 165. Schreb. 220. Willd. Sp. Pl. v. 2. 96. Mart. Mill. Dict. v. 2. Juſſ. 48. (Dens canis; Tournef. t. 202.) Claſs and order, *Hexandria Monogynia*. Nat. Ord. *Sarmentaceæ*, Linn. *Liliа*, Juſſ.

Gen. Ch. *Cal.* none. *Cor.* Petals ſix, regular, lanceolate, pointed, lying over one another alternately towards the baſe, ſpreading gradually, reflexed from about the middle; three of them external, three internal. Nectary two ſcars, or little ſcales, at the baſe of each of the inner petals. *Stam.* Filaments ſix, uniform, awl-ſhaped, ſhort; anthers oblong, erect, as long as the filaments. *Piſt.* Germen ſuperior, roundiſh or oblong, with three angles; ſtyle ſimple, ſhorter than the corolla, taper at the baſe, and a little bent at that part, otherwiſe ſtraight; ſtigmas three, ſpreading, ſomewhat cylindrical, furrowed, or notched. *Peric.* Capſule nearly globular, contracted at the baſe, of three cells and three valves. *Seeds* numerous, ovate, pointed.

Eſſ. Ch. Corolla bell-ſhaped, of ſix reflexed petals. Nectary two ſcars at the baſe of the three inner ones. Capſule globoſe, contracted at the bottom. Seeds ovate.

1. E. *Dens canis*. Linn. Sp. 437. Jacq. Auſtr. v. 5. 31. append. t. 9. Curt. Mag. t. 5. Leaves with a blunt flat point. Style cylindrical. Germen globoſe, obtuſe. Native of mountainous places in Italy, Switzerland, Carniola, Styria, Carinthia and Tartary, flowering in the ſpring. In our gardens it is a hardy perennial, diſtinguiſhed by its elliptical radical *leaves*, very various in breadth, elegantly ſtained with purple, and its ſolitary drooping crimſon or whitiſh *flower*, with pendulous dark purple anthers. No remains of the herbage are to be ſeen after the end of June. Lobel and ſeveral botaniſts of his time preſumed this to be the real σατυριον of Dioſcorides, nor does it ill accord with the deſcription, though Dr. Sibthorp ſeems not to have met with the plant in Greece. It cannot, however, be made to agree with the σατυριον ερυθρονιον of the ſame author, though the latter appellation ſeems to have given riſe to its preſent generic name. The old authors made two ſpecies on account of the various dimenſions of the leaves, which Linnæus reduced to one, but he very improperly made a third variety of the following ſpecies.

2. E. *flavum*. (E. americanum; Curt. Mag. t. 1113. E. Dens canis γ; Linn. Sp. Pl. 437.) Leaves involute at the point. Style club-ſhaped. Native of the colder parts of North America. It flowered in April 1808, in the gardens of Mr. Loddiges at Hackney, and Mr. Saliſbury at Brompton, and was firſt well determined by Mr. Gawler in Curtis's Mag. The leaves reſemble the former, except in having a hooded termination, from the involute edges of the point. *Flower* deep yellow ſpotted with red. *Anthers* and pollen yellow. *Style* very thick in the upper half. *Germen* obovate.

3. E. *revolutum*. Leaves flat-pointed? Style cylindrical. Germen elliptic-oblong, acute.—Gathered by Mr. A. Menzies on the weſt coaſt of North America. The *leaves* are broadly elliptical, and in our ſpecimens appear pale, and ſcarcely ſpotted. *Petals* purpliſh, very much rolled back, as in the Martagon Lily. *Stamens* with unuſually long taper-pointed filaments, and pale or yellowiſh, not dark purple, anthers. *Germen* elliptic-lanceolate, pointed. *Style* contracted at the baſe, but otherwiſe pretty exactly cylindrical, with much longer ſtigmas than either of the foregoing.—The whole plant alſo is larger, and appears to us unqueſtionably diſtinct. The diſcovery of this ſpecies in America renders the original name of the laſt ſo exceptionable, that we hope we may be pardoned for changing it before it is adopted in any regular ſynoptical work, otherwiſe it would be too late. S.

ERYTHROPHTHALMUS, in *Ichthyology*. See Cyprinus.

ERYTHRORHIZA, in *Botany*, ερυθρα ριζα, *a red root*; Michaux Fl. Boreali-Amer. v. 2. 36. t. 36, is *Galax aphylla*, which ſee.

ERYTHROXYLUM, ερυθρον ξυλον, *red wood*. Brown. Jam. 278. Linn. Gen. 228. Schreb. 307. Willd. Sp. Pl. v. 2. 746. Mart. Mill. Dict. v. 2. Juſſ. 253. Claſs and order, *Decandria Trigynia*. Nat. Ord. *Trihilatæ*, Linn. *Malpighiæ*, Juſſ.

Gen. Ch. *Cal.* Perianth of one leaf, turbinate, very ſmall, withering, in five ovate acute ſegments. *Cor.* Petals five, ovate, concave, ſpreading. Nectary an upright, coloured, notched ſcale, attached to the baſe of each petal. *Stam.* Filaments 10, the length of the corolla, connected at the baſe by an abrupt

abrupt membrane; anthers heart-ſhaped. *Piſt.* Germen ovate, ſuperior; ſtyles three, thread-ſhaped, diſtant, the length of the ſtamens; ſtigmas thickiſh and obtuſe. *Peric.* Drupa ovate, of one cell. *Seed.* Nut oblong, with four obtuſe angles.

Eſſ. Ch. Calyx turbinate. Petals five, each with a notched nectariferous ſcale at its baſe. Stamens connected at their baſe. Drupa of one cell.

This genus, founded by Browne, conſiſts of two ſpecies only in his work. 1. *E. areolatum*, Linn. Sp. Pl. 612. Brown. Jam. t. 38. f. 2. and t. 14. f. 3. (E. carthaginenſe; Jacq. Amer. 134. t. 87. f. 1.) This is called, in Jamaica, Red Wood, or Iron Wood, and is ſaid to be excellent for the ſize of the tree, which is not above five or ſix inches in diameter. The *leaves* are obovate, two inches long, marked with two lines at the back, which circumſcribe the part that was expoſed before each leaf expanded. *Flowers* ſtarry, white, fragrant, on ſimple, cluſtered, lateral ſtalks.

2. The ſecond ſpecies of Browne has been neglected by following authors, probably as a variety of the firſt. He deſcribes it as different in its manner of growth, with ſmaller rounder *leaves*.

Cavanilles and Lamarck have much increaſed the number of ſpecies, ſo that they now amount in Willdenow's work to 12, all except the above unknown to Linnæus. They are natives either of South America, Madagaſcar, or the iſlands of Mauritius and Bourbon, and were chiefly gathered by Commerſon. The French call many of them Bois d'huile. The wood is, in ſome inſtances, ſaid to have a very ſtrong and diſagreeable ſmell while burning.

ERYX, in *Ancient Geography*. See Erix.

Eryx, in *Zoology*, a ſpecies of Anguis, being the *Anguis dorſo trilineato* of Boddaert, above cinereous, with three black lines, and light blueiſh beneath. It is found in England, and in America.

ERZ, or Erzi, in the *Botanical Writings of the Ancients*, a word uſed originally by the Hebrews, and by them made the name of the cedar.

ERZEN, in *Geography*, a town of Germany, in the circle of Lower Saxony, and principality of Calenberg, ſeated on the Humme; 7 miles S.W. of Hameln.

ERZERUM, or Arzerum, a city of Aſiatic Turkey, and capital of a pachalic to which it gives name, and is a part of Armenia, ſituated near the head of the Euphrates, at the foot of a chain of mountains which are uſually covered with ſnow till the latter end of ſpring. The town is ſurrounded with a double wall, and defended with ſome ſquare towers; the houſes are mean, and none of them large. The ſuburbs are inhabited by Chriſtians. Of the inhabitants, they count 18,000 Turks, of whom two-thirds are Janizaries; 6000 Armenians, who have an archbiſhop, and two churches; and 400 Greeks, who have a biſhop, and one mean church. The Greeks are moſtly employed in the manufacture of copper, brought from ſome mines three days journey from the city; this, and the manufacture of the ſkin of a ſpecies of martin, are the only articles of their commerce. Erzerum is the ſtaple of the merchandize of India, eſpecially when the Arabians infeſt the environs of Aleppo and Bagdad. This merchandize conſiſts of ſilk from Perſia, cotton, painted linens, ſpices, rhubarb from Bucharia, madder from Perſia, zedoary, &c. This town was one of the laſt which was taken from the Greek emperors by the Arabians; 250 miles N.N.E. of Aleppo, and 510 E. of Conſtantinople.

ERZGEBIRG. See Ertzgebirge.

ESAPHE, from εσαφαω, *I feel with the fingers*, a word uſed by Hippocrates, to expreſs the touching of the mouth of the uterus, in order to diſcover its ſtate of diſeaſe.

ESAU, in *Biography*, the ſon of Iſaac and Rebecca, and the twin-brother of Jacob, whom he ſucceeded at his birth, was born in the year 1836 B.C. At his birth he was covered with hair, indicating great bodily ſtrength, by which he was fitted for the kind of life to which he afterwards devoted himſelf. As he was fond of hunting, he ſupplied his father with a variety of delicious food, and became his favourite. Jacob, however, was the favourite of his mother, and by means of a circumſtance mentioned in his hiſtory, ſupplanted Eſau of his birth-right, which he conſented to barter for a meſs of red pottage, that had been prepared for their father, during his abſence. Hence he and his poſterity derived the appellation of Edom, ſignifying red. At the age of 40 years Eſau diſtreſſed his parents by marrying two wives out of idolatrous Canaanitiſh families, with which the poſterity of Abraham were prohibited from forming any connection. In proceſs of time, he regained his father's favour, and as death approached, Iſaac determined to confer his laſt prophetic benediction on Eſau, as his firſt-born ſon and heir. The artifice of his mother, however, counteracted his purpoſe; and ſhe contrived to impoſe upon Iſaac, and to obtain the father's parental bleſſing for her ſon Jacob. Eſau was indignant on account of the treatment of his brother; and determined to kill him as ſoon as their father ſhould die.

Rebecca again interpoſed, and ſent Jacob away to her brother Laban, with whom he might be ſecure from the threatened vengeance of his brother. During the period of ſeparation, which laſted ſeveral years, Eſau married a wife of the family of Iſhmael, and removing to mount Seir, acquired great power and wealth. When Jacob returned, after long abſence, to his father's country, with a numerous family, and large flocks and herds, he dreaded his brother's diſpleaſure; and though they had an amicable and affectionate interview, he entertained ſuſpicion of remaining reſentment, and inſtead of complying with the wiſhes of his brother, who was deſirous that he would ſettle in his neighbourhood, he dwelt in Shechem. After their father's death they lived in peace and amity; but as their poſſeſſions enlarged, and there was not ſufficient room for them in the land in which they were ſtrangers, Eſau returned to mount Seir, where his poſterity multiplied under the denomination of Edomites. (See Edom.) The time of his death is not mentioned, but biſhop Cumberland thinks it probable that he died about the ſame time with his brother Jacob, at the age of about 147 years. Geneſis, ch. xxv—xxxvi.

Esau, in *Geography*, a mountain of Arabia, in the country of Yemen, 4 miles N. of Udden.

ESAULOVO, a town of Ruſſian Siberia, in the government of Kolivan; 36 miles E.S.E. of Kraſanoiarſk.

ESBONITÆ, in *Ancient Geography*, a people of Arabia Petræa, who took their name from the capital, which was ſeated in the mountains over-againſt Jericho.

ESBUS. See Heshbon.

ESCACENA, in *Geography*, a town of Spain, in the country of Seville; 20 miles W. of Seville.

ESCAILLON, a river of France, which runs into the Scheldt, about two miles above Valenciennes.

ESCALA, La, a town of Spain, in the province of Catalonia, on the coaſt of the Mediterranean; 22 miles E. of Gerona.

ESCALADE, or Scalade, in the *Military Art*, a furious attack of a wall or a rampart; carried on with ladders, to paſs the ditch, or mount the rampart; without proceeding in form, breaking ground, or carrying on regular works to ſecure the men.

When the troops are prepared to paſs the ditch, either with the affiftance of boards, hurdles, and fafcines, when it is muddy, or with fmall boats of tin, or bafkets covered with fkins, or oil-cloth when it is deep, and filled with water, a party muft be placed on the counterfcarp, oppofite to the landing-place, ready to fire at the garrifon if they are alarmed, and oppofe the mounting on the rampart. If the ditch is dry, the ladders are fixed in fome place fartheft diftant from the centry; and as foon as they get upon the rampart, they put themfelves in order to receive the enemy; if the centry fhould be furprifed, and filently overcome, the detachment haftens to break open the gate, and to let in the reft of the party. If the ditch is wet, the rampart high, and provided with a revetement, it will be difficult to furprife the town in this way; but if there is no revetement, the troops may hide themfelves along the outfide of the rampart till all are over. Since the invention and ufe of gun-powder, and the walls of cities have been flanked, they are feldom taken by efcalade.

ESCALANA, in *Geography*, a town of Spain, in Old Caftile; 14 miles N.N.E. of Segovia.

ESCALANTE, a town of Spain, in the province of Bifcay; 15 miles E. of Santander.

ESCALAON, a town of Portugal, in the province of Beira; 16 miles N. of Almeida.

ESCALLION, in *Botany*. See Scallion.

ESCALLONIA, fo called by the younger Linnæus, at the recommendation of Mutis, in honour of a learned Spaniard named Efcallon, the pupil of Mutis in botany, mathematics and philofophy, and his infeparable companion during his abode in New Spain. This gentleman difcovered the fhrub in queftion, as well as a vaft number of new or rare plants befides, in his various journeys through New Granada, moft of which were, by Mutis or himfelf, communicated to Linnæus or his fon. A very fine plant was originally chofen by Mutis for the above purpofe, of which a fpecimen and drawing were fent to Linnæus; but it proved, on a careful examination, to be a *Loranthus*, and remains undefcribed in the Linnæan herbarium. —Linn. Suppl. 21. Schreb. 152. Willd. Sp. Pl. v. 1. 1149. Mart. Mill. Dict. v. 2. Juff. 321. Clafs and order, *Pentandria Monogynia*. Nat. Ord. *Onagræ*, Juff.

Gen. Ch. *Cal.* Perianth of one leaf, inferior, hemifpherical, with five large, fpreading, ovate, acute, permanent teeth. *Cor.* Petals five, equal, inferted into the calyx, tongue-fhaped or obovate, obtufe, a little diftant from each other, longer than the calyx-teeth. *Stam.* Filaments five, equal, erect, awl-fhaped, inferted into the calyx between the petals, oppofite to its teeth and about the fame length; anthers incumbent. *Pift.* Germen half invefted with the calyx, globular; ftyle cylindrical, ftraight, the length of the ftamens; ftigma capitate, umbilicate. *Peric.* Berry roundifh, of two cells, crowned with the calyx-teeth. *Seeds* very numerous, minute.

Eff. Ch. Berry of two cells, with many feeds. Calyx encompaffing the fruit. Stigma capitate. Petals five, inferted into the calyx.

1. E. *myrtilloides*. Linn. Suppl. 156. Sm. Pl. Ic. t. 30. —Leaves finely ferrated, minutely pointed, veiny beneath. Flowers folitary.—Gathered in New Granada by Efcallon. —*Stem* fhrubby, branched, flightly angular, with a fmooth deciduous bark. *Young branches* numerous, alternate, fhort, fimple, leafy, each terminated by a folitary, ftalked, terminal *flower*. *Leaves* alternate, fpreading, about three-quarters of an inch long, obovate, obtufe with a minute point, minutely ferrated, efpecially towards the end, fmooth, deciduous; with no perceptible veins on the upper fide; paler and veiny beneath; the bafe tapering down into a fhort, often fringed, *footftalk*, each of whofe edges unites at their bafe with a glandular toothed angle or rib in the branch. *Stipulas* none. *Flower-ftalks* angular and glandular. *Petals* about thrice as long as the calyx-teeth, apparently white, erect, their extremities reflexed. *Berry* black? the fize of a large pea, or bigger, crowned with the calyx and bafe of the ftyle.

2. E. *ferrata*. Sm. Pl. Ic. t. 31.—Leaves ferrated, fomewhat abrupt, fmooth and without veins at the back. Flowers folitary.—Gathered about the ftraits of Magellan, by Commerfon; in Staten land, (not Terra del Fuego,) by Mr. Archibald Menzies.—A humble branched fmooth *fhrub*, with fomething of the afpect of a *Vaccinium*. *Branches* alternate, fomewhat zig-zag, angular, with a pale fmooth bark; thofe of the prefent feafon green, leafy, ftraighter, each bearing a folitary, terminal, ftalked flower. *Leaves* deciduous, alternate, obovate, obtufe, often abrupt or retufe, with a minute central point or tooth, equally ferrated or fomewhat crenate, very fmooth; flightly veiny above; pale and deftitute of lateral veins beneath, though furnifhed like the former with a ftrong central rib. *Footftalks* fmooth and entire, as are the angles of the branches. *Stipulas* none. *Flower-ftalk* fmooth. *Petals* white, fpreading, not recurved. Top of the *germen* violet. All the parts of fructification, except the petals, are but one-third the fize of the former. The little *berries*, crowned with the permanent ftyle, appear to remain through the winter, and their upper part, above the calyx-teeth, eafily feparates like a lid as they ripen, expofing the pulp full of fmall feeds, with its tranfverfe partition.

3. E. *glandulofa*. Leaves double ferrated, acute, glandular at the back like the branches. Flowers fomewhat corymbofe.—Gathered in Chili by Mr. A. Menzies.—*Branches* wand-like, roundifh, leafy, when young clothed with abundance of prominent glandular tubercles. *Leaves* alternate, when full grown near an inch and half long, obovate, pointed, ftrongly and doubly ferrated; fmooth or flightly downy above; veiny, and rough with innumerable prominent refinous glands, beneath; tapering at the bafe into a fhortifh glandular *footftalk*. Each leaf is accompanied by an axillary tuft of fmaller ones, the rudiments of future branches. *Stipulas* none. *Flower-ftalks* feveral about the tops of the branches, axillary and terminal, fimple or fubdivided, each about an inch long, angular, glandular like the branches, as is alfo the bafe of the calyx. *Bracteas* few, at the bafe or fubdivifion of each ftalk, linear, glandular. *Calyx* about the fize of the laft. *Petals* more like the former, and fomewhat longer, with rounded, reflexed extremities. *Style* furrowed, furrounded at its bafe with an annular lobed gland or nectary, of which we can find no traces in the other fpecies. *Germen* of two cells. The *fruit* we have not feen. S.

ESCALONA, in *Geography*, a fmall, tolerably built, walled town of Spain, in the province of New Caftile, with feveral fuburbs, feated on an eminence defended by a caftle, in a fruitful fpot watered by the Alberche, 20 miles N.W. of Toledo, and 32 S.W. of Madrid. It has four churches, and two convents.

ESCALOP *Foffil Shells*, in *Conchology*, are defcribed by Da Cofta (Conchol. p. 247.) as found in the lime-ftone quarries at Thame in Oxfordfhire; Mr. Walcot, in his "Petrifactions found near Bath," has alfo defcribed a fimilar kind of fhell, as found in the clay on the fide of the road between Claverton-Down and village, and in the free-ftone at the quarries near King's Down; and another kind found in a flaty loam at the limeftone quarry near the Crefcent in Bath.

ESCAMBIA, one of the moſt conſiderable rivers that fall into the bay of Penſacola, in Weſt Florida, diſcharges itſelf near the head of the north branch, about 12 or 15 miles from Penſacola, through ſeveral marſhes and channels which have a number of iſlands between them, that are overflowed when the water is high. The courſe of this river from an unknown ſource is very winding. The lands on each ſide are, in general, rich, low, or ſwampy, or well adapted for the culture of rice or corn. The numerous rivulets that fall into this river from the high country about it may be led over every part of the rice lands, at any ſeaſon of the year. The iſlands at the mouth of the river, of which ſome are conſiderable in extent, are not inferior for rice to any in America.

ESCAMBIO, from the Spaniſh *cambier*, to change, was anciently a licence granted any one for making a remittance, or giving a bill of exchange to another, beyond ſea.

For, by ſtat. 5 Rich. II. no perſon might exchange, or return money beyond ſea, without the king's licence

ESCAMUS, in *Ancient Geography*, a river of Mœſia, which has its ſource in mount Hæmus.

ESCAPE, Fire. See Fire-Escape.

Escape, in *Law*, an evaſion out of ſome lawful reſtraint, either by violence or ſtealth.

Eſcapes are either *voluntary*, or *negligent*.

Voluntary, are ſuch as are, by the expreſs conſent of the keeper to whoſe cuſtody, in civil actions, the debtor has been committed; after which, he can never retake his priſoner again, (3 Rep. 52. 1 Sid. 330.) though the plaintiff may retake him at any time, (ſtat. 8 or 9 W. III. c. 27.); but the ſheriff muſt anſwer for the debt.

Negligent eſcapes are where the priſoner eſcapes without his keeper's knowledge or conſent; and then upon freſh purſuit the defendant may be retaken, and the ſheriff ſhall be excuſed, if he has him again before any action brought againſt himſelf for the eſcape. (F. N. B. 130.) A reſcue of a priſoner in *execution*, (which ſee,) either going to gaol or in gaol, or a breach of priſon will not excuſe the ſheriff from being guilty of and anſwering for the eſcape; for he ought to have ſufficient force to keep him, ſince he may command the power of the county (Cro. Jac. 419.)

An eſcape of a perſon arreſted upon criminal proceſs, by eluding the vigilance of his keepers before he is put in hold, is an offence againſt public juſtice; and the party himſelf is puniſhable by fine or impriſonment. (2 Hawk. P. C. c. 122.) But the officer permitting ſuch eſcape, either by negligence or connivance, is much more culpable than the priſoner. Officers, therefore, who, after arreſt, *negligently* permit a felon to eſcape, are puniſhable by fine (1 Hal. P. C. 600.); but *voluntary* eſcapes, by conſent and connivance of the officer, are a much more ſerious offence; for it is generally agreed that ſuch eſcapes amount to the ſame kind of offence, and are puniſhable in the ſame degree, as the offence of which the priſoner is guilty, and for which he is in cuſtody, whether treaſon, felony, or treſpaſs; and this, whether he was actually committed to gaol, or only under a bare arreſt. (1 Hal. P. C. 590. 2 Hawk. P. C. 134.) But the officer cannot be thus puniſhed, till the original delinquent hath actually received judgment or been attainted, upon verdict, confeſſion, or outlawry, of the crime for which he was ſo committed or arreſted; otherwiſe it might happen, that the officer might be puniſhed for treaſon or felony, and the perſon arreſted, and eſcaping, might turn out to be an innocent man. But before the conviction of the principal party, the officer thus neglecting his duty may be fined and impriſoned for a miſdemeanor. (1 Hal. P. C. 588, 9. 2 Hawk. P. C. 134, 5.). See Rescue.

Escape *warrant*. If any perſon committed or charged in cuſtody in the king's bench, or Fleet priſon, in execution, or on meſne proceſs, &c. go at large; on oath thereof before a judge of the court where the action was brought, an eſcape warrant ſhall be granted, directed to all ſheriffs, &c. throughout England, to retake the priſoner, and commit him to gaol when taken, there to remain until the debt is ſatisfied; and a perſon may be taken on a Sunday upon an eſcape warrant. Stat. 1 Anne, cap. 6.

ESCAPEMENT, in *Horology*, is an ingenious mechanical contrivance for tranſmitting, in a modified way, and at equidiſtant intervals of time, the maintaining power of a clock or watch to the regulator, whether balance or pendulum, in order to reſtore that loſs of motion in every vibration or oſcillation, which neceſſarily ariſes from the friction of the acting parts, and the reſiſtance of the air in every machine. It has been ſaid, under the article Clock, that the maintaining power, whether conſiſting of a weight or ſpring, when ſuffered to expend itſelf unreſtrained, would make the wheel-work run on with an increaſing velocity, until the obſtacles to motion, ſuch as the friction in the teeth and at the pivots, the reſiſtance of the air, &c. fixed the maximum of velocity with which it could expend itſelf; at which period the friction and reſiſtance would jointly operate as a regulator, whilſt they and the maintaining power remained unaltered, and the machine ſo circumſtanced would greatly reſemble a common kitchen-jack; and if an index were inſerted on the arbor of the firſt or ſlowly moving wheel, it would indicate ſuch portions of time as the ratio between the maintaining power and the regulating friction and reſiſtance of the air taken together would produce; but it is obvious, that every alteration produced in the friction by wear, foulneſs, &c. or in the denſity of the air by the ſtate of the atmoſphere, would affect the indication ſo much, as to render it extremely irregular; hence the balance and the pendulum were ſucceſſively invented and applied to regulate the indication of time by their iſochronous vibrations; but then as both theſe regulators have alternate motions backwards and forwards, they could neither of them be applied *immediately* to check a wheel that moves continually in one direction, without the intervention of ſome contrivance, connected both with the wheel and regulator, which ſhould convert a direct circular motion into a motion changing its direction by perpetual alternations. To deviſe and execute a piece of mechaniſm that ſhould perform ſuch an office ſteadily and accurately, required much ſcience as well as mechanical ſkill, and the invention once executed was denominated an *eſcapement*, or by contraction among the workmen *'ſcapement*, becauſe it ſuffers a tooth of the wheel, with which it acts, to *eſcape*, or paſs on, at ſuch intervals of time as are meaſured by the regulator, which wheel is therefore alſo called the *eſcapement wheel*.

From this ſhort account of the origin and office of an eſcapement, the reader will perceive, that the accuracy of its conſtruction conſtitutes one of the moſt eſſential conſiderations in an horometrical machine, it being an indiſpenſable condition, that the ſucceſſive impulſes taken from the maintaining power through the medium of the wheel-work, and given to the regulator, ſhould be ſo modified, as to diſturb as little as poſſible the natural iſochroniſm of the regulator, or, if it do diſturb it, that it ſhould ſomehow compenſate that diſturbance. Hence it becomes neceſſary, that the workman, or mechanician, ſhould be fully acquainted with the theory of the natural iſochroniſm of his propoſed regulator, when he undertakes to deſign and execute his eſcapement; he muſt not only know how much of the

 maintain-

maintaining power will be fufficient to balance the lofs fuftained in the natural length of a vibration, by reafon of friction and the refiftance of a ftandard medium, but he muft confider and indeed afcertain, by theory or experiment, or both, at what part of the arc of vibration the power muft be applied; likewife how long the impulfion fhall continue to act, and whether that action ought to be uniform, increafing, or decreafing in its intenfity. Thefe and fimilar confiderations have produced, as might be expected, a great variety of conftructions of an efcapement, both with regard to their external fhape and *modus operandi*. As a good efcapement is of the utmoft importance in the ufeful art of clock-making, and as we have no author in the Englifh language who has given us the different conftructions in hiftorical order, together with fuch remarks as may enable the reader to judge of their refpective excellence, we will devote fome time to the detail of both the theory and practical conftruction of fuch different efcapements as feem to merit a general notice.

But before we enter upon our defcription and examination of different efcapements of clocks and watches, as the reader has not yet had an opportunity of perufing the article PENDULUM, and as all efcapements derive their fhape and manner of action from the relation they bear either to the laws of its motion, or to thofe of a moving balance, it will contribute greatly to his better underftanding the fubject, if we premife firft fome of the chief circumftances which relate to the theory of a free pendulum, and to the influence that any external impulfe will have on it when applied to become the regulator of a clock; and fecondly, if we explain the theory of a balance's motion, which we have purpofely referved for this place by reafon of its intimate connection with the efcapement.

1. In *fig.* 1. of *Plate* XXXI. of *Horology*, let C D reprefent a *free pendulum*, or pendulum that has no weight but what is collected at the centre of ofcillation or point D, and let the arc D B reprefent a femi-vibration round the point C, taken as the centre of motion or point of fufpenfion, at which we will fuppofe there is no friction, then if the refiftance of the air and rigidity of the ftring or rod were not to interfere, when the pendulum was once removed from its natural or perpendicular fituation C D to B, and fuffered to defcend again by the fole force of gravity, it would acquire fuch a velocity at its loweft point D, by means of the accelerating force of gravity, as would, under thefe circumftances, carry it up an equal femi-vibration or arc D G, the increments of accelerated motion being equal in the arc B D to the decrements of retarded motion in the equal arc D G, the fame reafoning would apply in the returning vibration from G to B; the velocity acquired at D by the defcent from G to D would carry the pendulum again up to B, and the confequence would be, under fuch *unnatural* circumftances, if they could be effected, that there would be a perpetual alternation of vibrations of the fame length, which would confequently be ifochronal with refpect to each other, fo long as the pendulum remained of the fame length; and fuch a pendulum would of itfelf be a perfect time-meafurer, and would only want a regifter to indicate the number of its vibrations, to make it a complete regulator or chronometer: but the fact is, the friction and rigidity at the point of fufpenfion cannot by human art be entirely annihilated, though ingenuity can greatly diminifh it; nor can the obftacle to free motion arifing from the refiftance of the air be removed, or even rendered uniform; hence it is found that when a pendulum is drawn afide from its point of reft, every fucceeding vibration, after motion has commenced, is fomewhat fhorter than the preceding one, until after fome hours have been fpent in alternate vibrations continually fhortening, the pendulum finds its original point of reft; the time expended in doing this is longer in proportion to the diminution of friction, the air and other circumftances remaining unchanged. Ferdinand Berthoud, the famous French clock-maker, made fome experiments to afcertain this fact, and conftructed the knife-edge fufpenfion of a fecond's pendulum, with a heavy lenticular ball, fo free from friction, that an arc of vibration of 10° was not reduced to $15'$ till $29^h\,46^m$ had elapfed; but notwithftanding every attempt to reduce the friction, the pendulum came to reft at laft. From this fhort view of the tendency of a pendulum to come to reft after it has had a motion communicated to it, we clearly perceive the neceffity of making fome auxiliary additions to the natural force of gravity, in order that the pendulum may keep up the length of its original vibration in every fucceeding one, notwithftanding the obftructions which continually oppofe the operation of gravity; thefe auxiliary additions to the motion, produced by gravity only, conftitute the operation of the maintaining power, modified by the wheel-work and efcapement, in every pendulum clock; and hence arifes a *difturbance* in the *theory* of the free pendulum, which makes fuch a theory no farther of ufe in clock-work, than as it affords certain laws and a fcale of forces, fuch as the mechanician may labour to imitate, by modifying the joint agency of his *auxiliary additions* and of the operation of gravity, fo that they fhall act in concert; which imitation is to be effected principally, as to its *mode*, by the efcapement, the maintaining power being concerned only as to the *quantity* of any additional power to be applied in aid of gravity.—Now, if we fuppofe the pendulum at the fituation B, or extremity of its arc, and draw A B perpendicular to the vertical line C D, and B E = C B perpendicular to the line A B, or, which is the fame thing, parallel to the line C D; alfo, if we draw B F a tangent to the arc at the point B, and from the point E demit the line E F upon it, to form a right angle at F, in which cafe the line F E will be parallel to the line C B, B E will reprefent the force of gravity, which, by the refolution of forces, is equivalent to B F and F E; but F E is perpendicular to the tangent, or is in the direction C B of the radius, and therefore can neither accelerate nor retard the motion, whilft B F, being in the direction of the tangent, or perpendicular to the radius, is wholly employed in accelerating or retarding the pendulum's motion: hence, the line B E : B F : : the force of gravity : the accelerating force; but from the fimilar triangles B E F, C B A, B E is = C B, and B F = B A, therefore, by fubftitution, C B : B A : : force of gravity : accelerating force, and confequently the accelerating force $= \frac{\text{gravity} \times \text{B A}}{\text{C B}}$, in which expreffion gravity and the radius C B are invariable, therefore the accelerating force varies as the fine B A of the arc of vibration. From this law of variation of the accelerating force of a body moving in a circular arc, it follows, that the longer arcs require longer times than the fhorter arcs in the proportion of 34 : 29, as Huygens has demonftrated; for the fine does not increafe fo faft as the arc, which it ought to do, to make the vibrations of the fame pendulum in different arcs ifochronal: if, however, the body could be made to move along the chord or ftraight line B D, inftead of the arc B D, then the vibrations of different lengths would be ifochronal, becaufe two fimilar bodies will run down each a feparate chord of different lengths to the loweft point of the fame circle in the fame time, namely, in the time that each would take in falling

through

through the whole diameter of the circle, and the acquired velocity of each, at the loweſt point, would be in proportion to the length of its chord. But the mechanician has not attempted to make his pendulum vibrate in chord lines, which probably is impracticable, but has invented another curve, called the cycloid, generated by a point in a circle revolving on a ſtraight line, which curve poſſeſſes this peculiar property, that the accelerating forces, which a body acquires by moving along it, are exactly proportionable to the *arcs*, (ſee CYCLOID,) ſo that a pendulum vibrating in this kind of curve, will perform its long and ſhort vibrations in the ſame time. This property of the cycloid was firſt diſcovered by the celebrated Huygens, who owed much of his celebrity to it, and adopted a contrivance for making a pendulum move in ſuch a curve, which will be deſcribed under our article PENDULUM, and alſo the reaſons will be given why it was laid aſide in the practice of clock-making. It may be proper, however, to remark here, that with a pendulum vibrating in the arc of a cycloid, with all its weight collected in the ball, and its length rendered invariable, if ſuch a pendulum could be made, it would, notwithſtanding, be of conſequence what the nature of the eſcapement were, becauſe though the variations in the *arcs*, ariſing from varied gravity alone, would not affect the *times* of the ſucceſſive vibrations, yet, when *additional force* is applied in aid of gravity, by means of the maintaining power and eſcapement, the uniform law of acceleration juſt deſcribed would be partially diſturbed by ſuch addition, though the diſturbance would be leſs perceptible than in circular arcs of conſiderable extent.

When, however, a pendulum vibrates in a ſmall arc, it is demonſtrable that ſuch an arc differs very little from a cycloidal arc near its loweſt point, nay almoſt coincides with it; it is alſo found from experience, that a heavy ball is leſs diſturbed by the requiſite additional force, communicated by the maintaining power, than a light one, as might be inferred from theory; on which two accounts the prevailing practice among clock-makers is, to make ſuch eſcapements for a pendulum as require but ſhort vibrations, and, in order to gain momentum, to append a heavy ball; and it has been diſcovered, and is now indeed an acknowledged fact, that a regulator with an exact compenſation for the effects of variable temperature in its pendulum, and that vibrates by means of a good eſcapement in ſmall arcs, with a heavy lenticular ball, goes with a degree of accuracy beyond what Huygens durſt even hope for from his cycloidal contrivance; in effecting which, theory and practice were found to be greatly at variance.

But the cycloidal theory, which, conſidered as a theory, is not only ingenious, but illuſtrative of the principal circumſtances which relate to the motion of a pendulum, will furniſh us with a conciſe and clear notion how the natural arc and time of a vibration will be altered by an acceſſion of external force to the force of gravity, without ſome knowledge of which alteration no mechanician can proceed on ſcientific principles in the conſtruction of an eſcapement.

Suppoſing now the pendulum in *fig.* 2, ſimilar to that in the preceding figure, and the arc to be ſo ſmall as nearly to coincide with the cycloidal curve, let the arc G B be unbent into the ſtraight line h H, and with the ſemi-arc D H, as a radius, deſcribe the ſemi-circle H L h; ſet the line A B from H to M, and from h to m perpendicular to the line h H, and join m M, which line will paſs through the centre D; from any other points I and K in the ſemi-arc or radius, draw the lines I N and K O parallel to H M, and alſo the correſponding ones $i\ n$ and $k\ o$ parallel to $h\ m$, and we ſhall obtain the following relations of the properties of the pendulum's motion, *viz.*

1ſt. The forces of gravity urging the pendulum towards D from B, at the points I and K of the ſemi-vibration, will be repreſented by, and proportional to, the ordinates I N and K O of the ſtraight line M D m; and the correſponding ordinates $i\ n$ and $k\ o$ will repreſent, and be proportional to, the retarding forces of the ſame gravity, at the points i and k of the other ſemi-vibration, and *vice verſâ* in each half of the returning vibration.

2dly. The velocities acquired by the uniform action of gravity at the points I K and $i\ k$, will be reſpectively proportional to the ordinates I P, K Q, and $i\ p$, $k\ q$, of the ſemi-circle H L h; hence the velocity of the pendulum at the loweſt point D, is to its velocity at any other point of the arc I, as D L (= D H, or whole ſemi-arc) is to I P.

3dly. The times of the pendulums vibrating through the portions H I, I K, K D, &c. of its arc, will be repreſented by, and proportional to their correſponding arcs H P, P Q, Q L, &c. reſpectively in the ſemi-circle H L h; which proportions will be equally applicable in the aſcending portions of the arc D k, $k\ i$, and $i\ h$, which will alſo be moved through in times proportional to the arcs L q, $q\ p$, and $p\ h$, reſpectively; if the pendulum is projected from the loweſt point D with the initial velocity D L, this velocity will be reduced at the point k to $k\ q$, at i to $i\ p$, and at h to nothing, whence the pendulum will return, and the operation of gravity will begin to be reverſed.

4thly. If one pendulum deſcribe the arc repreſented by H D h, and another deſcribe the arc K D k, (ſtill ſuppoſing them to be cycloidal or very nearly ſo,) they will deſcribe them in equal times, but their velocities at D, or greateſt velocities, will be reſpectively proportional to H D and K D, or length of their ſemi-arcs; that is, while a pendulum, projected with the initial velocity D L, from the loweſt point, aſcends to the point h, or extremity of its ſemi-vibration, another ſimilar pendulum, projected with the initial velocity R D, will aſcend to the point k, or extremity of its arc, D R being = D k, and the ſame will be true in the deſcent, where the increments of motion exactly balance the aſcending decrements.

5thly. The areas M H I N, M H K O, &c. are proportional to the ſquares of the velocities acquired in moving down the arcs H I, H K, &c. or to the diminution of the ſquares of the velocities effected by the retardation of gravity in the returning or aſcending ſemi-vibration.

From a due examination of the relations exhibited in the preceding illuſtration of the principles of a pendulum's motion, the reader will readily perceive that there is a certain length of the arc of every vibration, whether performed in a circle or cycloidal curve, which correſponds to its maximum of velocity, or velocity at the loweſt point; which length, in large circular arcs, is determined by the greateſt chord line, but in cycloidal curves, or *ſmall* circular arcs, is the whole arc itſelf: he will alſo underſtand how, when the weight of a pendulum is given, its accelerating action in any given point of the arc may be appreciated; from which and ſimilar conſiderations he will be able to form ſomething like an eſtimate of the effect that will be produced in the above natural relations by the application of an external force of an aſcertained quantity, acting in a given manner: for inſtance, let us ſuppoſe that a maintaining power is applied to keep up the vibrations of a pendulum, as in our laſt figure; that the quantum of power to be added to gravity be to its accelerating force at H or h, as $h\ m$ is to $m\ r$, which we will ſuppoſe to be a number of grains to ſome number of ounces; and that this additional

power

power is applied through the agency of an escapement, which so modifies it, that its action is exerted but a short time, and at the extremity of the arc: the rough conjecture which the reader would be apt to form would be, that as the two forces began to act in concert, a pendulum actuated by them would obey a compound scale of forces, differing in quantity but not in quality from the simple scale of gravity, and that therefore little or no alteration would take place in the time of its vibration; let us see what would be the result according to our theory; from the point *m* of the line *h m*, of the greatest acceleration or retardation, as the case may be, set off *m r* equal to its representative, for so many grains of augmenting or retarding force, and then *h r* will be the whole force urging the pendulum towards D: do the same for every point of *h* D, and we get a new scale of forces represented by the dotted line *r s t* D, and the space *m* D *r*, contained between the two scales D *m* and D *r*, will represent the addition made to the square of the velocity in moving over *h* D by the joint action of gravity and of the maintaining power. Then if we make the area D *u v* equal to the area D *h m*, by leaving out as much space parallel to the perpendicular *h m*, as we take in beyond the hypothenuse *m* D, the point *u* will limit the excursion or extent of the returning, as well as of every succeeding vibration, because the area of the triangle D *u v* is proportional to the square of the velocity, and *u* is therefore the point where the initial velocity D L will be extinguished. Lastly, if the arc *h w* of the semi-circle be bisected, its half will very nearly represent the contraction effected in the time of the outward semi-vibration, agreeably both to theory and practice; and in a similar manner might be estimated the effect to be produced on a natural vibration, or vibration from simple gravity, by any accession of external force differently applied: in the instance we have given, a temporary impulsion would evidently make a greater derangement when given at the extremity of the arc, than if it had been given at I, and greater at I than at K, and consequently the least derangement would have arisen if the impulsion had been given at the lowest point D, which is worthy of recollection; though the fact is, that most of the escapements, that are not of the detached kind, continue to act for a sensible time, and, after all, the thing principally aimed at in modern practice is, to construct all the parts of an horological machine so, that the arc of vibration may vary as little as possible under the different influences that affect the pendulum's motion; for then, whatever the length of the arc be, whilst there is no variation in it, the vibrations will be isochronal, whatever be the nature of the curve; but completely to effect so desirable a purpose can hardly be expected under all the combinations of variable resistances arising from friction, oil, air, &c., however detached the escapements may be, *i.e.* however small the continuance of each of their impulsions. Hence, certain ingenious artists have attempted such a compound scale of forces, consisting of gravity and maintaining power conjointly, as shall render even circular vibrations of different lengths isochronal among themselves, when they shall happen to vary in length, which plan would certainly make the best compensation for the effects of variable resistances, if such plan could be completely executed at pleasure; and the compound scale of forces to do this, must be to the scale of gravity alone, as the *arc* of semi-vibration is to the *sine* of the same in every point of the excursions. For in *fig.* 1, if B F be supposed equal to the semi-arc B D, then B E, the whole compound force at the point B, will be greater than C B or force of gravity alone, and will be to it, by similar triangles, as B F (= B D) is to the sine A B, as has been demonstrated; therefore the whole compound force at any point B of either semi-vibration should be to the force of gravity alone in that point, as the arc D B is to the sine A B, which compound scale consequently will demand a certain limited variation, or scale, in the auxiliary force derived from the maintaining power through the modifying medium of the escapement.

2. When a balance was first applied as a regulating power, it possessed no natural property, like the pendulum, of perpetuating its own oscillations, but had its motion produced by an artificial force acting alternately on its opposite pallets, and derived entirely from the maintaining power at certain intervals; so that to perform all the oscillations in equal times, the action of the force applied was required to be the same in mode, quantity, and duration, in each oscillation, which conditions could not be fulfilled by reason of the constant changes that took place in the friction of the works, and in the density and consequent resistance of the air; a simple balance therefore was no otherwise better than a continued fly, except that its alternate oscillations prevented the acceleration of motion that would ensue, if there were no such frequent checks as the balance experiences at each alternate impulse of the pallets. Dr. Hooke's invention of a regulating spring, to be to the natural balance what gravity is to a pendulum, was an important one, to which all the excellence of an ordinary watch may have its origin imputed, and without which the compensations for different temperatures in the best chronometers would not be of any utility. The discovery of a *spring's force* being *as its tension*, or distance moved from the point of rest, *(ut tensio sic vis,)* was the first step towards a theory of motion by which the balance and its regulating spring, taken conjointly, may have their effect estimated, and by which such a balance with the best compensation and escapement now vies in accuracy even with the pendulum itself.—George Atwood, esq. of Cambridge, has published an excellent memoir in the Philosophical Transactions of London, vol. 84, part i. 1794, intitled "Investigations founded on the Theory of motion, for determining the times of Vibration of Watch Balances," from which we beg leave to extract so much as falls within our purpose in this place.

"Let P M N S, *fig.* 3. of our last plate, represent the circumference of a watch balance, which vibrates by the action of a spiral (or helical) spring, on an axis passing through the centre C. Let O D B E be the circumference of a concentric circle, considered as fixed, to which the motion of the balance may be referred. In the circumference of this circle let any point O be assumed, and when the balance is in its quiescent position, suppose a line to be drawn through C and O, intersecting the circumference of the balance in the point A; the radius C A will be an index, by which the position of the balance, and its motion through any different arcs of vibration, will be truly defined. In the sequel, the motion of the balance, and the motion of the index C A, will be used indifferently, as terms conveying the same meaning. Since the balance is in its quiescent position when the index C A is directed to the fixed point O, on this account O is called the point of quiescence of the balance, or balance spring, indicating the position when the balance is not impelled by the spring's elastic force either in one direction or the other. If the balance should be turned through any angle O C B, the spiral spring being wound through the same angle, endeavours by its elastic force to restore itself, and when at liberty, impels the balance through the arc B O with an accelerated velocity, till it arrives at the position O, where the force of acceleration ceases; with the velo-

city

-city acquired at O, the balance proceeds in its vibration, defcribing the arc O E with a retarded motion. The elaftic forces of the fpring at equal diftances, on the oppofite fides of the point O, are affumed to be equal; it is alfo affumed that the effects of friction, and other irregular refiftances, which retard the motion of the balance, are compenfated by the maintaining power, fo that the time of defcribing the firft arc of vibration B O, by an accelerated motion, fhall be equal to the time of defcribing the latter arc O E, by a retarded motion, and that the entire arc of vibration B O E is bifected by the point O.

To render the conftruction of *fig.* 3. more diftinct, the fixed circle O D B E is reprefented to be at a fmall diftance from the circumference of the balance, but is to be confidered as coincident with it, fo that the arc B O, fubtending the angle B C O, may be of the fame length with an arc of the circumference of the balance, which fubtends the fame angle B C O: on this principle C O or C A may be taken indifferently as the radius of the balance.

The determination of the time in which the balance vibrates, from the theory of motion, requires the following particulars to be known, *viz.*

Firft. The fpring's elaftic force, which impels the circumference of the balance, when it is at a given angular diftance O D, (*fig.* 3.) from the quiefcent point O:

Secondly. The law or ratio obferved in the variation of the fpring's force, while the balance is impelled from the extremity of the femi-arc B, to the point of quiefcence O, where all acceleration ceafes.

Thirdly. The weight of the balance, including the parts which vibrate with it.

Fourthly. The radius of the balance C O, and the diftance of the centre of gyration from the axis of motion C G.

Fifthly. The length of the femi-arc B O.

Suppofe the plane of the balance to be placed vertically, and let a weight P, (*fig.* 4.) be applied by means of a line fufpended freely from the circumference at T, to counterpoife the elaftic force of the fpring when the balance is wound through an angle from quiefcence O C D. This weight P (the weight of the line being allowed for,) will be the force of the fpiral (or other) fpring, which impels the circumference of the balance, either at reft or in motion, when at the angular diftance O D from the quiefcent pofition. It appears from many experiments (of Berthoud) that the weights neceffary to counterpoife a fmall fpring's elaftic force, when the balance is wound to the feveral diftances from the quiefcent point, reprefented by the arcs O G, O H, O I, &c. *fig.* 4, are nearly in the ratio of thofe feveral arcs. It alfo appears, that the fhape, the length, and number of turns of the fpiral, may be fo adjufted to each other, that the forces of elafticity fhall be counterpoifed by weights, which are in the precife ratio of the angular diftances from the quiefcent pofition, or, as it is fometimes expreffed, in the ratio of the fpring's tenfions; at leaft as nearly as can be afcertained by experiment: this law of elaftic force is affumed in the fubfequent inveftigation.

The pofition of the centre of gyration may be always determined when the figure of the vibrating body is regular, by calculating the fum of the products, which arife from multiplying each particle into the fquare of its diftance from the axis of motion, and dividing the fum by the weight of the vibrating body; the fquare root of the refult will be the diftance of the centre of gyration from the axis of motion. When the figure of a vibrating body is irregular, recourfe muft be had to experimental methods, in order to determine the pofition of the centre of gyration. See Atwood's treatife "On the Rectilinear Motion and Rotation of Bodies."

Let the radius of the balance C A or C O $= r$, *fig.* 3, the femi-arc B O $= b$; let the fpring's elaftic force, acting on the circumference of the balance, when wound to any given angle O C D, from the quiefcent pofition, be P, and let the arc O D $= a$; the weight of the balance and the parts which vibrate with it $=$ W; the diftance of the centre of gyration from the axis of motion C G $= g$. Thefe notations being premifed, the refiftance of inertia, by which the mafs contained in the balance oppofes the communication of motion to the circumference, is $\frac{Wg^2}{r^2}$, and confequently the force which accelerates the circumference at the angular diftance O C D from the quiefcent pofition is $\frac{Pr^2}{Wg^2}$. This quantity remaining invariably the fame, while the balance defcribes the arc of vibration B O E, may be denoted by the letter F, fo that $F = \frac{Pr^2}{Wg^2}$; fuppofe the radius C A commencing a vibration from the point B to have defcribed the arc B H, and let O H $= x$, fince the force which accelerates the circumference at the angular diftance from quiefcence O D $=$ F, and the forces of acceleration are fuppofed to vary in the proportion of the angular diftances from the quiefcent point O, the force which accelerates the circumference of the balance at the point H will be $= \frac{Fx}{a}$; let u be the fpace through which a body falls freely from reft by the acceleration of gravity, to acquire the velocity of the circumference at the point H; the principles of acceleration give this equation $\dot{u} = \frac{-Fx\dot{x}}{a}$; (Newtonii Princip. vol. i. prop. xxxix.) and taking the fluents while x decreafes from b to x, $u = \frac{F \times \overline{b^2 - x^2}}{2a}$: if therefore l is made $=$ 193 inches, being the fpace which bodies falling freely from reft by the force of gravity near the earth's furface defcribe in one fecond of time, the velocity of the circumference, when the extremity A of the index C A has arrived at the point H, will be $= \sqrt{\frac{2lF}{a}} \times \sqrt{b^2 - x^2}$. Let t reprefent the time in which the circumference defcribes the arc B H; then will $\dot{t} = \sqrt{\frac{a}{2lF}} \times \frac{-\dot{x}}{\sqrt{b^2 - x^2}}$; and $t = \sqrt{\frac{a}{2lF}} \times$ a circular arc, of which the cofine $= \frac{x}{b}$ to radius $= 1$, which is the time of defcribing the arc B H expreffed in parts of a fecond; when $x = o$, that is, when the circumference has defcribed the entire femi-arc B O, the circular arc of which the cofine $= \frac{x}{b}$ is a quadrant of a circle to radius $= 1$. Let $p = 3.14159$, &c. the time t of defcribing the femi-arc $BO = \sqrt{\frac{a}{2lF}} \times \frac{p}{2} = \sqrt{\frac{p^2 a}{8lF}}$.

In this expreffion for the time of a femi-vibration, the letter a denotes the length of the arc O D (*fig.* 3.); if this arc fhould be expreffed by a number of degrees $c°$, a will then $= \frac{prc°}{180°}$; and this quantity being fubftituted for

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a, the time of a ſemi-vibration will be $t = \sqrt{\frac{p^3 r c^\circ}{8\,l\,F \times 180^\circ}}$; if inſtead of F, its value $\frac{P r^2}{W g^2}$ is ſubſtituted in the equation $t = \sqrt{\frac{p^3 r c^\circ}{8\,l\,F \times 180^\circ}}$, the time of a ſemi-vibration will be $t = \sqrt{\frac{W p^3 g^2 c^\circ}{8 P r l \times 180^\circ}}$.

Let the given arc c° be $= 90^\circ$; in this caſe $t = \sqrt{\frac{W p^3 g^2}{16\, P r l}}$. Theſe are expreſſions for the time of a ſemi-vibration, whatever may be the figure of the balance, the other conditions remaining the ſame as they have been above ſtated. If the balance ſhould be a cylindrical plate, it is known that the diſtance of the centre of gyration from the axis is to the radius as 1 to $\sqrt{2}$; wherefore in this caſe $g^2 = \frac{r^2}{2}$; and the time of a ſemi-vibration, or $t = \sqrt{\frac{W p^3 r}{32\, P\, l}}$."

Agreeably to this expreſſion, Mr. Atwood wiſhed to try the practical reſults of a chronometer made by Kendal, to prove how far his theory agrees with practice, and aſſuming the centre of gyration to be the ſame as if the balance were a cylindrical plate, he obtained from Mr. Earnſhaw the following data, *viz.*

W, the weight of the balance and vibrating parts $= 42$ grains.

P, the force at the circumference of the balance, which counterpoiſes the force of the ſpring when wound to the diſtance of $90^\circ = 24$ grains.

r, the radius of the balance $= 1.125$ inches.

l, the ſpace deſcribed in one ſecond of time by bodies which deſcend freely from reſt by the acceleration of gravity $= 193$ inches.

p, the circumference of a circle to radius $1 = 3.14159$, &c.

The balance, when adjuſted to mean time, made juſt five vibrations in a ſecond; the actual time of a ſemi-vibration is therefore 0.1000.

Then t, the time of a ſemi-vibration by the theory, will be $= \sqrt{\frac{42 \times 3.14159^3 \times 1.125}{32 \times 24 \times 193}} = 0.0994$ parts of a ſecond; hence $(0.1000 - 0.0994) = 0.0006$ is the difference between the actual time and the time by calculation from the theory; and the near coincidence of the two reſults proves that the ſuppoſition of the centre of gyration being nearly as in a cylindrical plate, is near the truth.

"It is obſervable," ſays our author, "that the ſemi-arc of vibration B O $= b$, does not enter into theſe expreſſions for the time of a ſemi-vibration; if, therefore, inſtead of the ſemi-arc B O, an arc of any other length L O, terminating in the point of quieſcence, (*fig.* 3.) ſhould be ſubſtituted in the preceding inveſtigation, the time of deſcribing L O would be ſtill $= \sqrt{\frac{a p^2}{8\, l\, F}}$, or, $\sqrt{\frac{p^3 r c^\circ}{8\, l\, F \times 180^\circ}}$, equal to the time of deſcribing the other ſemi-arc B O; conſequently, whether the balance vibrates in the largeſt or ſmalleſt arcs, the times of vibration will be the ſame. From the preceding inveſtigations it appears, continues our author, that when the force by which the circumference of the balance is accelerated at the given angular diſtance c° from the quieſcent poſition is $=$ F, the time of a ſemi-vibration $t = \sqrt{\frac{p^3 r c^\circ}{8\, l\, F \times 180^\circ}}$; and converſely, when the time of a ſemi-vibration is $= t$, the force which accelerates the circumference at the given angular diſtance c° from the quieſcent poſition, that is, $F = \sqrt{\frac{p^3 r c^\circ}{8\, l\, t^2 \times 180^\circ}}$.

"Since time-keepers are uſually adjuſted to mean time when the balance makes five vibrations in a ſecond, the time of a ſemi-vibration will, in this caſe, be $= \frac{1}{10}$th part of a ſecond; the ſubſtitution of $\frac{1}{10}$th for t being made in the preceding equation, the force which accelerates the circumference of the balance, when at any given angular diſtance c° from the quieſcent poſition, will be determined for all time-keepers adjuſted to mean time, in which the balances make five vibrations in a ſecond. Suppoſe the given angle $c^\circ = 90^\circ$, then making $c^\circ = 90^\circ$, $p = 3.14159$, &c. $l = 193$, $t = \frac{1}{10}$, the accelerative force at the angular diſtance from quieſcence 90° or $F = \frac{p^3 r\, 90^\circ}{8\, l\, t^2 \times 180^\circ} = r \times 1.00408926$. We have therefore arrived at the following concluſion; if the radius of the balance is equal to one inch, and the time-keeper is adjuſted to mean time when the balance makes juſt five vibrations in a ſecond, the force which accelerates the circumference of the balance at the diſtance of 90° from the quieſcent poſition is $= 1.00408926$, the accelerative force of gravity being $= 1$. And if the radius of the balance is greater or leſs than one inch, the force by which the circumference is accelerated at the diſtance of 90° from quieſcence will be greater or leſs than 1.00408926 in proportion to the radii.

"According to the principles aſſumed in the preceding ſolution, the ſpring's elaſtic force is ſuppoſed to vary in the proportion of the angular diſtances from the quieſcent poſition, and on this condition the vibrations are ſhewn to be iſochronous, whether they are performed in longer or ſhorter arcs; but if the ſpring's elaſtic force at different diſtances from quieſcence ſhould not be preciſely in the ratio here aſſumed, the longer and ſhorter arcs may be deſcribed in times differing in any proportions of inequality. If, for inſtance, the ſpring's force, inſtead of varying in the ratio of the aforeſaid diſtances, ſhould vary in the $\frac{999}{1000}$dth power or $\frac{1001}{1000}$dth power of the diſtances, it does not appear from the preceding ſolution what alteration in the daily rate would be cauſed by this change in the law of the force's variation, when the ſemi-arc of vibration is increaſed or diminiſhed by a given arc. To aſcertain this point fully, other reſearches will be neceſſary, by which it may be known, what alteration of the daily rate of a time-keeper is occaſioned by a given increaſe or diminution of the arc of vibration, when the ſpring's elaſtic force varies in a ratio of the diſtances from the quieſcent poſition, the general index or exponent of which is any number or fraction n.

"The force which accelerates the balance being aſſumed in that power of the diſtances, the exponent of which is n, let B O $= b$, (*fig.* 5.) be the ſemi-arc of vibration when the time-keeper is adjuſted to mean time; let D O $= a$; the accelerating force on the circumference at the diſtance from quieſcence O D $=$ F; ſuppoſe the circumference to have deſcribed the arc B H from the extremity of the arc B; and let H O $= x$: then the force by which the circumference is accelerated when at the angular diſtance from the quieſcent poſition O H $= \frac{F x^n}{a^n}$; let u be the ſpace through which a body falls freely from reſt by the acceleration of gravity, to acquire the velocity of the circumference when it has deſcribed the arc B H; the principles of acceleration gave this equation $\dot{u} = \frac{-F x^n \dot{x}}{a^n}$: taking the flu-

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ents while x decreafes from b to x, $u = \frac{Fb^{n+1} - Fx^{n+1}}{\overline{n+1} \times a^n}$, and l being 193 inches, the velocity acquired by the circumference, after defcribing B H, will be $= \sqrt{\frac{4lF}{\overline{n+1} \times a^n}} \times \sqrt{b^{n+1} - x^{n+1}}$; let T be the time of defcribing the arc BH; wherefore $\dot{T} = \sqrt{\frac{\overline{n+1} \times a^n}{4lF}} \times \frac{-\dot{x}}{\sqrt{b^{n+1} - x^{n+1}}}$. The time of defcribing the arc B H will be the fluent of this fluxion, while x decreafes from b to x, and the time of defcribing the femi-arc B O will be the entire fluent of $\sqrt{\frac{\overline{n+1} \times a^n}{4lF}} \times \frac{-\dot{x}}{\sqrt{b^{n+1} - x^{n+1}}}$, while x decreafes from b to o. Now let the balance commence its vibration from any other point I, (*fig.* 5.) and let $IO = c$; fuppofe the circumference to have defcribed the arc I K, and make $OK = y$; let t be the time of defcribing the arc I K; then by proceeding in the fame manner as in the former cafe, it is found that $\dot{t} = \sqrt{\frac{\overline{n+1} \times a^n}{4lF}} \times \frac{-\dot{y}}{\sqrt{c^{n+1} - y^{n+1}}}$; and the time of defcribing the femi-arc I O will be the entire fluent of this fluxion, while y decreafes from c to o. Although the fluents of the fluxions $\frac{-\dot{x}}{\sqrt{b^{n+1} - x^{n+1}}}$, and $\frac{-\dot{y}}{\sqrt{c^{n+1} - y^{n+1}}}$, cannot be expreffed in general terms, yet the exact proportion of the faid fluents may be affigned, which will be the proportion of the times in which the balance vibrates in the two femi-arcs B O, I O; the multiplying quantity $\frac{\sqrt{\overline{n+1} \times a^n}}{4lF}$ being common to both fluxions; and fince the entire fluent of $\frac{-\dot{x}}{\sqrt{b^{n+1} - x^{n+1}}}$ is to the entire fluent of $\frac{-\dot{y}}{\sqrt{c^{n+1} - y^{n+1}}}$ as $b^{\frac{1-n}{2}}$ is to $c^{\frac{1-n}{2}}$, it follows that the time of a femi-vibration in the arc B O is to the time of a femi-vibration in the arc I O as $b^{\frac{1-n}{2}}$ to $c^{\frac{1-n}{2}}$, or as 1 to $\left(\frac{IO}{BO}\right)^{\frac{1-n}{2}}$.

Suppofe a watch to be adjufted to mean time when the femi-arc of the balance's vibration is $=$ B O, (*fig.* 5.) and let this femi-arc be afterwards diminifhed to I O; the time fhewn by the watch in any given portion of mean time t, when the femi-arc of vibration is I O, will be $= t \times \left(\frac{BO}{IO}\right)^{\frac{1-n}{2}}$; and if t is put $= 24^h$, the alteration of the daily rate, in confequence of the diminution of the femi-arc of vibration from BO to IO, will be $24^h \times \overline{\left(\frac{BO}{IO}\right)^{\frac{1-n}{2}} - 1}$. To apply this propofition, let a cafe be affumed; fuppofe a watch to be regulated to mean time, when the femi-arc of vibration is 135°, and let this femi-arc be diminifhed 8°, fo as to become 127°; let the ratio of the fpring's elaftic force deviate from that of the diftances from the quiefcent pofition by a fmall difference of $\frac{1}{1000}$dth power of the diftances, inftead of in the entire ratio of the faid diftances from the quiefcent pofition. The alteration in the daily rate of the watch will be obtained from the preceding theorem, by making the following fubftitutions; $BO = 135°$, $IO = 127°$, $n = \frac{999}{1000}$, the alteration of the daily rate $= 24^h \times \left(\frac{135}{127}\right)^{\frac{1}{2000}} - 1 = + 2''.62.$"

From this theory of the balance and balance fpring it is evident, that when there is a very minute alteration in the law of the force's variation, amounting to no more than $\frac{1}{1000}$dth part of the entire ratio of the diftances, an acceleration is caufed in the daily rate of more than $2\frac{1}{2}''$, when the diminution of the femi-arc is only 8°, and as this alteration in the force is lefs, probably, than can be detected by actual meafurement of the force by mechanical means, it is very probable that a much greater acceleration or retardation of the rate, than in the example before us, may occur from the fame caufe, which can only be corrected by a correfponding alteration either in the length or ftrength of the balance fpring, or both, as the cafe may require, and the beft way of detecting the law of force by which the fpring acts at different diftances from the quiefcent pofition, is by increafing or diminifhing the maintaining power, fo as to render the arc of vibration unequal in fucceffive trials for a limited time. The neceffary conclufion, from fuch trials with different maintaining powers, will be, that when an acceleration of the daily rate accompanies a diminution of the arc of vibration, the elaftic force of the fpring ufed varies in a lefs ratio than that of the diftances from the quiefcent pofition; but on the contrary, when a retardation takes place under the fame circumftances, the faid elaftic force varies in a higher ratio than that of the diftances from the point of quiefcence. We here fuppofe the fame efcapement to be ufed in all the trials, and that the impulfe given to the balance is no more than fufficient to overcome the inertia of the balance and the refiftance it meets with from friction and the denfity of the air; but as there is generally an overplus of power communicated to the balance to guard againft ftopping by the acceffion of dirt or thickening of the oil, this fuperfluous power has fuch an influence on the balance and its fpring when in motion, as to produce a compound law of varying forces, fomewhat different from the fimple law derived folely from the elafticity of the fpring, and the more this compound law varies from the fimple law derived from the fpring's elafticity, the greater will be the difcrepancy between the theory and performance of a watch balance. The bufinefs of a good efcapement of a watch or balance clock is to keep the balance in continual motion with as little interference as poffible with the fimple law of its natural varying forces, which it has been fhewn are in proportion to the diftances from the point of quiefcence.

After thefe remarks on the laws by which a pendulum and a balance together with its fpring become the regulators of an horological machine, the reader will be able to form an opinion, founded on fcientific principles, on the merits or demerits of the different efcapements that are fucceffively defcribed, not only in this article, but in the articles CHRONOMETER and CLOCK, which have been already publifhed.

Henry Sully, who was an ingenious clock and watch maker about the beginning of the 18th century, wrote a hiftory of the efcapements of his time down to the year 1727, which Julien le Roy added to Sully's "Regle Artificielle du Temps," in the fecond edition, publifhed at Paris, 1737, from which Berthoud has extracted his account of feveral efcapements in his "Hiftoire de la Mefure du Temps," and which we mean to avail ourfelves of in a certain degree in our fubjoined defcriptions.

The

The different efcapements of clocks and watches may be divided into four claffes; *viz;*

1. Thofe with a *recoil*, or which produce a backward motion of the efcapement wheel and fecond's hand in fome parts of the vibration; (echappement a recul.)

2dly. Thofe that have the *dead-beat*, or that allow the efcapement wheel and hand to reft while the whole vibration is made; (echappement a repos.)

3dly. *Detached*, or *free* efcapements, which act on the balance or pendulum an almoft infenfible time, and fuffer the vibration to be performed almoft without connection with the pallets; (echappement a vibrations libres.)

4thly. *Detached*, or *free* efcapements with a *remontoir*, or auxiliary fpring frequently wound up by the maintaining power, to equalife the arcs of vibration; (echappement a vibrations libres et a remontoir d'égalité d'arcs.)

The moft ancient efcapement in ufe at this time, and probably the firft that was ever contrived, is the *crown-wheel efcapement* at prefent employed in our table-clocks and common watches; we know not who was the original inventor, but find mention made of it by Leonard de Vinci, who died in the year 1513; and Venturi thinks that the horological machines of Wallingford and Dondi, early in the fourteenth century, had the fame, as we have feen, under our article Clock, that Henry de Wyck's clock had in the year 1364. The idea of converting a rotatory into a vibratory motion, and the means adapted to effect this purpofe mechanically are equally ingenious; as an effort of genius this thought is much to be admired. We have already given a general defcription of the connection that the efcapement-wheel has with a train of wheel-work on one fide of it, and with the balance on the other, under our article juft referred to, but as the balance had no rim, and was without the *regulating*, or, as it is fometimes called, the *pendulum fpring*, we think it right to give a feparate drawing and defcription of this efcapement, as made at prefent, together with fome remarks on its properties.

1. *Crown-wheel efcapement.*—In *Plate* XXXI. of *Horology*, *fig.* 6. reprefents the crown-wheel and balance in connection, which may be in either a horizontal or vertical pofition, and is in fact fometimes in one pofition and fometimes in the other in a common watch agreeably to the different pofitions of the body of the wearer; and it is eafy to conceive that a fhort pendulum might be fubftituted for the balance when the crown-wheel moves horizontally in a fixed pofition, and the axis of the balance is placed horizontally, which is the cafe in moft of the portable clocks. The name of crown-wheel is taken, no doubt, from the refemblance it has to an old fafhioned *royal diadem;* but when applied to a watch it is frequently called fimply the *balance-wheel*, from its connection with the *balance:* this wheel and the balance, including the pallets and regulating fpring, may be confidered as conftituting the *efcapement*, the action of all which may be underftood from the following fhort account.

Suppofe the pinion *a*, on the arbor *a b* of the balance-wheel or crown wheel *c d*, to be actuated by the main-fpring, or weight which forms the maintaining power, by means of the train, in the direction *c f d e*, while the pallets *e* and *f*, attached to the axis of the balance *g h*, and ftanding at right angles to each other, or very nearly fo, are long enough to fall in the way of the ends of the floped teeth of the wheel, when turned round an angle of 45°, fo as to point in oppofite directions, as in the figure; then a tooth of the wheel below, for inftance, meets with the pallet *f*, fuppofed to be at reft, and drives it before it a certain fpace, till the end of the tooth *efcapes;* in the mean time the balance attached to the axis of the pallets moves in the direction *h k g*, and winds up the fmall fpiral fpring *i*, one end of which is faft to the axis and the other to a ftud on the plate of the frame, in this operation the fpring oppofes the momentum given to the balance by this pufh of the pallet *f*, and prevents the balance from going quite round before the pallet *e* meets with another tooth at the oppofite end of the wheel's diameter; here this pallet receives a pufh which carries the balance back again, having as yet but fmall momentum, in the direction *h l g*, and aids the fpring, which now unbends itfelf till it comes to its quiefcent pofition, but beyond that point is unwound, partly by the pufh from the maintaining power on the pallet *e*, and partly by the acquired momentum of the moving balance, particularly when this pallet has efcaped; at length pallet *f* again meets with the fucceeding tooth, and is carried *backward* by it, in the direction the balance is now moving in, till the maintaining power and force of the unwound fpring together overcome the momentum of the balance; during which time the *recoil* of the fecond's hand is apparent, when put on the pivot of the arbor *a b*; at length the wheel brings the pallet *f* back again till it efcapes, and the fame procefs takes place with pallet *e* that has been defcribed with refpect to pallet *f*, and thus two contrary excurfions, or ofcillations of the balance, take place before one tooth has completely efcaped, which is the reafon why there muft be always an odd number of teeth in this wheel, that a fpace at one fide of the wheel may always be oppofite to a tooth at the other, in order that one pallet may be out of action while the other is in action. The fame account will apply to the vibrations of a fhort pendulum fubftituted for the balance, when this efcapement is ufed. This efcapement, which is of the firft clafs, is evidently calculated to derange the natural law of the fpring's varying force, which, we have feen, is in theory in proportion to the diftances from the quiefcent pofition; for as the action of the maintaining power continues to prefs on the pallets, either with or againft the balance's motion, during a large portion of each vibration, this extraneous force acting along with the elaftic force of the fpring makes a new law compounded of the two forces, which may or may not be a regular law, as modified by circumftances, that are to be taken into confideration; for inftance, the relative forces of the maintaining power and of the regulating fpring, the uniformity of each force feparately confidered, the ratio between the radius of the pallet-wheel and length of the pallets, the weight and diameter of the balance, the angle of action in the efcapement relatively to the whole arc of vibration, the adjuftment of the length and ftrength of the fpring for ifochronifm, and of its quiefcent place to the pofition of the pallets, together with the friction and inertia of the acting parts, as well as refiftance of the air to the moving balance muft all enter into the account, which complex data render all calculations founded in theory very inadequate to their purpofe of determining the practical refults independently of experimental trials, which are neceffarily adopted by the workmen in finifhing the adjuftments. The bad effect of an almoft conftant force on the balance, as derived from the maintaining power, is evident by the application of the key to the fufee-arbor of a watch, and by urging it in a direction contrary to that of winding up, for the additional force thus given to the maintaining power, will very fenfibly accelerate the beats of the watch, and leffen the arc of vibration; hence any inequality occafioned in the maintaining power, by the acceffion of dirt, or by want of perfect compenfation in the fufee of the varying force of the main-fpring, &c. will alter the daily rate very materially, though the me-

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chanical adjuftments at the balance may, in the firft inftance, have produced jointly a law of varying forces in the regulating mechanifm that fhall approximate near enough to the ifochronous law of the balance fpring, while the arcs of vibration remain unaltered. It is of the utmoft importance, therefore, when a crown-wheel efcapement is ufed in any watch, that, whenever a new main-fpring is put in, the fufee fhould alfo be altered, fo as to become as perfect a compenfator as poffible for that *identical fpring*, which, we believe, is feldom, if ever, attended to in practice. This efcapement ufually has a pin in the rim of the balance that may catch a notch on each fide of the cock beyond the extremities of the longeft vibrations, called the *banking*, to prevent the derangement of the balance and of its regulating fpring by any fhake or accident.

2. *Efcapement à pirouette by Huygens.*—About the year 1675, when Huygens was contriving the beft conftruction he could devife of a marine time-piece, he naturally dwelt upon the portability of the balance, as affording the likelieft plan of accomplifhing his purpofe, but he was aware that the balance vibrating in fhort arcs was not comparable in point of fteadinefs to a pendulum, as a regulating principle, feeing it is too much under the controul of the maintaining power, when ufed with the crown-wheel efcapement, the only one at that time known. The balance under fuch ftrong influence, and that a variable influence, had the property of putting itfelf into motion when in a ftate of reft: Huygens, therefore, made fuch additions to the balance and efcapement then in ufe, as produced much longer vibrations than had been before witneffed, and introduced an additional wheel and pinion between the pallet-wheel and the balance to effect this object; thus, in *fig.* 7. of our laft plate, is a fide view of a fmall frame containing the mechanifm of Huygens' efcapement, confifting of two wheels, one pinion, a pair of pallets, and a balance with the fpiral fpring, together with the requifite cocks to bear the pivots of the arbors; *a b* is the crown-wheel or pallet-wheel of the ufual fhape and number of teeth, placed in a vertical pofition, like the contrate wheel of a common watch or table clock; *c d* is a contrate wheel placed horizontally, like the pallet-wheel of a common watch, having two pallets *e*, *f*, as ufual on its arbor, at right angles to each other, and acting exactly as we have explained above; the contrate wheel *c d* drives a pinion *g* on the axis of the balance *h*, under which, as ufual, is the fpiral fpring *i*; the action of this efcapement differs from that of its predeceffor only, inafmuch as the contrate wheel impels the pinion feveral times round at each impulfe of one of the pallets, thereby occafioning feveral revolutions of the balance itfelf at each ofcillation; and Sully fays, that when the fpring is not ufed he has feen the ofcillations performed in the fpace of two feconds, and with a fpring in one, in imitation of a feconds' pendulum clock, to which this efcapement is not applicable. The influence, however, of the maintaining power muft have been exerted on the balance in this conftruction alfo, during at leaft one of its revolutions, and the extraneous force interfering with the law of the fpring's varying forces would produce a compound fcale of forces, in which, as in the former inftance, one would be nearly conftant while it acted, and the other varying; befides, the friction in the teeth of the wheel and pinion, however well executed of the refpective fizes and fhapes, would produce checks that would be unfavourable to the fteady ofcillations of the balance, we therefore are not furprifed to find that this efcapement, which was of the firft clafs, was foon difcontinued.

3. *Efcapement with two balances by Dr. Hooke, and by Du Tertre.*—Dr. Hooke, fays Sully, produced a balance in the year 1675, which he had invented in 1658, with two balances engaging each other by means of teeth cut in their edges, and one of them having a fpiral fpring on its verge or axis; but Berthoud attributes the invention of this efcapement with two balances, without the fpring, to a German artift on the authority of Thiout (Traité d'Horlogerie de Thiout) where there is a drawing of the efcapement in queftion; J. B. Du Tertre afterwards made fome additions, which we have given in *fig.* 8. of *Plate* XXXI., and of which the following is a defcription, *viz.*; A and B are two balances acting together, like wheels with equal numbers of teeth, and having on one of the croffes of each a pallet, at *a* and *b* refpectively; at equal diftances from the axes of thefe balances is the arbor of the laft wheel of the train, bearing two ftars with each five radii, one numbered 1, 2, 3, &c. which is fmaller than the other, lying the lower in pofition, and the other marked *d e f*, &c. with radii long enough to reach almoft to the centres of motion of the balances, which they can pafs only when the femi-circular parts that are cut away are prefented to them; but at other times they reft againft the central femi-circular pieces that remain uncut: the radii of the fmall ftar reach far enough to fall on the pallets *a* and *b* fucceffively, which they impel alternately, and give motion to both balances at the fame time; but the efcape takes place by means of the radii of the large ftar, that reft fucceffively againft the femi-circular portions of metal not cut away, above the centres of the balances refpectively. The three axes ftand in the angles of an ifofceles triangle, and have their upper pivots fupported by three feparate cocks, placed over the upper plate of the frame, the lower pivots of the balances refting on the upper plate, but the arbor of the two ftars paffing acrofs the frame to take the laft wheel. The action is thus; radius 1 of the fmall ftar has parted with the pallet *a* of balance B, and the long radius *d* is efcaping; prefently radius 4 will fall on the pallet *b* of balance A, and impel it in a direction from 4 to 5, the balance B at the fame time moving in a contrary direction; this impulfe will continue till the radius 4 falls from the pallet, foon after which the long radius *g* will fall on the femicircular central piece of balance A, and ftop the further motion of the two ftars, which move together on the fame arbor, and the balances will go on in their vibrations till the fpring under balance B brings them back again, fo as to prefent the cut half of the central piece of balance A to the point *g* of the long radius, which, being impelled by the train, now efcapes; the ftars go on till radius 4 of the fmall ftar meets with the pallet *a* of balance B, the motion of which it now oppofes, and is itfelf brought back, fo as to make a recoil of the hands till it has ftopped the motion of the balances, which now begin each another ofcillation: this radius 4 efcapes the pallet *a*, and the long radius *g* falls on the femi-circular piece, at the centre of balance B, as it did before on that of balance A; the ofcillation continues forward again till the fpring brings it back, when another following radius of the fmall ftar falls again on the pallet *b* of balance A, as before, and drives it; foon after which a fucceeding long radius falls on its femi-circular central piece, and refts till at the return of the ofcillation it can efcape; thus an alternation of ofcillations is produced by the fhort radii acting alternately on the two balances, while the long radii fufpend the impulfes by refting on the femi-circular parts of the centres of the balances, during the latter portion of each excurfion. This efcapement was evidently of the firft clafs, like its predeceffors, and though it avoided the jerk ufually given to one balance by the ftroke of the pallet, yet was fubject to the friction arifing from the action of the teeth, like the preceding

ing one; it had, however, a capability of making the angle of action and angle of the balance's motion before the eſcape in any ratio to each other, by altering the lengths or number of the radii reſpectively, as well as the diſtance of the pallets from the centres of motion; it had alſo the good property of preventing an increaſe in the maintaining power from affecting the balances in the ſame proportion, by the long lever preſſing againſt the ſemi-circular central part of the balances alternately, during the latter part of the excurſion of the balances, ſo as to check any acceſſion of momentum occaſioned by an acceſſion of maintaining power: the law of this preſſure, however, might be modified by changing the figure of the ſemi-circular piece into a ſpiral ſhape, ſo that the preſſure might bear a proportion to the angular diſtances of the balances from the ſpring's quieſcent poſition. The friction in both caſes, it muſt be admitted, would be detrimental to the performance. The banking, we preſume, in this eſcapement, was the ſame as in an ordinary watch, as no remark is made thereon. The invention, it appears, muſt be attributed to three ſucceſſive artiſts; firſt the German, whoever he was, invented the eſcapement without the balance ſpring, and with the ſmall ſtar only, in which ſtate it would act under the controul of the main-ſpring, without the regulating ſpring: ſecondly, the regulating ſpring was added by Dr. Hooke, and, thirdly, the large ſtar was introduced by Jean Baptiſte Du Tertre, about the year 1724, which addition completed the eſcapement as given in our drawing, which in its preſent ſtate will not act without a regulating ſpring. Of courſe this laſt addition followed Tompion's and De Baufre's eſcapements hereafter deſcribed, from which probably the idea of the large ſtar preſſing on the circular part of the axis of motion was derived. Each addition was evidently an improvement on the original German eſcapement as deſcribed by Thiout; but the number of pivots in motion, and the increaſed friction occaſioned by the preſſure of the ſemi-cylindrical pieces at the centres of the balances, were obſtacles too powerful to be overcome in this conſtruction.

4. *Firſt dead beat eſcapement by Tompion.*—The ingenious Tompion of London was probably the firſt watch-maker who contrived an eſcapement without recoil, or eſcapement of the ſecond claſs, called a *dead-beat* eſcapement from the circumſtance of the ſecond's hand remaining motionleſs, or, as it were, dead, during the motion of the balance after the eſcape. Sully ſays that he ſucceeded in effecting this about the year 1695. In this eſcapement, of which *fig.* 7. of *Plate* XXXV. is a plan, the balance verge carried a cylindrical piece of metal *a b c*, terminating with a pallet *c*, with a notch cut between *a* and *c* to allow the eſcape of each ſucceſſive tooth of the balance wheel. This wheel had its plane parallel to the planes of the plates of the frame, and its teeth bent at the end, and ſo diſtant, that the cylindrical piece and pallet could revolve between any two of them. When the cylindrical part of the pallet preſented its notch to a contiguous tooth of the eſcapement wheel, it received a puſh therefrom, which put the balance in motion, and the next ſucceeding tooth falling on the circular or cylindrical portion of the pallet, now in motion in the direction *c b a*, reſted againſt it without recoil till the balance ſpring had brought the notch back again, when it eſcaped in its turn by giving its puſh, and a third tooth fell on the cylindrical part of the pallet, and in like manner remained motionleſs till the notch came back again and allowed the eſcape: thus one eſcape took place at every alternate vibration, and the contrivance was admirably calculated to prevent the bad effect on the balance of any change in the impulſes derived from the main-ſpring; but the friction on the back of the pallets when large, and at the balance pivots occaſioned by the preſſure of the reſting teeth, conſtituted the ſame objection in practice as applied to Du Tertre's modification of the eſcapement with two balances. This eſcapement, however, was the archetype of all the ſucceeding dead-beat eſcapements, and therefore is deſerving of the notice we have given it.

5. *Cylinder eſcapement in diamond by De Baufre.*—A native of Geneva of the name of Facio had applied rubies to the pivot holes of a watch about the year 1700, and went into partnerſhip with De Baufre, a French watchmaker, eſtabliſhed in London; the latter artiſt finding the advantage of applying the poliſhed ſurfaces of the precious ſtones for diminiſhing friction at the parts of action, contrived a new eſcapement about 1704, of which the pallets were of diamond. Sully ſays that a watch of De Baufre, with the diamond pallets, was put into his hands by ſir Iſaac Newton, who had found its accuracy of performance admirable. The following account will be intelligible, we preſume, to any artiſt who underſtands the mechaniſm of a watch. The balance had two pallets on its verge conſiſting of a ſemi-cylindrical diamond, and the eſcapement wheels, of which there were two, were vertical, with their common arbor at right angles to the verge of the balance; *i. e.* with their planes parallel to the verge: theſe wheels, which were ſimilar, were placed one oppoſite the other on contrary ſides of the verge in ſuch way, that a tooth of one fell in the middle of the ſpace of the other, and *vice verſâ*; the pallets were $\frac{1}{24}$th of an inch thick, and two and a half twelfths in diameter, and the diſtance between the ends of the teeth of the double eſcapement wheel about $\frac{1}{12}$th of an inch, or twice as much as the thickneſs of the pallets; the pallets had their planes parallel to the plane of the balance, and had their ſemi-circle ſloped in an angle of about 45° at the ends for the pallets to ſlide over, after preſſing on their planes alternately during the reſpective oſcillations. We will endeavour to explain the action, as we comprehend it to have been by a verbal deſcription. Let the leading pallet be called *a*, and the following pallet *b*; and let the balance be ſuppoſed in motion with a tooth of the eſcapement wheel reſting on the plane of the diamond; when the ſloped end of pallet *a* arrives at the ſaid tooth, the tooth falls off, accelerating the balance by its ſliding motion, and goes on till an oppoſite tooth of the other wheel falls on the plane of the diamond in motion; this tooth reſts without recoil, as did the former one, till the ſloped end of the pallet *b* comes to it, when it falls off in its turn, and gives motion to the balance, which has thus its ſpring wound up by the momentum of the balance ſufficiently far to bring the balance back again after every impulſe; and thus an alternation of vibrations is continually maintained while the force of the mainſpring laſts. This eſcapement is alſo of the ſecond claſs, or of the dead-beat kind, but is ſubject to the conſtant friction of its immediate predeceſſors, though this friction is greatly diminiſhed by the ſubſtitution of the diamond for metallic pallets, and by the buſhing of the pivot holes with rubies; it poſſeſſed all the good properties of Tompion's eſcapement juſt deſcribed. (See Machines and Inventions approuveés, &c. vol. vii. p. 137.) Larcum Kendal uſed two crown wheels in a ſimilar manner, which W. Howell improved by adding a forked detent to make the eſcapement detached, which was rewarded by the Adelphi Society, in 1792. See their Tranſactions, vol. x. p. 216.

6. *Sully's modification of De Baufre's eſcapement.*—The praiſe which ſir Iſaac Newton beſtowed on De Baufre's new watch induced H. Sully to beſtow much attention on it, and in the year 1721 he adopted an alteration in it, which made only one wheel neceſſary for the eſcape at both oſcillations;

lations; but Berthoud has expreffed an opinion that his alteration conftituted no real improvement, but made the adjuftment of the pallets more difficult. Sully having applied his modification of the efcapement in queftion both to a pendulum clock and a marine time-piece, prefented two memoirs on its conftruction to the Royal Academy of Sciences in the years 1723 and 1724; which are alfo printed in his defcription of marine time-pieces, publifhed in 1726. *Fig.* 1. of *Plate* XXXII. of *Horology*, reprefents a fide view of this efcapement, where A is the efcapement wheel, B the contratc wheel between it and the balance C, which has a pinion only on its verge, that is actuated by the contrate wheel; the pallets 1, 2, are two circular pieces of agate, placed at the diftance from one another of one fpacc of the efcapement wheel nearly; thefe pallets have each an inclined or floped end, like De Baufre's, thc flopes alfo being at thc contrary ends of each; the intention of this modification is not only to make one wheel A perform the whole bufinefs of the efcapes, but to produce long vibrations of the balance, even beyond a complete circle. The action was thus; on giving motion to the balance C, fuppofe the tooth *b* to reft on the plane of the pallet or agate 1, it foon meets with the end flope, and falls off till it meets with the pallet 2 below, on which it refts, after having given a pufh to the pallet during the act of fliding off; the balance goes on, till the fpring, now wound up, brings it back, there being in the mean time no recoil, by reafon of the arbor of the contrate wheel being alfo the axis of the pallets, and at right angles thereto; the tooth *b* now finds, after the return of the balance, the floped end of pallet 2, and efcapes entirely; but at the fame inftant tooth *c*, which follows, falls on the plane of pallet 1, and is then in the fame fituation we at firft found *b* in, therefore the fame action is repeated with this, and every fucceeding tooth, till the power of the main-fpring is exhaufted. This modification of De Baufre's efcapement is confequently of the fecond clafs alfo, and enables us to comprehend more clearly the action of the original one, which had its double efcapement-wheel placed with refpect to the balance verge, as the prefent one has its fingle one, with refpect to the arbor of the contrate wheel. The effect produced muft have been nearly the fame on the pallets, though the vibrations of the original balance muft neceffarily have been fhorter than of the latter, but then it had not the friction in the wheel-work between the pallets and balances.

7. *Efcapement with two cylindrical pallets.*—In the year 1727 Julien le Roy fhewed Sully fome watches juft brought from England into France, which had each two cylindrical pallets with notches cut in them like Tompion's fingle pallet, which kind of efcapement feems to have differed from his, only in having an efcape at every vibration, and in having the old crown-wheel as an efcapement wheel; but as we have not been able to trace the inventor of this efcapement, we muft confider it as a lineal defcendant from Tompion's, and therefore as a variety of Englifh extraction. Its utility has been, however, evinced by the circumftance of Julien le Roy's having adopted it as a favourite, and ufed it in fome of his productions: it had the property of converting the recoil of the crown-wheel into a dead-beat.

8. *Cylinder or horizontal efcapement of Graham.*—We are not informed in what particular year Mr. Geo. Graham, the celebrated watch and clock-maker, invented the efcapement with a cylinder, called alfo the horizontal efcapement, from its wheel being in an horizontal pofition, but it appears that Julien le Roy introduced this conftruction into France in the year 1728, when wonderful properties were attributed to it, but particularly the property of compenfating all the inequalities of the maintaining power, which at that time was the great defideratum among watch-makers. The contrivance bears a great analogy to Tompion's efcapement, and was probably originally derived from his, which, however, does not leffen the merit of the contrivance, as it requires as much ingenuity to improve an exifting inftrument, frequently, as to invent a new onc. *Fig.* 2. of *Plate* XXXII. is a perfpective view of Graham's horizontal efcapement, in which A is thc efcapement-wheel, B the balancc, and C the hollow cylinder fixed on the verge of the balance; each tooth of the wheel, which may have any convenient number of teeth, is formed of a triangular inclined plane or wedge, fupported by a ftem projecting perpendicularly from the plane of the wheel at its circumference; the length of the wedge of each tooth is juft a diameter of the internal part of the cylinder, fo that the cylinder may revolve round the wedge when the balance is in motion; in this fituation the anterior point of the wedge juft touches the cylinder's interior furface, but the pofterior point of the fame is free, fo as not to touch and ftick faft in the cylinder, but to give it a pufh on the edge when the contact ceafes; the diftance between the teeth is alfo great enough to allow the exterior portion of the cylinder to come between them, when the efcape has taken place, and while the balance continues its ofcillation. The action is performed in the following manner; fuppofe the wedge to be juft efcaping from the hollow part of the cylinder, and to be giving its impulfe to the edge of the cylinder which it quits, the balance goes on and winds up the fpring, as ufual, at the fame time prefents its exterior face, or convex furface to the point of the fucceeding tooth or wedge; this point falls on the faid convex furface and refts there, without recoil, till the ofcillation is finifhed, at the return of the balance, by means of the fpring now wound up, the hollow or concavc part of the cylinder comes to the point of this following wedge, and being rounded at this end, admits it eafily into its concavity, at which inftant the other edge of the cylinder receives a fecond impulfe in a contrary direction; the balance now makes another ofcillation, and the point of the wedge refts againft the interior face of the cylinder, as it did before on the exterior, without recoil, and in both fituations of reft the wedge has no other effect on the balance than that of retarding it by its preffure againft the circular furface; the fecond tooth is now in the fame fituation as we found the firft, and prefently in its turn gives another pufh at leaving the cylinder altogether, and leaves the third wedge to perform the fame office by firft refting on the back of the cylinder, then entering it, and laftly giving its parting impulfe to the fecond edge of the faid cylinder, as the two wedges that preceded had fucceffively done before. At one period this efcapement was in high eftimation in England, as well as on the continent, and even now the common watches that are conftructed with this efcapement will fetch greater prices than thofe with the ordinary crown-wheel efcapement, but the detached efcapements of the beft chronometers are now held in much higher eftimation than either. We have feen that the hollow cylinder, though conftituting but one pallet, in effect performs the office of two pallets, and permits but one tooth or wedge to efcape entirely at two ofcillations, during one of which the point refts at the outfide, and during the other at the infide of the cylinder, while the two edges of the cylinder perform the part of feparate pallets on receiving feparate impulfes in contrary directions, it is, therefore, of importance in this, as indeed in all efcapements with a regulating fpring, that the quiefcent pofition be duly adjufted to render both ofcillations precifely fimilar in extent and duration at each fide, otherwife the performance will be a fpecies of hobbling, and the compound law of motion,

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derived from the spring's action and impulses on the pallets conjointly, will be far from regular; consequently not likely to be an isochronal law. Berthoud has described a cylinder escapement with two balances connected by two pinions, but it did not prove successful.

9. *French escapement a Virgule.*— The French escapement known by the appellation of *a virgule*, from the pallet's resemblance of a *comma*, is represented by *fig*. 6 of *Plate* XXXV. A, B, C, are three teeth of the balance wheel, placed very obliquely compared to a true radial line, and carry each a pin at their extreme ends, standing vertically like the supports of Graham's wedges for his cylindrical escapement; the pallet B A has its centre of motion at *c*, the centre of both the concave and convex portion, exactly over the verge of the balance; this centre is in the circumference of the circle that passes through the points or pins of the teeth; the pallet, which is of hardened and polished steel, has its plane parallel to that of the wheel, and is supported between *f* and *e* by a crank piece put over the verge, which cannot be admitted as high as the pallet; this end *a o*, which connects the convex and concave portions, is a portion of an equi-angular spiral, and the part *b d* of the pallet is called the *horn*, probably from its resemblance of the beak of a bird; the inferior face *b* A may be straight like the dotted line, or curved, at the option of the maker, and the superior part *f* A may be of any shape: the convex part *a e f* contains about 100°. The length of the pallet from *a* to *d* is such, that when the pin at B presses against the curved part at *a*, the point *d* of the horn will just miss the pin at A of the preceding tooth, and the height at which the pallet stands is such as to make it pass over the rim of the wheel, but not over the pins at the ends of the teeth. When the balance is at rest, and has its spring in equilibrio, the point *d* of the horn is at the point *i*, about 30° from *d*; but the present position is that which the pallet has when the tooth A has just escaped from the point *d* of the horn. To explain the action, on a supposition that the tooth A has just escaped, the succeeding pin B has just fallen on the point *a*, joining the spiral and convex portions of the pallet, and the balance has just received its impulse from tooth A as it passed from *b* to *d* along the inferior face of the horn; it, therefore, proceeds in its motion in the direction *d g h* of the dotted circle, while the point B slides on the convex side *e f*, and is detained without recoil; when the point *d* of the horn has arrived as far as *h*, more than 90° from A, the momentum of the balance is exhausted, and the balance returns; the point *d* comes to about the point *i* before the pin of tooth B comes to *o*, and enters the concave part of the pallet, where it slides till the point arrives about *k*, where the momentum of the balance spring is again exhausted; the balance returns again, and when the point *d* comes to *i*, the pin of tooth B escapes the concave part at *b*, and slides along the inferior face of the horn, at the same time giving it a push till it escapes entirely, and is in the situation of tooth A, where the process began; in the same manner the following tooth C, and every succeeding tooth in its turn, will fall on the convex side of the pallet, return and enter the concave side, and then finally escape. We must observe, however, that the pallet opposes the motion of the balance as it passes along the small spiral part from *a* to *o*, which may be so proportioned as to be a counterbalance to the impulse previously given to the balance by the leading tooth, in case the friction on the back of the cylindrical part is not competent to retard the balance's impulse sufficiently. The effect produced by this escapement must be very similar to that produced by Graham's cylindrical escapement, but has this advantage, that the inclined plane formed on every wedge of Graham's construction is transferred to the pallet, and serves for all the pins to slide on in succession, thereby removing the difficulty of forming all the wedges alike in size and shape. Besides, the convex and concave sides of the pallet may be reduced to any dimensions, provided the acting tooth may not slide at once from the spiral to the horn, and allow the train to run down, which may be the case if the parts of action be small, and there be much play in the pivot holes of the wheel and balance. The construction is a compound of Tompion's and Graham's watch escapements, to both of which it has certain points of resemblance. In 1752, Le Paute altered this escapement, by putting pins for teeth in both planes of the wheel, as he did in Amant's escapement *a cheville*, which addition gave it some advantages.

10. *Escapement with one pallet and one detent by Thiout.*— Thiout, a French clock-maker of considerable eminence, published a work in 1741, entitled "Traité de l'Horlogerie Mechanique et Practique, approuvé par l'Academic Royale des Sciences," 2 vols. 4to. in which he has described an escapement of a watch that has been mistaken sometimes for a real detached escapement, and considered as the first that has been made of such a construction, though the inventor himself did not consider it as such, as is evident from his own description. This escapement is given in *fig*. 8. of *Plate* XXXII., and to use the author's own account, "it is an escapement of a watch in which half of the vibrations *seem* independent of the train of wheels, while they are performed. The detent B stops the escapement wheel, the balance bringing back the pallet A, the detent recedes, to leave the wheel free to strike the pallet; and so on. This escapement could not perform without a spiral spring." — It hence appears, that the pallet A is on the verge of the balance, but that the detent B is on a separate arbor, while they are connected by the tail of the pallet entering the slit in the remote end of the detent, so that the balance is never disengaged from the detent, and therefore cannot be considered as of the detached class. When the balance moves in a direction from A to B the pallet gets out of the teeth, but the detent falls in, and *vice versâ*. The curves of the claw of the detent appear to have been drawn from the centre of its motion, and therefore we are disposed to think that there would be no recoil in the escapement wheel.

11. *The anchor escapement by Clement, or Dr. Hooke.*—While these improvements were going on in watch escapements, an equal attention was paid to the contrivance of new clock-escapements. Huygens had placed the pallets of the crown-wheel escapement at an angle of about 60° instead of 90°, as they were made for a watch, in order that they might be accommodated to the short vibrations of a pendulum, or rather, perhaps, to the vibrations of some length performed in a cycloidal curve, by means of his cycloidal cheeks near the point of suspension; but still the arc of action on the pallets was too long to allow practice and theory to coincide, as to the performance of long and short arcs of vibration in the same time. The preference that seemed due to short arcs, when circular, suggested the propriety of contriving an escapement that would admit of very short arcs of vibration. This was first effected about the year 1680 according to Smith's account, by Clement, who was a clock-maker in London; but Dr. Hooke has disputed the priority of the invention, and has affirmed that he exhibited a pendulum with what is now known by the name of the *anchor* escapement, to the Royal Society of London, in the year 1666, soon after the great fire of that year. We will not endeavour to settle the point that relates to priority of invention, but proceed to describe the contrivance itself, which has continued, and is likely to continue, to be of permanent

use

ufe in ordinary clocks. *Fig.* 3. of our laft named plate is the reprefentation of the anchor efcapement, as it is commonly conftructed for a pendulum clock that fwings feconds, which pendulum, in conjunction with the anchor efcapement, gained the appellation of the *Royal pendulum.* The efcapement, or fwing-wheel A, has ufually thirty teeth, when a vibration is performed exactly in a fecond, in which cafe a fecond's hand is ufually inferted on its elongated pivot, to indicate feconds; but if no attention is intended to be fhewn to the indication of feconds, the train may be made to admit of any other convenient number of teeth; B C is the anchor and pallets, taking its name from a refemblance to a fhip's anchor, that may be obferved in its fhape; the diftance from its centre of motion *a* to that of the wheel *b* is determined by the number of teeth that the pallets take in between them, it being effential to the freedom of action that two lines, drawn from the two centres of motion *a* and *b*, fhould conftitute a right angle at each of the two points of action, as feen included by the dotted lines, meeting at the ends of the acting teeth *d* and *e*: in the pallets which we have made to include nine teeth, the centre of the pallet's motion falls at the point *a*, but if they were made to include eleven teeth the faid point would fall above at *h*; and if they included fewer than nine the point for the centre of motion would fall below *a*: in general ten or twelve are contained between the pallets of a fecond's pendulum, but this muft depend on the arc that the pendulum is intended to vibrate; for the more teeth are taken in, the greater is the diftance of the two centres of motion, and confequently the fmaller the angle or arc of action on the pallets. If a circle *f g* be defcribed by a radius equal to half the diftance of the centres of motion *a b*, round the point *a*, the two faces of the pallets B and C ufually lie in the tangent lines *e i* and *d g* of that circle, which lines are the guides for making the flopes. The action of the efcapement before us may be explained thus; fuppofe the tooth *d*, feen refting on the flope of pallet C, to be urging this pallet outwards from the centre of the wheel, by which a motive force is applied to the moving pendulum through the medium of the crutch; prefently it efcapes, and pallet B is brought inwards towards *b*, fo as juft to avoid the tooth *e*; the wheel is now at liberty to move, and goes on, by the force of the maintaining power, till the fucceeding tooth *k* falls on the floped face of pallet B, which is now urged outwards, and endeavours to give a contrary motion to the pendulum; but the momentum of the moving pendulum is too powerful for its impulfe, and carries the tooth *k* back again till the momentum is expended, at which inftant a recoil of the wheel and fecond's hand placed on its arbor take place; prefently the pendulum returns, and the tooth *k* now pufhes it on, and efcapes; the pallet C is now brought back, fo that the tooth following *d* falls on its floped face, and in its turn experiences a recoil till the pendulum returns, when it pufhes on and efcapes; then another tooth next after *k* falls on the face of B, and experiences the fame recoil and fubfequent power of efcaping that the others did; and thus the alternate vibrations of the pendulum are perpetuated as long as the maintaining power continues. The effect of this efcapement on the pendulum is fimilar to that of the crown-wheel efcapement on the balance; the pendulum is either accelerated or retarded in every part of its vibration, except during the almoft infenfible inftant of the drop of the fucceeding tooth, when one has efcaped; but as the momentum of a heavy pendulum in motion is greatly exceeding that of a balance in motion, the bad effect is fmaller in degree. When an additional weight is added to the weight conftituting the maintaining power, the arc of vibration is increafed, whence one might be led to expect a retardation in the time of a vibration, the arcs being circular; but the fact is, that the vibration is accelerated very fenfibly by means of the pendulum being both accelerated in its defcent and oppofed in its afcent, and the pendulum comes fooner back than gravity alone would bring it. Here then the compound law of motion differs from the fimple law of gravity, but not in the ratio of the arcs to the fines of the angle of vibration; for if the compound law were to the fimple law of gravity as the *arcs* are to their *fines*, the vibrations would be ifochronal, whatever their extent might be. It is hardly neceffary to add that this efcapement is one of the firft clafs.

12. *Graham's dead-beat.*—The dead-beat efcapement, as originally contrived by Graham, is a modification of the anchor efcapement we have juft defcribed, from which it differs only by taking off a part of the flope of each pallet, and by making the pads, that is, the back of one pallet and interior part of the other, portions of circles defcribed from the anchor's centre of motion, fo that when the point of a tooth refts on thofe parts, while the pendulum is finifhing a vibration, no recoil takes place, but the wheel continues motionlefs, or, as it were, *dead*. *Fig.* 4. of the fame plate gives the figure of the dead-beat efcapement-wheel and pallets, where we have reprefented the wheel, as we did the wheel of recoil, with only four inftead of fix radii, that there might be more fpace for our geometrical lines. In this conftruction, as in the preceding one, the diftance of the centres of motion *a*, *b*, is determined by the tangent lines meeting the radii at the points of the acting teeth; when this diftance is an exact diameter of the efcapement wheel, we find that the pallets take in juft ten teeth out of thirty, which is the cafe in the figure before us, but when twelve teeth are taken in, the centre of the anchor's motion falls at *h*, juft a diameter and a half from the centre of the wheel; and this is Berthoud's rule for giving the diftance *a b* without any reference to the tangent and radius; for he has found that the arcs of action on the flopes of the pallets *a m n*, and *a o p*, are each only one degree, but that if fewer teeth than twelve were included between the pallets, the anchor would be fhorter, and the arcs of action proportionally longer. This rule might be a good one with a given maintaining power, that is, where the whole arc of vibration is of a given extent, but it does not follow that one degree for the arc of action before the efcape is the beft in all cafes where the motive powers vary. We are of opinion that experiments might be inftituted to afcertain this important point, by applying various weights fucceffively, firft with pallets that have twelve teeth included, and then with fuch as have eleven, ten, &c. but the experiment could not go beyond 14 teeth, becaufe when half the wheel is included the tangent becomes a vertical line, parallel to the line of diftance *a b*, and therefore this diftance becomes *infinite*. There is probably a certain maintaining power that is beft for a certain angle of action, with a pendulum of a given weight, but that does not feem to have been afcertained either by calculation or experiment hitherto. The thing to be aimed at is, to make the compound law of the pendulum's motion fuch that the varying forces may accelerate or retard it in proportion to the arcs of diftance from the loweft point, which is the cafe with the fimple law of gravity, as it regards the *fines* of the faid arcs. We have put the fame letters of reference to our prefent figure as to *fig.* 3, that the reader may the more eafily comprehend the correfpondence between them, and to prevent the neceffity of further minute defcription of the parts; the flopes of the pallets being determined by the fame tangent lines *e i*, and *d g*, as before. We fhall, therefore, confine the remainder of

of our defcription to the features that differ, and to the mode of action depending thereon. The circle B C, paffing the points of the firft and eleventh teeth, including the ten fpaces between the pallets, forms the interior faces of the faid pallets B and C, and the exterior portions B *e* and C *d* are formed by a concentric circle of larger radius. Thefe circles are defcribed from the point *a*, or centre of the anchor's motion, therefore a tooth refting at any time againft any one of thofe circular portions remains without recoil; the diftance between the faid circles is fomewhat lefs than one-half of the fpace contained between the extreme ends of any two contiguous teeth, and the nearer it is to one-half of a fpace, the fmaller will be the drop after an efcape, or, as the workmen fay, the clofer the pallets will be laid. The teeth are fomewhat varied in fhape from the inclined teeth of the recoil efcapement, a portion of the flope at the bottom being cut away, that the end of the pallet may enter the fpace, when the pendulum vibrates beyond the arc of action, without coming in contact with the metal of the wheel, which would make the pendulum rebound, and difturb the regularity of the vibration. Thefe obfervations being premifed, the reader will now be prepared to comprehend the action. The tooth at *e* has juft paffed the flope of pallet B, and is efcaping, after having given its ftroke or impulfe gradually, in fliding along the flope from *e* to its prefent fituation; the pallet B is now going from the centre of the wheel's motion *b*, and the pallet C is come back from its excurfion, in time to allow the tooth *b* to fall on its inner circular part, near the angular point of the flope; the pendulum goes on in its vibration till its gravity overcomes its momentum, during which time, the pallet B is no longer in contact with the wheel, but the pallet C enters the fpace between *b* and *d*, and the point of the tooth *b* refts on the inner circle of the pallet; prefently the pendulum returns, the point of tooth *b* flides back again till the flope *b d* prefents itfelf, when urged by the maintaining power, it efcapes after having made its pufh to the pallet C, which now continues its motion outwards, and confequently pallet B falls in the way of the tooth *k*, which follows, but which refts on the exterior circle B *e* of this pallet, till the pendulum returns as before; it then meets the flope at *e*, and, giving its pufh to the pallet, efcapes, as its preceding tooth had done; and thus the vibrations are alternately aided in future, while, as has been feen, one tooth only completely efcapes at the interval of two vibrations: which is the reafon why a wheel of 30 teeth is proper for the indication of 60 vibrations of a fecond's pendulum. When the wheel is made of hardened fteel, and the pallets of ruby or agate, the friction is greatly diminifhed, and will admit a fhort angle of action, or diminution of power.

13. *Modification of the dead beat by Grignon.*—When we gave the "Hiftory of the fucceffive Improvements in Clocks," under our article CLOCK, we faid that the fenior Thomas Grignon, of Covent Garden, London, improved the dead-beat efcapement of Graham, and prefented a clock to the Society of Arts in 1759, which remains in one of their rooms to this day, that has got this improved efcapement, the peculiar property of which is faid to be, that it performed alike with *four* and with *twelve* pounds fufpended as a maintaining power; if this is a fact, the efcapement muft have the property, fo much defired in all efcapements, of rendering all the arcs of vibration ifochronal. We have been favoured with a manufcript account of this efcapement, and of its principle of conftruction. It will be doing but juftice to the memory of departed genius, if we give the author's own figures, demonftration, and account of his improvement, as he has left it in his own hand-writing. *Fig.* 5. *of Plate* XXXII. is the *fcheme*, and *fig.* 6. the *demonftration*, as the author himfelf has intitled the figures, the latter of which has no letters of reference, but is fufficiently intelligible in conjunction with the other. "It appears from the fcheme," fays the author, "that the diftance of the centre of the pallets from the centre of the fwing wheel in that machine (at the Adelphi) is *one whole diameter* of the wheel, which has this peculiar excellence, that the triangles formed at the ends of the pallets, by drawing the tangents for the flopements are *equal*; (nor indeed can they ever be equal, continues he, where the diftance is more or lefs than *one whole* diameter of the fwing wheel,) and, on the contrary, where that diftance is duly obferved, all the triangles will ever be equal; for then all the interfections, made by drawing the two tangents to the circle of the pallets, will fall exactly alike, (*fig.* 6.) interfecting the intermediate circle, as may be feen by the figure, confequently the tangent lines, together with the chord of the fwing wheel form a rectangled triangle, the upper angle of which, by altering the flopement only, changes its place in the circumference of the circle, the fame chord always continuing its bafe. For a farther demonftration of which, fee 21ft propofition of the the 3d book of Euclid.

"Again, when the diftance is duly obferved, we fhall find that one of the lines for the flopement of the pallets will be the hypothenufe, and the other the perpendicular of rectangled triangles, whofe bafes are equal to 120°, the halves of which muft be 60°. That they are rectangled triangles may be eafily proved; for if the bafe be 120°, and perpendicular 60°, the hypothenufe muft be 180°. See 1ft Prop. of the 12th book of Euclid."

In another manufcript paper, Mr. Grignon fays, "that the teeth of the fwing wheel have an equal effort, when they act upon the flopements or faces of the two levers or pallets, may be thus demonftrated.

"Draw the lines A, A, upon the faces or flopements of the pallets or levers *a*, *a*, now thefe are the lines of direction; let fall the perpendiculars B, B, from the centre of motion of the pallets C; now, I fay, that if you meafure the lengths of thefe perpendiculars, they give you the efforts of the arms of the levers or pallets D C, D C; for by the 9th prop. of Mr. De la Hire's Treatife of Mechanics, the efforts of a weight or power are not to be meafured by the length of the arms of the levers, but by perpendiculars drawn from the hypomochlion upon the lines of direction of the weight or power. That thefe levers are equal is thus proved; for, taking C for your centre, defcribe the circle E E E; now if the perpendiculars B, B, are both radii of the circle E E E, they muft, of confequence, be equal, which is what was to be proved. Again, that the faces or flopements of the pallets or levers are equal may alfo be thus proved: *a* A, *a* A, are the lines of direction of the action of the teeth, and being both tangents of the fame circle E E E are confequently equal."

The remarks that have occurred to us on contemplating Mr. Grignon's *fcheme*, as he has called it, are, firft, that his diftance between the centres of motion require *ten teeth* out of thirty to be taken in by his pallets, as we have fhewn in our laft article; fecondly, the circle E E E is defcribed with lefs than half the diftance of the centres, and is yet made the circle to which the tangents are drawn, that form the flopes, the reafon of which he has explained, the radius C B of this circle, it appears, muft be determined by a line *a* A, drawn parallel to the line of diftance, which muft be a tangent to the faid circle, and which affords an eafy and practicable mode of drawing the flopes agreeably to this conftruction; thirdly, if the flopes thus formed by tangents drawn

drawn to a diminiſhed circle have the iſochronal property, they are worthy of future imitation, under the circumſtance particularly of ten teeth being included between the pallets; and laſtly, we obſerve, that the *ſame circle* forms the *exterior* curve of one pallet, and the *interior* one of the other, which is not the caſe with Graham's pallets, but which certainly makes the friction alike on both pallets, ſeeing the circular ſurfaces rubbed by the points of the wheel's teeth are at equal diſtances from their common centre of motion. Theſe conſiderations are all in favour of Mr. Grignon's modification of the dead-beat eſcapement, as each excurſion of the pendulum muſt be influenced by ſimilar circumſtances, and if moreover it poſſeſſes the iſochronal property attributed to it, it is ſomewhat remarkable, that the Adelphi ſociety have been labouring to reward inferior eſcapements in great variety, while one of the beſt *dead-beat* eſcapements is beating *dead* to the ſociety, having *eſcaped* their notice, while performing its functions within their own walls.

14. *Mr. Bennett's modification of the dead-beat.*—Mr. J. Bennett of Norwich has publiſhed an account of what he conſiders an improved method of deſcribing the curves and faces of Graham's dead-beat pallets (ſee Nicholſon's Jour. vol. xv. 8vo.) which account we think deſerves a place here in common with Grignon's method.

Draw the line A B (*fig.* 7. *Plate* XXXII.) ſays the author, on which deſcribe the circle B, the ſize of the intended ſwing wheel; then, according to the number of teeth the pallets are intended to eſcape over ſay, as 60 (the double of the number of the wheel's teeth) is to 360°, ſo is double the number intended and one more to that proportion; thus, ſuppoſe the number intended to eſcape over nine, the double of which is 18, to which add one, and there are 19; then ſay,

As 60 : 360° : : 19 : 114°; the half of 114°, which is the whole arc included, is 57°; then on the circle already drawn ſet off on each ſide of the line A B 57°, from which points draw lines to the centre of the circle; then on theſe points where the circle is croſſed erect perpendiculars, which will interſect at the centre of the pallet's motion in the line A: from this point as a centre draw the arc C C, to cut the points where the radial lines cut the circle; the arc thus drawn deſcribes the receiving and leaving pads of the pallets. The inclination or inclined plane of each pallet muſt form an angle of 60° with the ſaid radial lines; thus from the points of interſection, near E and G, draw the ſmall ſemicircles D and G with any radius, and ſet off 60° from *f* to *g* on the ſemi-circle D, and from *h* to *m* on the ſemi-circle G, then will lines drawn from the centres of the ſemi-circles, through the points *g* and *m* reſpectively, give the proper direction of the ſlopes of the pallets' faces.

This conſtruction is very ſimilar to Grignon's, though differently projected: the centre of motion A is determined in the uſual way, and the odd unit given to double the number of teeth included is an allowance for the breadth of the pallet, to have as little drop as poſſible; the ſlope of the pallet G is parallel to the line A B, in Grignon's conſtruction, but is not quite ſo here, for the difference of the angles at the oppoſite ſides of the radial line is $60° - 57° = 3°$, which is what theſe lines want of being parallel, which quantity of deviation ſeems to conſtitute the principal difference between the two conſtructions; if the radial line of pallet G had been drawn to the lower point of the pallet, ſo as to have made the angle at the centre 60°, and the teeth included had been exactly ten, then the two methods would have coincided, and the point A of the pallets' motion would have been an exact diameter of the wheel from its centre. We conceive that the effects of the two conſtructions may be ſo nearly alike, that their difference in practice may be almoſt imperceptible. If there is any difference, varying the maintaining power conſiderably in different trials will detect it, by rendering the alterations in the rates perceptible from the compariſons. Otherwiſe the alternate angles might each have been 57°, inſtead of one of them being 60°.

15. *Iſochronal eſcapement for a pendulum.*—So long ago as about the year 1720 Saurin, Julien le Roy, and Enderlin, wrote memoirs on the nature of the curve that was neceſſary to give to the pallets of an anchor, inſtead of the concentric circles, in order that the ſwing wheel may have juſt ſo much recoil only, as will render all vibrations, performed in arcs of different extent, iſochronal; and ſince their time Berthoud in France, Reid in Edinburgh, Melville and others in London, have put in practice a method of conſtructing pallets founded upon the ſame principle. We think it not improbable, however, but that the Scotch and Engliſh artiſts have borrowed their contrivance from the French author, who publiſhed his conſtruction in his "Eſſai ſur l'Horlogerie" in the year 1786, before which time we do not find any traces of an iſochronal eſcapement except Grignon's juſt deſcribed, and Smeaton's, which follows. The conſtruction of the eſcapement in queſtion differs from the dead-beat only in one particular, which is, that the circular portions of the pallets, which in the dead beat are concentric, deſcribed from the centre of the pallet's motion, in the iſochronal eſcapement are *excentric*, with reſpect to each other, thoſe curves on which the ends of the teeth of the ſwing wheel reſt being deſcribed from points out of the centre of motion. Berthoud had made ſeveral experiments with different eſcapements, and different maintaining powers, from which he found that the ſame addition to the power which accelerated the vibrations of the pendulum, when a recoil eſcapement was uſed, retarded the ſame when a dead-beat eſcapement was ſubſtituted; hence he concluded that there muſt be a medium between much recoil and no recoil, which would make the pendulum vibrate in the ſame time in all arcs, or, which is the ſame thing, with any addition or diminution of the maintaining power; he therefore fixed, after various trials, on a conſtruction producing but a *ſmall recoil*, which anſwered his moſt ſanguine expectations, and which we ſhall be happy to deſcribe here, particularly as it promiſes to anſwer a better purpoſe than the common dead-beat, which has been long in high eſtimation; and as it has not, we believe, been deſcribed by any Engliſh author. *Fig.* 1. of *Plate* XXXIII. is a plan of Berthoud's iſochronal eſcapement, where A, as before, is the ſwing-wheel, B and C the pallets of the anchor, and *a* the centre of their motion; the diſtance of the centres *a*, *b*, alſo, as before, depending on the number of teeth taken in by the pallets; the angles *m a n* and *o a p*, are the angles of action by which Berthoud has given his ſlopes of the pallets without the tangent lines *e i*, and *d g*, but we have thought it right to ſhew how they may be given both ways. Berthoud's method of ſloping to ſuit any angle previouſly given is more extenſive in its application, but the quantity and direction of the impulſe will vary as the angles *m a n*, and *o a p*, vary; whereas the method of ſloping by the tangent lines can only vary by varying the circle *f g*; as Grignon has propoſed: in our plan we have taken the circle's diameter equal to the diſtance *a b* of the centres for the ſake of uniformity of plan, that the reader may ſee how the pallets, ſo formed, differ in ſhape from the dead-beat pallets. The exterior portion of the circle *d* C, of pallet C, is deſcribed with the extent *a d* from the centre *a*, but the interior portion *b* 4 is deſcribed with the ſame extent from a point 5

below

below the centre; the difficulty confifts in determining the true fituation of this excentric point 5; Berthoud's rule, founded on the refult of experiments, is this; having determined the breadth of the pallets, equal to fomewhat lefs than half a fpace of the fwing-wheel, defcribe from *b*, in the line *a p*, the concentric dotted circle 1, 2, 3, &c. fet the diftance between the two concentric circles, or breadth of the pallet, *three times* over along the inner curve to 1, 2, and 3, then in a direction from 3 towards *a* fet the fame *once* to 4; in the next place, with the extent *a b* find the point 5 by interfection from the points *b* and 4, and this point 5 is the excentric point defired, from which the curve *b* 4 is defcribed with the extent *a b* as before, which is the interior curve to be fubftituted for the concentric curve 1, 2, 3 of the dead-beat efcapement; and it is evident that while the pendulum is in motion inwards, with a tooth refting on this excentric curve, the wheel muft have a certain recoil. Again, the exterior curve of excentricity, of pallet B, is thus defcribed; the curve 1, 2, 3, &c. is defcribed, from the point of the tooth that is in the line *a m*, and the points therein are taken as before at the diftance from each other of the breadth of the pallet, or at fomewhat lefs than half a fpace of the wheel; the point 4 is here fet outwards in the direction from *a* to 3; then with the extent *a e* the excentric point 6 is determined by interfection from *e* and 4, which point is above the centre; laftly, with the extent *a e*, as before, defcribe the excentric curve *e* 4 from the point 6, which being fubftituted for the concentric circle 1, 2, and 3, will produce a fimilar recoil in the pallet B, as the curve *b* 4 produces in pallet C. The inner curve of pallet B having no action, like the outer curve of pallet C, may be defcribed from *a*, or be a ftraight line. The writer of this article has a half-fecond's pendulum clock with this efcapement, and Troughton's tubular pendulum, which goes admirably with any power that will keep it in motion.

16. *Smeaton's efcapement of the turret-clock at Greenwich.*—The efcapement which Mr. Smeaton contrived for the turret clock at Greenwich refembles the ifochronal efcapement, which we have juft defcribed, in a certain degree, and was, no doubt, intended to anfwer the fame purpofe. *Fig.* 2. of *Plate* XXXIII. contains the plan of this efcapement, in which A B is the radius of the efcapement wheel; B C a tangent line at $3\frac{3}{4}$ teeth from the vertex, drawn from C, the centre of the pallet's motion; B D E is a circle defcribed from the centre C through the points B and E, which are each $3\frac{3}{4}$ teeth from the vertex; F G is a line drawn parallel to the vertical line A C at the diftance from the vertex of $3\frac{1}{2}$ teeth, and cutting the circle B D E in the point G; then G C B is half of the angle of vibration, and fetting off the arc B H = B G, G C H will be the whole angle of vibration. Draw the line C H cutting F G in I, and through the point G of this pallet from the centre A defcribe a circle that may cut the radius A K in the point K; this will be the point of the other pallet; the line E C being alfo a tangent to the wheel at $3\frac{3}{4}$ teeth from the vertex. Now fetting off K L on the circular arc = G H, the angle of vibration K C L will be equal to the other angle of vibration G C H, and if through the point L the line C L be produced, and L M be fet off = I H, then will the wheel move equally forward, by a fimilar motion of each pallet. Again, with the radius K C, upon K as a centre, defcribe the arc C N, and alfo with the fame radius from the point M defcribe the interfecting arc O P; then from Q, the point of interfection with the radius unaltered, defcribe the curve through the two points K and M to R, which curve will give the working face of the pallet that will produce a fmall recoil nearly equal to that produced by the plane G I; in this conftruction the depth of the teeth is equal to a fpace contained between two contiguous teeth, and the acting fide of the tooth is a portion of a circle defcribed from the bottom of the floped fide of the *fifth tooth* inclufive. The circle to which the flope of the tooth is a tangent is $\frac{1}{6}$th of the diameter of the wheel. When the fwing-wheel has a greater number of teeth than 30, $7\frac{1}{2}$ teeth are ftill contained between the pallets, and the centre of their motion is determined, as in the former conftructions, by a tangent line drawn from the point of the acting tooth. The two ends of the anchor may be made more apparently equal in length by letting the pallet K efcape over $3\frac{1}{4}$ teeth and the pallet G over $4\frac{1}{4}$, in which cafe the arc B D will be of a greater radius than the arc N D. The fteel pallets or end-pieces are fixed by fcrews that allow an adjuftment for diftance or depth of the pallets, fo that they may be detached, newly formed, and replaced, at any time after they have been in ufe.

17. *Efcapement with two levers by De Bethune.*—Thiout fays that De Bethune was the firft contriver of the clock efcapement with two detached levers, and that the origin of this conftruction was derived from the efcapement of Dr. Hooke, or of a German artift, with two balances, which we have defcribed. Thiout made the firft of his in the year 1727, and fays that from that time the efcapement with two levers became common among clock makers in France. *Fig.* 3. of our laft plate is a reprefentation of this efcapement as made for a pendulum; where A and B are the two levers placed faft on each a feparate arbor included within the frame; to the lever B is attached the crutch or fork that communicates with the pendulum not feen, and the fork C which is vifible in the figure; the lever A has a bar of metal D faft to it, that carries the roller E, of a diameter equal to the aperture of the fork C; and the ends of thefe levers conftitute the pallets placed at the diftance from each other of five out of thirty teeth of the fwing wheel. During the action of this efcapement, when one of the levers is acted on by a tooth, the roller and fork are raifed up, and the other lever becomes a detent to the wheel; then when at the next vibration the other lever is acted upon, the roller and fork are depreffed, and the firft lever in its turn becomes a detent; and thus the vibrations are alternately affifted while the maintaining power continues to actuate the fwing wheel. This efcapement has a recoil, and Julien le Roy difcovered (Memoire fur l'Horlogerie par M. le Roy, fils ainé de Julien le Roy, 1750) that when the levers are each the exact length of the radius of the fwing wheel, it poffeffes the ifochronal property, that is, all arcs of vibration will be performed with it in the fame time. We are not aware that this efcapement was ever made in England.

18. *Dead-beat efcapement for a pendulum by Amant, (a cheville)*—*Fig.* 4. of the fame plate fhews the plan of an efcapement by Amant, formerly a clock-maker at Paris, that has an efcapement wheel without teeth, but with pins or pegs inferted in a concentric circle in the plane of the wheel, as appears in the figure; the pallets A and B are both faft to the verge or arbor of the crutch, in the ufual way, and are brought fo nearly together that the fame pin that flides along the floped face of one pallet B immediately falls on the inner circle of the other pallet A, and continues without recoil till the pendulum has made its vibration; at the return of the pendulum the pin meets with the floped face of pallet A and efcapes; then the next pin falls on the interior circle of pallet B, and remains without recoil till the pendulum returns from its vibration, when it flides down the flope and gives a pufh to the pallet as the firft one did before; thus the two pallets are alternately actuated by the fame pin before

 its

its final efcape, and fixty vibrations are made during one revolution of the plate with thirty pins. The flopes appear to ftand at right angles to each other, but it is not faid, in the account we have feen, how either of the flopes ought to be drawn geometrically. This is the kind of efcapement at prefent ufed in the large turret clock at Hampton Court, and we have feen many other clocks in England with a fimilar efcapement, which, we have no doubt, may perform as well as with the ordinary dead-beat efcapement as originally conftructed by Graham, provided the drop from the firft to the fecond pallet, which muft neceffarily be equal to the thicknefs of the pin, do not produce a jerk that may affect the vibrating pendulum.

19. *Dead-beat efcapement (a cheville) by J. A. le Paute.*—In Le Paute's "Traité d'Horlogerie," publifhed at Paris in 1755, is an account of a dead-beat efcapement as made by him for a clock, which differs from our laft by Amant only in its mode of pofition, and which therefore requires no figure for its defcription; the levers of the two pallets open like a pair of dividers to any extent, but are not in the fame plane, one of the levers being over the anterior plane of the pin wheel, and the other over the pofterior plane; hence two fets of pins are neceffary, one on each plane; but the action is the fame as we have defcribed it in Amant's efcapement, which it probably excels inafmuch as the drop may here be made as little as poffible, becaufe the fame pin is not required to pafs between the ends of the pallets in efcaping; but one pin acts only with one pallet before it efcapes; there are confequently fixty pins in all, thirty on each plane of the wheel.

The fame author alfo publifhed an account of a watch efcapement with pins (a cheville) which the reader will find defcribed at page 198 of the fame treatife.

It is eafy to conceive, after what we have faid about the ifochronal pallets, that both Amant's and Le Paute's efcapements, and indeed all the dead-beat efcapements, may be made to have a little recoil, fo as to become of the ifochronal kind, provided the acting concentric circles of the pallets were made in a certain degree excentric; that is, if they were defcribed from points out of the centre of motion of the pallets themfelves. The only difficulty is in determining the fituation of thofe points under different circumftances, which we think is a fair object for future experiments.

20. *Harrifon's clock efcapement.*—The efcapements which we have hitherto defcribed require oil on the pallets, to diminifh the friction of the parts that rub againft one another in action; but the efcapement we are now going to defcribe as the invention of the ingenious Harrifon requires no oil, on account of his conftruction being free from rubbing at the time of the pallets' action. *Fig.* 5. of *Plate* XXXIII. exhibits the fhape of Harrifon's efcapement. G D O is a portion of the fwing wheel, moving round M as a centre: A is the verge or arbor of the crutch that communicates with the rod of the pendulum; to this are attached the pallets, each confifting of a long and a fhort lever with a joint at the place of union; the fhort lever A B is faft to the arbor or axis of motion, and carries the longer lever B C which has a claw or hook *a* C, and a flender fpring is fo applied as to keep thefe two levers nearly at right angles to each other; at right angles to A B is alfo the other fhort lever A E faft likewife to the axis of motion, and bearing the longer lever E F, as A B bears the lever B C; the joints are at B and E, and a fimilar fmall fpring holds the levers AE and E F in like manner at right angles to each other, when not otherwife acted on. The lever E F has not only a claw, like the other long lever, but a heel to it, or projecting part *f*. The action of this contrivance may be thus explained; fuppofe the tooth D urging the pallet or claw C, while the pendulum is moving towards the right hand in its excurfion; this preffure of the tooth produces a tendency in the lever B C to move round, but the joint at B yields, and opens the angle A B C a little; during this motion round A, the fhort lever A E is lowered a little, and with it the long lever E F, which we will call the detent; its claw F therefore falls in the way of the tooth G, which now drops on the back part of the claw, and is inferted into a notch under the projecting heel *f*; the further motion of the pendulum, and confequent depreffion of the fhort lever A E, carry the end of the tooth G back again till the vibration is finifhed, and produce a recoil. At the moment when the tooth begins to have a recoil, the tooth D at the pallet or claw C is withdrawn and efcapes; the flender fpring of the lever B C, which had been bent from its quiefcent ftate, now refumes its original fituation, and throws out the lever B C, till its angle formed at B is again nearly a right angle; in the mean time the wheel is detained by the heel of the detent E F, in which fituation it oppofes the vibration through the medium of the two levers E F and E A, which are attached to the crutch of the pendulum. The vibration being finifhed, the pendulum returns towards the left, and the wheel is at liberty to advance again; the preffure of the tooth G on the claw of the detent now affifts the vibration through the arc of efcapement or arc of action, and caufes the pallet C to approach the wheel, till the tooth following D falls on it and experiences a recoil in its turn. This recoil fets the detent F at liberty from the preffure of the tooth G, which now flies back by means of its flender fpring to its rectangular fituation, as it regards the fmall lever A E: prefently this vibration terminates and the pendulum returns, while the tooth following D aids its vibration by pulling forwards the pallet C, when the procefs of making two fucceffive vibrations is gone through, and the fame operation is repeated. The reader will have obferved in this account that the tooth and pallet, or tooth and detent, do not *flide* on one another, but give each other a *direct pufh*, or pull, the bufinefs of the fmall fprings being to remove them from contact by one fudden leap, where rubbing is altogether avoided, which contrivance fuperfedes the neceffity of having oil applied to the pallets, and is certainly an ingenious contrivance, as well as ufeful in practice. It muft be obferved, however, that the recoil, fuch as it is, takes place at the extremities of the vibration, when the momentum of the pendulum is almoft exhaufted, and is therefore the moft unfavourable part of the vibration to occur in; notwithftanding which difadvantage the efcapement has performed as well as any other that had preceded, perhaps as well as any that has followed it, as the regulator to which it was applied has feldom if ever been excelled in fteadinefs and accuracy of performance for fourteen years of uninterrupted fucceffion. The imperfection arifing from the recoil taking place at the extremities of the vibrations feems to have been compenfated by the immenfe momentum of the pendulum that this efcapement admitted of with a comparatively fmall maintaining power, while the abfence of friction and of oil gave it the advantage of permanently uniform action. Of courfe the pendulum was of the grid-iron form, that compenfated the effects of varying temperature, and allowed the efcapement to have its merit appreciated. The report of the performance of Harrifon's regulator with the efcapement in queftion was, that it did not vary *one fecond* per day from any preceding or following day for the fpace of fourteen years, and that the aggregate of the variations from true mean time did not amount to half a minute.

Haley alfo conftructed clock pallets that required no oil,

but

but as none of them have fallen under our notice, we pretend not to ſay how they differed from Harriſon's.

21. *Eſcapement by Alex. Cumming for a clock.*—Mr. Cumming publiſhed his elements of clock and watch-making in the year 1766, in which, among other matters, he deſcribes a conſtruction of an eſcapement of his contrivance, that removes the friction and influence of oil not only during the time of reſt of the pallets, but alſo during the motion of the ſwing wheel, ſo far as they can influence the vibrations of the pendulum; and alſo obviates all the irregularities that can poſſibly ariſe from the maintaining power as tranſmitted through the train. *Fig.* 6. of *Plate* XXXIII. exhibits as much of this eſcapement as is neceſſary for explaining its general action, but thoſe readers who wiſh to ſee all the minutiæ of the conſtruction, as repreſented by different plates of ſections, muſt have recourſe to the book itſelf, as the complexity of the parts repreſented in various points of view demands more minute repreſentation than our plan admits of. Our figure is a copy of plate 5 of the author, in which A B C is the eſcapement or ſwing-wheel; D E the pallets ſeparately moveable on the axis of motion, and having each a little ball or weight H and I reſpectively ſupported by horizontal arms; each pallet with its attached weight is ſeparately moveable from the other round its reſpective axis of motion, ſo that when one is raiſed by the wheel the other remains at reſt; F and G are two detents firmly attached together, like the ordinary pallets of a common dead-beat or recoil eſcapement, and are fixed to a cylinder of braſs P P, that ſurrounds the two axes of motion of the pallets, which are in the ſame ſtraight line but ſeparated from each other at the middle of the cylinder, where is a partition that bears the interior pivot of one axis and the exterior one of the other; the crutch of the pendulum is alſo faſt to the cylinder; ſo that the two detents and crutch move together along with the cylinder, without the motion of either pallet; and each pallet can move ſeparately without the detents and crutch. M is a load to counterpoiſe the detents and crutch in any poſition given them; and *n o* are two pins carried by the pendulum that project far enough to fall alternately in the way of the arms that carry the balls H, I, as the pendulum vibrates.

To explain the action of this eſcapement, let us ſuppoſe the pallets D and E, the detents G and F, the crutch L, and pins *n* and *o*, together with the balls H and I to be exactly as repreſented in the figure, where the lever of the detent G is hid behind the lever of the pallet E, but may be conceived to be parallel to it, the pallet D having been previouſly lifted from its quieſcent poſition, where its point reſted on the rim near the foot of tooth A; then if we conceive the pendulum moving from right to left with the ball I urging the pin *o* attached to an arc fixed to the pendulum, or crutch of the pendulum, the vibration is aided by the gravity alone of this ball. The arc, that bears the pins *n* and *o*, has a contrivance not ſeen in the figure for unlocking the detents at the moment when either of the pins bears againſt its ball, which contrivance it will be ſufficient for our purpoſe to call Z. Conceive now the pin *n* brought into contact with the arm of ball D by the moving pendulum, the detent F is unlocked, and the tooth A of the wheel quits the end of pallet D; the ball H now acts by its gravity on pin *n*, and deſcends, at the ſame time aiding the returning vibration, while the pallet D, united to the arm of ball H, deſcends alſo towards the wheel; but as ſoon as the pendulum firſt began its original vibration, the pin *o* was withdrawn from the preſſure of the ball I, by means of the attached pallet E falling on the tooth C of the wheel, ſo that all the latter part of the vibration was free; this preſſure of pallet E on the tooth C diminiſhed the preſſure of tooth A on the detent F at the inſtant of the unlocking, which we have mentioned; the wheel now in motion by the action of the maintaining power, (through the medium of the train,) goes on till the tooth C, acting on the pallet E, raiſes it outwards, together with its attached ball I, till the detent G ſtops the wheel's motion, when all the parts are at reſt till the pendulum nearly finiſhes its returning vibration, and then its pin *o*, meeting with the elevated arm of ball I, preſſes againſt it and concludes the vibration; at the moment this preſſure is felt the contrivance Z unlocks the detent G, and allows the tooth C to eſcape; in the mean time the ball I by its gravity urges the pendulum for a ſhort time, while the tooth following A, meeting with pallet D, raiſes it and the ball H a ſecond time, the tooth following C comes in the way of pallet E, and ſtops the further action of the ball I on the pendulum, which now vibrates, as before, free, till its pin *n* again meets with the arm of ball H, when the ſame proceſs is repeated; and thus the weights H and I are alternately raiſed by the wheel, and then alternately act for a ſhort time on the pendulum, at the beginning of each vibration, ſo that gravity alone is properly ſpeaking the maintaining power of the pendulum, and whatever may be the maintaining power of the train, it never affects the motion of the pendulum; but only raiſes the balls, that afterwards act on the pendulum by their gravity alternately exerted from a ſtate of reſt. Thus, whatever may be the effects of oil, duſt, friction, wear, &c. on the action of the train of wheel-work, as it has no immediate connection with the pendulum, except during the ſmall inſtant of unlocking the detents, theſe effects are almoſt entirely avoided, as they regard the pendulum or regulating part of the motions. The greateſt objection in theory to this conſtruction is, that the additional gravity commences inſtantaneouſly, and alſo ceaſes inſtantaneouſly, and at a part of the vibration where the inſtantaneous exertion of extraneous force of any ſort is the leaſt favourable for aiding the ſimple gravity of the pendulum's ball, which conſideration is analogous to the obſervation we had occaſion to make on Harriſon's eſcapement; but, like his, the eſcapement before us has ſtood the teſt of practical experience, notwithſtanding its complexity, in his majeſty's private obſervatory. If, however, this eſcapement is not *better* than any of the other eſcapements, the number of its adjuſtments, and variety of its parts, conſtitute a practical objection to its general adoption; and we believe no proof has been given of its being preferable to Harriſon's, or even to the common dead-beat or iſochronal eſcapements, except that the works of the clock that has this eſcapement may not require to be ſo often cleaned. This eſcapement leaving the pendulum free or detached from the wheel-work during the greateſt part of each vibration, is of the third claſs of eſcapements.

22. *Eſcapement by Mudge for a clock.*—The clock eſcapement contrived by Mr. Mudge to detach the pendulum from the train, ſo as to allow it to have nearly a free vibration maintained by gravity alone, may be conſidered as a ſimplification of Cumming's eſcapement juſt deſcribed, from which its principal difference is, that each of his two ſeparate pallets act alſo as detents; the mode of action and effect produced are very ſimilar in both. Mr. Mudge's eſcapement is repreſented by *fig.* 7. of our laſt plate, in which L M is a portion of the ſwing wheel; G A and G B are two levers ſeparately moveable round one common axis of motion, and have each a pallet at the lower extremities; theſe pallets are formed like the common recoil pallets, except that each has a claw at the loweſt point, that prevents the eſcape of the ſliding tooth when acting thereon: the pallet G A has a lever, which

which may be called its tail-piece G O, attached to it, and alfo a fmall metallic ball u furmounted on a pin over the pallet, which may be eafily changed for one of a different weight; the pallet G B has a fimilar tail-piece I O, with a fimilar ball v over its pallet B; and the dark circular fpot at N is the end of a ftiff pin projecting from the pendulum, or its crutch, far enough to fall in the way of the tail-pieces alternately, as the pendulum vibrates. After having perufed our account of the action of the preceding efcapement, the reader will anticipate the explanation we have to offer of this mechanifm. Suppofe the wheel to be urged by the train in its proper direction from I towards M, and an impulfe given to the pendulum, to produce a motion in it in a contrary direction; the pin N keeps pace with the pendulum towards L, while the tooth at L is locked in the claw of pallet A, (which it is fuppofed to have raifed fo as to bring the tail-piece G O out of its vertical direction,) and at length meets with this tail-piece, to which it gives a pufh, at the extremity of the vibration, fufficiently ftrong to drive the pallet A from its locked tooth L, when the wheel is at liberty to proceed, till the tooth near pallet B raifes it and its furmounted ball v until the claw detains the further motion; in the mean time the returning vibration commences, and the ball u urges the pendulum, by means of its tail-piece G O being in contact with the pin N; when, however, the tail-piece has gained its vertical fituation, the pallet A meeting with the rim of the wheel ftops; the pendulum now finifhes its vibration in a detached ftate, having gained an acceffion of force by the impulfe from the ball u downwards, which has been greater than the refiftance it met with in moving upwards at the inftant of unlocking: the tail-piece I O is now in the fituation of I P, by reafon of the ball v being elevated by the wheel, therefore when the pin N of the pendulum arrives at I P, which is at the other extremity nearly of the returning vibration, its ftroke drives the pallet B in its turn from the locked tooth near M, which now efcapes; the wheel is again at liberty to proceed till the tooth behind L has raifed the pallet A a fecond time, when it is again locked; the pendulum begins another vibration, aided by the ball v, till its tail-piece refumes its vertical pofition, and then the pendulum is again detached, after being a fecond time urged down a longer arc than it was oppofed up; and thus the vibrations are maintained by the excefs of the downward pufh over the refiftance upwards at every new vibration, which excefs, derived from gravity alone, is in fact the maintaining power of the pendulum. This efcapement is alfo of the third clafs, and being more fimple in its conftruction than its predeceffor and parent, perhaps we may add, is better adapted for practice. The external force derived from the gravity of the balls in aid of the pendulum's gravity is here alfo both applied and withdrawn fuddenly, as well as at the moft unfavourable parts of the vibration, as was the cafe with Cumming's efcapement; but it poffeffes the fame advantages of detachment from the train.

23. *Detached efcapement by Peter le Roy in* 1748.—We have deviated a little from the regular order of time, in having noticed the detached clock-efcapements before thofe that were previoufly applied to the balance, in order that the fucceffion of improvements made in clock-efcapements might not be interrupted by an intermixture with watch-efcapements. We now go back again to the year 1748, when Peter, the eldeft fon of Julien le Roy, invented an efcapement for a balance that vibrated a confiderable portion of its total arc without any connection whatever with the efcapement wheel, and which therefore may be confidered as the father of the third clafs of efcapements, and the origin of the fubfequent more recent improvements in the efcapement of chronometers. *Fig.* 8. *of Plate* XXXIII. will afford us the means of explaining this efcapement, a model of which was prefented to the Academy of Sciences at Paris in the year 1748, previoufly to which year, no detached efcapement had been made public, though Du Tertre is faid to have invented one, and even to have made it at the time; but as the invention, or at leaft the conftruction, was kept a fecret, it did not derogate from the merit of Peter le Roy's contrivance, which muft be confidered as original. G H is the efcapement wheel of the contrate kind, actuated by a pinion on its arbor, receiving the force of the maintaining power; its profile is feen contiguous to it, at $g\ h$; T V is the balance, the verge of which has a fpiral fpring attached to it at the interior end in the ufual way; a curved pallet A E is faft to the verge under the balance, and the femi-circular piece C I is affixed to the fame above the balance, but under the fpiral fpring; the end C of this piece is rounded, and fo fituated, that a line drawn from it to the centre of the balance would form with the curve A E an angle of about 80°. An angular lever Q P X, turning on pivots under a little cock on the plate at C, is fo proportioned, that the branch P Q will reach the pallet, while the other branch P X with a concave end will reach to a tooth G in the balance wheel, when not refting on a pin K, to which in its quiefcent ftate it is kept by the fpring R M, made faft to the plate on the other fide at R. Suppofe now, the regulating fpring moved from its ftate of natural reft, and the balance to move with it through a certain arc of vibration, more or lefs, till the rounded end C of the femi-circular piece falls on the branch P Q of the angular lever near Q, and pufhes it from its fituation, at the fame time bringing the concave end of branch P X into the way of a tooth G of the wheel; when the acting tooth, which we will call D, efcapes the pallet A E; the wheel is then at liberty till its tooth G falls on the concave end of the branch P X, which may be called the detent, becaufe it now *detains* the wheel from moving further under exifting circumftances. The balance is now perfectly free from all contact of the acting part of the branch P Q, and continues its vibration, after having received a pufh from tooth D on its pallet: prefently its velocity is deftroyed by the tenfion of the regulating fpring, the re-action of which now makes it return with an accelerated motion, when the pallet comes into contact with the efcapement wheel at the tooth following D, which now experiences a recoil for about half of a fpace in the wheel: the branch P X, or detent, is relieved by this partial recoil, and obeys its fpring R M, which takes it back again to its ftate of reft at the pin K; when the wheel, having ftopped the balance, fends it off again with a new impulfe, by ftriking the pallet in a contrary direction, when the fame operation of the angular lever is repeated, and the vibrations are maintained as in other efcapements. It muft be remarked of this efcapement, that it does not allow the balance to be detached for an entire vibration, but oppofes the balance back from the point where it gave its forward pufh, thereby producing a certain recoil, which, fo far as this is a leading confideration, would entitle us to rank the efcapement among thofe of the firft clafs, but inafmuch as the balance vibrates in a detached or free ftate in the remaining portion of its vibration, we may place this efcapement with propriety at the head, in point of time of the third clafs.

24. *Peter le Roy's fecond or improved detached efcapement.*—Some time after Peter le Roy had completed his firft detached efcapement, and had confidered its principal defects, he fet about contriving another, lefs liable to objections, in which he fucceeded in a very confiderable degree; when in the

the year 1766 he presented a time-piece to the Academy of Sciences, which was afterwards tried at sea by the French government, with his improved escapement, which we shall now describe. *Figs*. 1, 2, and 3, of *Plate* XXXIV. exhibit sufficient of Peter le Roy's improved escapement to enable our readers to form a complete idea of its construction; the leading feature of which is to give the balance one temporary push that shall maintain its motion for two successive vibrations, one forwards and the other back, and that this push may be given at a moment of the balance's vibration that is most favourable for avoiding a derangement of the law of the spring's forces. *Fig*. 1. is a view of the balance-wheel, which has six radial levers for teeth, but no rim, that it may be as light as possible, the ends of which levers are bent downwards, that is, in an opposite direction to those on the horizontal wheel with Graham's cylinder escapement; the connection of this horizontal balance-wheel with the train is by means of the pinion on the opposite end of its arbor; *fig*. 2. is the arbor of the detents, on which there are three levers, one double one for locking, and two single ones for unlocking, all clearly shewn in the figure; *fig*. 3. shews the wheel, detents, unlocking levers, and balance in their relative situations, and in one of the acting positions. A is a portion of the balance, on the plane of which is screwed a pallet *p*, so as to fall in the way of one of the levers of the balance-wheel. The same letters denote the same parts in *fig*. 3. as in *figs*. 1 and 2, which therefore explain themselves. The action may be explained thus: suppose one of the levers of the balance-wheel to be detained by the claw of the detent D, while the balance put in motion is vibrating in the direction from *i* to A; when the force of the balance spring, not seen, overcomes the momentum of the balance, it returns by means of the spring's force, which is now at its greatest tension, or distance from the point of quiescence; the direction of the balance, we have said, is now from A towards *i*; in this return a pin at *i*, situated in the superior plane of the balance, strikes the end of the lever H F of the detent arbor, unlocks by this stroke the detent D from the claw of the wheel's radial bar or tooth, and at the same instant directs the other end H *e* of the double detent into the way of a succeeding radial bar of the wheel K *r*, which now rests on this end of the detent; this part of the action is called by the inventor the *preparation*, the vibration goes on to finish, and the spring brings the balance back; at a certain part of this vibration the balance receives its stroke from the radial bar K, which impels the pallet *p*, screwed on the balance itself, in this manner; a pin, situated like the former pin at *i*, but placed on the inferior plane of the balance, out of sight, and a little farther from the balance's centre than the former pin, strikes the end of the short lever H *c*, and unlocks the radial bar of the wheel, that has been resting against the opposite end of the detent D, and that now runs on to D, which is in the way to catch it; during this short period the wheel is free, the pallet *p* of the balance being at that instant in the situation F, the point K of the radial bar K *r* of the wheel pursues the pallet and makes its stroke on it, about the time when the balance-spring, as we suppose, is at its quiescent point, and therefore when the balance is moving with its most accelerated velocity; the stroke is of short duration on that account, as well as on account of the short distance the wheel has to run before it is again detained by the detent D: the backward vibration is made as before, and the same process is repeated of two lockings and unlockings at each stroke of the wheel on the balance. The stroke, however, which the balance receives, has more force than both the strokes that its pins give in the acts of unlocking, and therefore the difference of these contrary strokes constitutes the real maintaining power of the balance, which was of the thermometrical kind, with alcohol and quicksilver, as described under our article COMPENSATION-*balance*. The step made towards perfection, when this escapement was devised, was very long, and the principal objection to it in practice is, that it has too many pivots that require oil, as well other parts that come successively in contact during the action, which therefore are not sufficiently free from friction and consequent wear. It may be necessary to add, that to prevent the detent's being displaced by any jerk, a long tail-piece behind it is contiguous to a circular appendage of the balance, seen from *i* to F, against which it falls, but only when any derangement of the detent accidentally takes place, and thus reinstates it. The stroke is given to the balance not only when its velocity is greatest and least liable to be deranged, but the pallet that receives it, being removed from the centre of the balance, requires but a comparatively small impulse in this situation; besides, the spring, which the inventor considered as not desirable, for holding the angular lever to its place of locking, is here entirely dispensed with. This was considered as an improvement at the time, but subsequent experience has proved the utility of spring detents, which are now in universal use in the best English chronometers.

25. *Detached escapement by F. Berthoud.*—Ferdinand Berthoud, one of the members of the National Institute of France, and the author of various works on horology, has contrived different escapements for clocks and watches at different times, and has written more on the subject than any other author, but it will not come within our plan to detail here all the alterations that have presented themselves to him; we shall satisfy ourselves with describing a few of those which he has himself selected as most worthy of public notice in his last publication; "Histoire de la Mesure du Temps." Others may be seen in his "Traité des Horloges Marines;" or in the "Supplement" to that work. The first that we mean to describe is contained in *fig*. 4. of *Plate* XXXIV., which is a perspective view of all the parts necessary to be seen: A represents the verge of the balance, to which is affixed by two screws the circle of escapement B as a pallet; C is the escapement wheel, *a b c* the detent, which has at *b* a claw to catch a tooth of the wheel, when it suspends its motion, during the period of the balance's free vibration; the portion *a b* of the detent is a flexible spring, that yields first at the point *a*; this, therefore, is the *spring of the detent*; the other part *b c* properly forms the detent, which has a claw rounded at the end *c*; another slender spring *b e* lies cross-wise near the said end, and is held fast to the circle B by a screw and fixing-piece *f*; this second spring carries a pin *d* near its extreme end, which acting on the end of the detent, disengages the locked tooth of the wheel, when the balance vibrates in a direction from B towards A; at that instant the succeeding tooth of the wheel acts on the notch or pallet part of the circular piece B at *h*, and transmits an accession of force to the balance, which now vibrates in free space; at the balance's return, the pin *d* of the small spring *d e*, borne by the balance's circular piece B, applies itself to the end of the detent, so as to slide past it without disturbing its position with regard to the claw, against which the next tooth is now resting; when the balance has finished this second vibration it returns, the pin *d* again pushes aside the detent, and unlocks the wheel, which now gives another push at *h*, and the same operation is resumed that we have been describing. Thus two vibrations are performed at once unlocking, and at one stroke of the wheel on the notch of the circular pallet piece. The small spring *b e* may be

be called the lifting fpring, in oppofition to the detent fpring, or fpring detent ; and to give a clear idea how it detaches the claw of the detent in paffing forwards, but not in paffing back again, it may be neceffary to obferve, that this lifting-fpring has a pin in the circular piece B, againft which it refts, to prevent its laying too much hold on the back floping part of the detent's extremity ; but it is at liberty to yield in the contrary direction towards the verge of the balance ; and as the fpring is very flender, and has its yielding point or centre of motion at the remote end *e*, it gives way to the detent in the direction that pufhes the detent againft the tooth of the wheel, which becomes a prop to fteady it ; but when the impulfe is in a contrary direction, the detent, having no fuch prop, and its end being at that fide fuited to receive the blow of the pin without its fliding, itfelf yields and withdraws its claw from the wheel, which is then unlocked. The fpring of the detent is alfo confined from rebounding too far by a pin *g* fixed in the plate. Here we have an inftance of a retrograde ftep in the improvement of efcapements, the fpring which Peter le Roy laboured to reject in his fecond conftruction is here refumed with an additional fpring, and the adoption of the *fpring-detent* has become general in the fubfequent conftructions. Berthoud began his detached efcapements in the year 1754.

26. *Another modification of a detached efcapement by Berthoud.*—The efcapement which Berthoud employed in fome of his watches, particularly N° 60, was confidered by him to be more fure in its action than the preceding one, as well as more eafy of conftruction ; *fig.* 5. of the fame plate reprefents the plan of one of thefe efcapements, where L is the efcapement wheel ; *m* the circle of efcapement carried on the verge of the balance ; *p o r* the detent, the claw of which at *r* fufpends the motion of the wheel ; the verge carries above the circle *m* a fmall tube made faft by friction, and to this tube is made faft a projecting forked claw, in which a pin is adjufted to act on the detent and raife it. The pin, which we will call *s*, in turning in one direction, acts on the part *p* of the detent, and withdraws the claw *r* from the wheel ; this is now at liberty to impel the circle *m* by its notch and with it the balance ; the flender fpring *u* brings back the claw of the detent, and the vibration goes on ; at its return the pin meets with the end of the detent-fpring fixed on an arm at *t*, this fpring yields to the retrograde motion of the balance. The balance at its return makes its pin (of the fork) urge the fpring *p* againft a pin *s* in the arm *n* of the detent ; this arm turning on its centre of motion, withdraws the claw of the detent from the wheel, which now acts again on the notch of the circle *m*, as before. The pin *q* ferves as a ftop to the detent, and the arm *k* of *precaution* is to lock the wheel when the balance is difmounted.

27. *Another efcapement without a fpring by Berthoud.*—*Fig.* 6. of the laft plate is a view of an efcapement by Berthoud, in which he has difpenfed with fprings altogether. The action of the wheel A is tranfmitted to the balance, as before, by the notch of the circular piece B on the verge ; the prefent pofition of the parts is for the moment when the detent allows the wheel to begin its action on the notch of B. The detent C has two arms, with each a claw *a* and *b*, the faces of which are circular ; the claw *a* ferves to fufpend the action of the wheel after its ftroke is made ; but the claw *b* receives the tooth of the wheel when the balance in its return makes the tooth at *a* to efcape. Thefe effects are produced by two levers C *d*, C *e*, forming the fork that moves the detent C : this fork is fixed on the centre C of the detent, and its levers lie one above the other. The lever C *d*, which is contiguous to the detent, correfponds to the fmall femi-circular piece *d e*, placed on the circle of efcapement B ; this femi-circle is notched by lines, one of which tends to the centre ; this fide of the notch unlocks the wheel by its action on the arm C *d* whenever the balance retrogrades from the firft vibration of the pair ; during this effect the wheel advances but a fhort way, juft fufficient to unlock the claw *a*, and to fuffer the balance to proceed in its retrogradation. The balance, having finifhed in a detached ftate this fecond vibration, returns, when the femicircle *f g*, placed over the other femi-circle, and notched in like manner, prefents its acting fide to the upper arm *f* C of the fork, and unlocks the tooth at claw *b* ; at this moment another tooth, catching the notch at *c* of the circular piece B, gives it another impulfe, and confequently puts the balance in a ftate of renewed force, and the procefs already defcribed is renewed, while the femi-circular pieces *d e* and *f g* on the verge alternately ferve to keep the arms C *d* and C *e* of the fork in a firm pofition to enfure the defired effects of the efcapement. It is eafy to perceive that there muft be much friction in this efcapement, and that the femicircular pieces on the verge of the balance, if not fomehow counterpoifed, muft affect the rate of going in different pofitions of the time-piece.

28. *Detached efcapement with a detent and fpring by Berthoud.*—*Fig.* 7. of the fame plate is the plan of another of Berthoud's efcapements with a detent and fpring, and that which we underftand has been moft copied by others. It was ufed in the author's marine time-piece N° 9. A is the circle of efcapement ; C the wheel ; *a b d* the detent with three arms ; the arm *a* fufpends the motion of the wheel while the balance ofcillates in a free ftate ; the fpring *d* ferves to bring the detent *a* back again as foon as the pallet *c* has ceafed to act on the arm *b* ; at that moment one of the teeth of the wheel impels the circle by acting on the roller *h*, and communicates its force to the balance ; this having finifhed its ofcillation returns, and in the return the pallet *c* meets with the end *b* of the detent, which turns the pallet back towards B, the centre of the circle, till it has paffed without unlocking the wheel ; its fpring *b* brings the pallet back again to its original ftate of reft on the pin at *c*, the ofcillation ceafes, and in the return of the balance the pallet *c* again meets with the arm *b* of the detent, which it turns afide, the tooth being no prop to it in this direction ; the unlocking therefore takes place ; the wheel's motion is refumed, and a new impulfe is given to the moving balance. Here the detents are arms or levers acted on by a feparate fpring, as is alfo the pallet, confequently there ftill remain pivots that require oil, though we are difpofed to confider this as the beft of Berthoud's watch efcapements ; perhaps equal to any of the Englifh conftructions.

29. *Ifochronal efcapement of a watch by F. Berthoud.*—Among the other contrivances of Berthoud is an efcapement for a watch with ifochronal pallets, fimilar to thofe applied to a pendulum which we have defcribed above, but the mode of applying them is different. In *fig.* 8. of our laft plate, A is the efcapement wheel ; B the anchor with the ifochronal pallets producing a fmall recoil, and formed in the manner before defcribed, (fee *fig.* 1. of *Plate* XXXIII.) C D the balance ; *a* a pinion on the verge above the wheel, that is actuated by a fectoral toothed piece *b*, attached to the anchor of the pallets, and moving with it round the common centre of motion of it and the pallets at E ; the intention of this conftruction is to produce a long ofcillation of the balance compared to the motion of the wheel and toothed fectoral piece, and to render all the ofcillations, however long or fhort, of equal duration, the arcs of action being large in proportion to the whole ofcillations. This conftruction may

may have given rife to that which is now known by the name of the Liverpool efcapement, which fo greatly refembles it, that they may be confidered as the fame thing. We obtained a watch by Litherland of Liverpool, with a view of giving a feparate defcription and drawing, but we found that the only difference is, that the pallets are placed a little on one fide of the wheel, inftead of the three pivots being in one ftraight line, and that the centre of the pallet's motion is between the verge and pallets requiring a counterpoife behind: a further defcription is therefore unneceffary.

30. *Modern efcapements of Englifh chronometers.*—If we had not already anticipated our defcriptions of the modern efcapements for chronometers, as they are now made in England, we fhould have given them a place here; but as we have been very minute in our account of the efcapements of Meffrs. Mudge, Arnold, the Brockbanks, and Earnfhaw, under our article CHRONOMETER, and have given drawings of them in our *Plates* XIII. XIV. and XV., it would be fuperfluous to enter into a fecond detail of the fame here, and therefore we pafs over them by a fimple reference to the article already named.

It may not be improper to mention here, that Mr. John Watkin, of Weft Smithfield, has propofed an alteration in the fituation of the pallets in the modern fpring detent efcapement, for which he received thirty guineas as a premium from the Adelphi Society, in the year 1804. His alteration confifts in bringing the pallets into a fituation between the centre and circumference of the wheel, and making the wheel a contrate one with the teeth upwards. (See the Tranfactions of the Society, vol. xxiii. p. 375.)

31. *Mudge's forked efcapement.*—Mr. Mudge contrived another detached efcapement befides the one we have referred to as already defcribed, which we fhall now notice, though he did not feem to place fo much value on it as Emery, Margetts, and others have done after him; we fhall not be able to make the reader comprehend the conftruction without two figures: *fig.* 1. of *Plate* XXXV. is the plan of this efcapement, and *fig.* 2. a profile or fide view of the frame that contains the mechanifm: A is the efcapement wheel, B the anchor of the pallets, which are of Graham's dead-beat kind adapted to a watch, and which give the neceffary force to the balance for maintaining its motion; *a* is the centre of motion of the anchor, nearer to the wheel than to the balance; *b* is the forked part of the anchor, the two prongs of which appear in *fig.* 1. to be clofe together in the fame plane, but *fig.* 2. fhews that they are one above the other. The pallets are on the verge of the balance, and are of the cylindrical fort, one above the other, fo as to fall in the way of the two prongs alternately, pallet 1 is urged by *b*, and pallet 2 by the other prong in its turn; the time of action of the prongs on the two pallets is very fhort, and the blows are made alternately one in each vibration; the remainder of the vibration is perfectly free, the wheel being in the intervals refting on the circular portions or pads of the anchor's pallets, which may in this cafe be confidered as detents and pallets alternately. A timepiece by Emery with this efcapement performed with wonderful accuracy, though the detachment continues only for a portion of one vibration before the balance has its force renewed, which confequently might be fuppofed to have its motion more difturbed than if the impulfe had been given at each alternate vibration. The queen's watch by Mudge with this efcapement had a flight recoil, which kept one of the prongs preffing gently againft the cylinder of the verge to fteady the fork. The performance was excellent.

32. *Margetts' modification of Mudge's forked efcapement.*—The late ingenious Margetts adopted Mr. Mudge's efcapement, which we have juft defcribed, for his chronometers that indicated both folar and fiderial time, but made fome alterations with the fork. *Fig.* 3. of the fame plate fhews the plan and profile of Margetts' modification, where A is the wheel; *a b* the anchor moveable at *a*; *b* the fork where the prongs are in the fame plane; *c* a piece of fteel carrying a pin *e* under its extreme end that ftrikes the prongs of the fork *b* alternately, one at each ofcillation of the balance *g*, which ftrokes unlock the wheel; *h* and *i* are two banking fcrews, the points of which act as ftops to the anchor at oppofite fides of the centre of motion, and keep the fork in its place to be caught by the pin *e*, one or other of them at each vibration; *d* is a circular piece of metal, under the pallet piece *c*, that has a notch in it bounded by ftraight lines going towards its centre; and *f* is a pin carried under the anchor, as feen in the figure, the end of which gives the circular piece *d* a pufh, by acting on its notched fide at each unlocking of the wheel, thereby aiding the vibration: the pin *f* is always at the notch when the pin *e* is in the fork, therefore the notch in *d* and the pin in *c* are always placed in the fame vertical line over one another, and as they move together on the verge will always remain fo, while the pin *f* and fork *b* are alfo together on the anchor. The writer of the prefent article has a chronometer by Margetts with this efcapement, which acts very well when ftationary, but when carried in the pocket the pin is apt to catch the outfide of the prong, when any jerk has fent the anchor back during the balance's excurfion.

33. *Modification of Mudge's forked efcapement by R. Robin of Paris.*—R. Robin, a watch-maker of Paris, publifhed a memoir in 1794, containing an account of a free efcapement, which he confidered as new, but which we confider as another modification of Mr. Mudge's forked efcapement, though we allow that in theory it appears to be an improvement. *Fig.* 4. of the fame plate is a plan of this efcapement, in which the wheel reftores the exhaufted force of the balance once only in two vibrations, which circumftance conftitutes the improvement; to effect this, pallets G *a*, and G *b*, acting as detents, are made of unequal length from G, the centre of their motion, and the fork, which is feen feparately at *e*, as well as the tooth or pallet *d* and lever *f*, are concealed under B, the circular piece carried by the balance; the fork *e* is faft to the end of one of the pallets *a*, inftead of forming an anchor with the pallets, but this fhape makes no difference in the action; the lever *f* is alfo faft to the fame underneath the fork; but the tooth *d*, which acts with the fork, is faft to the verge under B, as we have already faid. We have given three pofitions of the circular part B and pallets, to fhew more clearly the nature of the action, as fome of the acting parts are concealed. One of the claws *a* of the pallets being removed, the wheel A efcapes, and acts on the notch of the piece B, thereby aiding the balance; the claw *b* receives another tooth and holds it as a detent, and the balance finifhes its ofcillation; at its return it unlocks the tooth at *b*, which is the longer pallet, and the wheel runs on a very fhort way till a leading tooth falls on the pallet *a*, and the balance vibrates without a new pufh; at its return the tooth at *a* is unlocked, and its efcaping tooth gives the notch of B another pufh, which ferves for other two vibrations; but if the two ends of the pallets G *b*, and G *a*, had been of equal lengths, the efcapement would have acted in the ufual way, and would have given its pufh at each ofcillation. The manner in which this effect is produced, however, does not yet appear evident: the lever *f*, which is faft to the end *a* of the pallet or detent G *a*, refts in a groove made in a circular collet on the verge, and holds the fork *e* from going on one fide, like as the banking

 fcrews

fcrews do in Margetts' efcapement, then the tooth d, faft to the balance, ftrikes the two prongs of the forks alternately, one at each vibration, which ftrokes make two unlockings during the time that one pufh is made to the balance by a tooth; becaufe the faid tooth previoufly made two fteps forward, one long and one fhort, before it efcaped to make its pufh. We have not been informed how this modification performed, but we fee no reafon to doubt its competency, while we fee much reafon to admire the ingenuity of the application of two detents of unequal length, formed like the pallets of the anchor efcapement, which detents we have named pallets on that account.

34. *Prior's modification of Mudge's forked efcapement.*—In the year 1798 Mr. John Prior received 30 guineas as a premium from the Society for the Encouragement of Arts at the Adelphi, for his invention of what he confidered a new detached efcapement; but its fork differs from Mudge's principally in its having a roller for a pallet borne by an arbor carried by the balance itfelf; the wheel of efcapement, together with its acting pallets, were fimilar to Le Paute's improvement on Amant's wheel, and therefore had nothing original in it. The reader who wifhes to fee the account and drawings of this efcapement, compofed as it is of Mudge's and Le Paute's contrivances, which notwithftanding the author might not have feen or known, may find it in the 16th vol. of the Tranfactions of the Society juft named, and alfo in the 2d vol. of Nicholfon's Journal, 4to. ed. p. 363 and 364, where the editor has remarked that Mr. Crofthwaite of Dublin had made a pendulum clock with fimilar pallets in 1788, which was defcribed in the Memoirs of the Irifh Acad. vol. ii.

Prior junior has very recently been rewarded by the fame fociety for another efcapement contrived by him for a clock, but the account of it is not yet publifhed in their Tranfactions, and therefore cannot with propriety be given here.

35. *Duplex efcapement.*—We are not informed who was the original contriver of the efcapement known by the name of *Duplex* efcapement, a name probably taken from the circumftance of its having a wheel with *two* fets of teeth neceffary for the efcaping; neither are we aware of its date: but the efteem in which it is held by thofe who have tried it, entitle it to a place in our collection. *Fig.* 5. of *Plate* XXXV. exhibits on a large fcale enough of the acting parts to enable us to convey an idea of its action. A B is a part of the efcapement wheel, having teeth a, b, c, &c. at the periphery, intended for detaining the wheel while it ofcillates beyond the angle of action. An agate cylinder $d\,e\,f$, placed on the verge of the balance, acts with thefe teeth to produce the defired effect. This cylindrical agate has a notch d, which paffes by the tooth at D, that is fuppofed to reft on the cylindrical furface, when the motion is in the direction $d\,e\,f$; but when the motion of the cylinder is in the contrary direction $f\,e\,d$, the tooth at D falls into the notch and accompanies it, preffing on one of its fides till the notch comes into the fituation d: the tooth, then at the fituation of b, efcapes from the notch, and a fucceeding tooth falls on the convex furface of the cylinder at D. The other fet of teeth are erect on the plane of the wheel's rim, and are ftrong and fquared at the fides; they ftand a little fhort of the middle of the fpaces between the pointed teeth on the edge of the wheel, but confift of the fame number; they are to be feen at h, i, &c. denoted by darkened parallelograms: above the fmall cylinder we have named as being made of agate, is a larger one E F G without a notch, and placed high enough on the verge to go over the edge of the wheel's rim; this bears a pallet of ruby or fapphire G, long enough to fall in the way of the fquare vertical teeth, when they happen to be near the line joining the centres of motion of the balance and wheel, but fhort enough to avoid touching the teeth when not near that line. The larger cylinder is fo placed with refpect to the fmall one, that when the tooth b has juft efcaped from the notch, the pallet G has juft paffed the fquare tooth h, which was at A, while D refted on the fmall cylinder, but is moved from A to h, while D moves to b. The wheel is now free, and the tooth h exerts its force, derived from the main-fpring, in the moft direct way on the pallet G, and urges it forward till another tooth on the edge falls on the convex part of the fmall cylinder $d\,e\,f$, and the fame action that has been defcribed is refumed. The angle of action in this efcapement depends partly on the length of the pallet G, and partly on the diameter of the fmall agate cylinder, and advance of tooth D into the notch; for when a horizontal tooth on the edge falls on the faid fmall cylinder, the motion of the wheel is arrefted, and the vertical fquare tooth ceafes to impel the pallet G fo far as it otherwife would have done. This efcapement requires very little oil on the fmall agate cylinder, and none at all on the pallet G, which receives a direct pufh without friction, and its excellence is confidered as at leaft equal to that of Graham's horizontal or cylindrical efcapement.

36. *Free efcapement under the pendulum.*—The clock efcapements which we have before defcribed fuppofe a connection with the upper end of the pendulum, which is the moft common connection, but there are efcapements that give their impulfe at the inferior end, one of which is reprefented by *fig.* 8. of *Plate* XXXV. which we fhall now defcribe, though we know not who was its original contriver. The part A B D C is made faft to the rod of the pendulum, and vibrates therewith; at B is a joint on which the lever B C is moveable; fo that when the end C meets with any refiftance the lever mounts upwards at this end, but cannot fall below a horizontal line; it terminates in a claw with both an interior and exterior flope or inclined plane; D is a pallet of agate or other polifhed ftone, with a flat face next the end C of the lever, and made faft into the vertical part A D; F G H I is a two-armed detent, moveable round H as a centre, but kept in its prefent pofition againft the ftop or pin K, by means of the weight G, when not otherwife acted on. In the prefent pofition the arm H I, which forms the detent, detains the tooth I of a vertical wheel of efcapement, while the pendulum is fuppofed to be vibrating clear of all the teeth. Let us fuppofe the end C of the horizontal lever, moving with the pendulum, to be approaching the end F of the fecond arm of the detent; prefently it gives the end F a blow, the lever C flies up, flides over the inclined face of F, and returns into its horizontal pofition; when the vibration terminates, the pendulum returns by virtue of its gravity, and the interior face of claw C catches the exterior one of the arm F, and gives it a pull fufficient to draw the end of H I from the tooth I; the wheel is then at liberty to run on till the tooth E, moving fafter than the pendulum, overtakes the pallet D, and gives it a direct pufh forwards; this pufh aids the claw C to get over the claw of F, and the weight G replaces the arm H I to catch the following tooth M, which prevents the further impulfe of the wheel on the pallet D, and fuffers the pendulum to finifh its vibration in free fpace; at the return of the pendulum the fame operation is repeated, and the pendulum continues to receive one pufh at every two vibrations, and that when the pendulum is in its vertical pofition, or moving with its greateft velocity, which we have faid is the moft favourable point of the arc. The arc of action, before the pallet is quitted, depends greatly on the

the radius of the wheel compared to the length of the pendulum, when the number of teeth is limited. The pendulum, however, ought to be of the compensating kind, otherwise an increase in the length of the rod will derange the action of the claw C, with the claw F, as well as of the tooth on the pallet D, in all the extremes of atmospheric temperature. The maintaining power of the train that actuates the wheel E M may be either a spring or weight, as the mechanist may think proper. Berthoud has proposed this construction of a free escapement for a half-second's pendulum in his "Histoire de la Mesure du Temps," tome i. p. 214; but he does not clearly say that it was of his own contrivance; on examining his drawings, since our observations were written on this escapement, we find that this author proposed a compensation pendulum to be used with it; and he proposes such a combination of parts as a proper model for an astronomical clock to vibrate half-seconds. Mr. Nicholson, who has also described the same escapement as one he has noticed in England, does not venture to ascribe its invention to any particular artist.

37. *Detached escapement of a clock by Berthoud.*—Among the numerous contrivances of F. Berthoud in clock-work, we frequently find this author applying the same contrivance to answer different purposes; for instance, when he had hit upon an isochronal escapement for a clock, he adapted it soon after, as we have seen, to a watch; and in the instance before us, he has converted a free or detached escapement of a watch into a clock escapement, which we shall here describe, not knowing the exact date of the application. *Fig.* 1. of *Plate* XXXVI. is a representation of an escapement of the third class adapted to a half second's pendulum, as described by Berthoud himself. F is the escapement wheel, and *a*, *b*, the detents of escapement, (formed like the pallets of the dead-beat escapement of Graham,) the action of the wheel F is transmitted to the pendulum by means of the notch made in the circular portion of the escapement piece A B, thus; the detent has two claws, *a* and *b*, formed by portions of a circle, at the holding parts. The claw *a* serves to suspend the action of the wheel, when it has communicated its motion to the notch of the escapement piece, which this does again to the pendulum, by means of the lever C, which it carries, and of the roller D, corresponding to the pendulum. The claw *b* serves to receive, and to detain the wheel, when the pendulum returns. These effects are produced by two levers *d c*, *e c*, fixed on the centre *c* of the detent; but one of them more distant from the plane than the other. These two levers form a fork that corresponds to the circle of escapement *b g*. The lever *d e*, which is nearest to the detent, answers to one portion of the circle *g*, carried by the circle of the escapement D. This part *g* presents a straight line to the fork *d*, which being acted on, detaches the claw *a* of the detent, and, consequently, sets the wheel at liberty. The notch *f* presents itself, and the tooth of the wheel acts on the notch, and restores to the pendulum the force that it had lost. The wheel having finished its action on the notch *f*, a tooth presents itself to the claw *b*, and the pendulum finishes its vibration in a free manner, at its return, the portion of the circle *g*, which is most elevated, meets with the arm *e* of the fork, and disengages the claw *d*; the tooth that was here detained now escapes, and runs on a short space before another tooth drops on the claw *a*, and the process is repeated. We have not seen this escapement in England.

38. *Escapement by Mr. Nicholson.*—Some time in the year 1784, Mr. Nicholson says (Phil. Jour. vol. ii. 4to. p. 59.) that he contrived a clock escapement to go without oil, and which is of the dead-beat kind; it was constructed in the year 1798, and when the account was written had been going freely for a year or more. His account is this, *fig.* 2. of *Plate* XXXVI. "is a sketch, in which G H represents a steel wheel; D and E are pallets of agate, with flat polished faces. The pallet D is fixed to the lever D C, which is confined to its present situation by the loaded branch or arm C B resting on the stop *k*. The lever E C is also kept in its situation by the loaded arm C A resting upon I. A pin N proceeds from the pendulum rod to its situation between the levers. The centre of motion of the pendulum is in the continuation of the axis of the pallets. Suppose the vibrations to be begun; the pin N in its progress will lift the pallet D towards L, while part of the weight B will be supported by the tooth of the wheel which will follow, and at last escape and suffer the opposite tooth F to fall on the pallet E. But in its return, or descent, the pendulum will be acted on by the whole weight B, and, consequently, its vibration will be kept up. When the pin N raises the pallet E, a similar effect will take place on the side of the perpendicular towards M, and thus the process will go on as long as the wheel G H retains any force." In this escapement, the two weights are not raised entirely by the action of the wheel, but are chiefly lifted by the pendulum itself; therefore though the vibration is made during the repose of the wheel, in a state detached from the train, yet the pendulum is not detached from the weights, and, consequently, the compound law of forces by which the pendulum is maintained consists of the action of the pendulum's gravity, of the action of the ball's gravity, which acts in concert with the other, and of a short action of the wheel on the agate pallet; this compound action differs from Mudge's and Cumming's in this respect, that their weights are raised by the wheel entirely without opposing the pendulum, otherwise than by the short stroke made at unlocking.

39. *Crank escapement by Simon Goodrich.*—In the year 1799 the Adelphi Society rewarded Mr. Goodrich for his contrivance of a crank escapement, which is exhibited in *figs.* 3. and 4. of *Plate* XXXVI. of which *fig.* 3. is a front view, and *fig.* 4. a side view of the same, where the same letters of reference apply to both. A A A A is the back plate of a clock frame; B the crank fixed to the end of C the arbor of the last pinion of the train; D, D, are two small wire chains, composed of two links only attached to the crank B, by means of two collets, with great liberty of play. These chains are fastened to E, E, two small springs screwed to F F F, a bar that goes across, and is fastened in the middle to G G, the crutch of the pendulum. I, I, are two screws going through the bar F; the ends of which being made to act against the springs E, E, serve to adjust them to a proper distance and degree of strength, and by that means easily to put the pendulum into proper beat. In *fig.* 3. the pendulum is partly represented by dotted lines, in order to shew the crank, &c. The advantages attributed to this construction are, simplicity of construction and consequent cheapness; total silence during the escape; uniformity of action on the pendulum; durability and certainty of continuance; and the power of acting without oil. These properties may recommend the escapement before us, but as its influence on the pendulum is constant, it is but ill calculated to counteract any irregularities in the maintaining power as transmitted and varied by the train under different circumstances of wear, dirt, and friction. The originality of the contrivance is that of a rotatory motion converted into a vibratory one, which Soumille had done very nearly in the same way in the year 1746. (See Machines et Inventions approuvées par l'Academie Royal des Sciences; tome xiii. p. 325.) As there is no escapement wheel, a

 further

further explanation is unneceſſary to every one who has ſeen a treadle in action; but it may be neceſſary to remark that an additional wheel and pinion muſt be requiſite in the train where the laſt pinion revolves more frequently than in other eſcapements.

40. *Eſcapement without a verge on the pallets by Ed. Maſſey.*—Mr. Maſſey's eſcapement without a verge was one of two eſcapements which together gained him twenty guineas from the Adelphi Society in 1803; the other, being of the 4th claſs, will be deſcribed in another place. *Fig.* 5. of *Plate* XXXVI. is a plan of this eſcapement, which is of a novel conſtruction, borrowed probably from the ſpring detent eſcapement of the modern chronometers, and adapted to a clock, where the pendulum is free, during a large portion of its vibration. The pendulum rod is ſeen at *a*, ſuſpended by a piece of watch ſpring in the uſual way, but without a crutch and verge; *b* is the ſwing wheel with its teeth ſhaped like the dead-beat kind, except that they are rounded at the end; this wheel is not within the frame as uſual, but on the outſide of the back plate; *c* and *d* are the arms of the pallets *f* and *g* reſpectively; theſe arms are attached to the frame, and are adjuſtable for the included angle by the ſcrews *h* and *i*, which preſs againſt the upper ends of the arms, that open like a pair of tongs, and are kept open by a ſlender ſpring *e* forced into notches at the ends. A croſs bar *k*, carried by the pendulum, gives alternate ſtrokes to the two pins fixed in the pallets *f* and *g*, at the time of unlocking. In the figure the pendulum is ſuppoſed to be in motion with the pin of pallet *g* reſting againſt the croſs bar *k*, which bar it impels on the returning vibration, and aids the pendulum, while the inclined plane of pallet *f* is raiſed by the wheel to give its ſtroke, when unlocked, in a contrary direction. Thus the pallets are raiſed partly by the wheel and partly by the pendulum, as is the caſe with Mr. Nicholſon's pallets; for the ſpring in this caſe performs the ſame office that the weight does in that; but in this eſcapement the inclined planes muſt require oil, which is not neceſſary in the other, where the wheel acts by a direct puſh without any ſliding motion. The inventor tells us, that a more than uſually large maintaining power is neceſſary when this eſcapement is adopted, which indeed muſt be the caſe with all detached eſcapements, where the duration of the impulſe is ſhort.

The reader may have obſerved that we have not yet noticed in this article the fourth claſs of eſcapements which act by the aid of *remontoirs*; this omiſſion has been intentional, not only for the purpoſe of avoiding the further enlargement of the article, but that we may give the hiſtory of the invention of the *remontoir*, and of its modifications by the different ingenious men, who have preferred its uſe to that of a detached eſcapement without ſuch additional aid. We have already had occaſion to ſpeak of Harriſon's and Mudge's auxiliary ſprings, or remontoirs, under our article CHRONOMETER, and it will ſuffice, for our preſent purpoſe, to name here that Huygens, Leibnitz, Gaudron, Haley, Breguet, De Lafons, Maſſey, Mendam, Antis, and others have taken a part in bringing the remontoir into notice, as we ſhall have occaſion to relate more particularly under the article REMONTOIR.

ESCARAY, in *Geography*, a town of Spain, in Old Caſtile; 5 miles S. of Calzada.

ESCARIGO, a town of Portugal, in the province of Beira; 12 miles N.W. of Penna Macor.

ESCARPE, or SCARP, in *Military Affairs*, relates to the exterior ſlope of each defence, while on the other hand the interior ſlope of every excavation beyond or facing the eſcarpe is deſignated the counter-ſcarp. It may be neceſſary to remark, that, in ſtrictneſs, the term is not applicable, except where ſome talus or ſlope is given to the exterior, though it is in very general and indiſcriminate uſe. Originally, when the ſides of hills, &c. were to be defended, it was found neceſſary to remove all ſuch maſſes as might afford cover to an approaching enemy, or enable them to aſcend to the aſſault; each rugged exuberance being in ſuch caſes adequate to the ſteps of a ladder, and offering a footing to the aſſailants.

To avoid this facility of attack, it became cuſtomary to chip away the prominent parts, and to render the ſurface inacceſſible; this was effected by eſcarping it, (from the French verb *eſcarper*, to cut ſteep or ſloping,) in ſuch manner as to render it impoſſible for any one to aſcend without the aid of ladders, &c.; giving at the ſame time a direct line of fire to the defenders, and enabling them to roll down ſtones, &c. with prodigious effect, upon ſuch as ſhould have the temerity to aſſault.

Latterly, however, the term has been applied to the exterior face of the works, whether the wall, or revetement, be inclined or perpendicular. Nor does the corruption ſtop here; for many are in the habit of calling the berm the eſcarpe, and of confounding the covert-way with the counter-ſcarp: whereas neither the eſcarpe nor the counter-ſcarp have any thing to do with the terre-pleine, or level ground; but are applicable ſolely to the inclined faces of the ditch and ramparts reſpectively.

It is true that modern engineers, who often allow their phraſeology to follow cuſtom rather than etymology, make little, if any, diſtinction between ſuch revetements as are inclined, and ſuch as are perpendicular: not that many opportunities exiſt for indulgence in this error; there being very few walls or revetements intended for military works, and eſpecially for the faces of parts ſubject to be battered, which have not a talus equal to at leaſt one-ſixth of their reſpective heights.

In ſome fortreſſes leſs reliance is placed on the artillery mounted upon the ſeveral works than upon the advantages afforded by the inclination of the eſcarpe. Thus, where a fort or redoubt is built upon a conical mound of rock, of which the interior may be excavated for lodging the defenders and their ſupplies, if the face of the cone be every where eſcarped to an angle of about 40°, or more, from the horizon, a very moderate perpendicular, ſay to the depth of ſeven feet, around the ſummit, will prevent any aſſailants, however numerous, from carrying the place by ſtorm; provided that perpendicular be properly manned and ſupplied with large ſtones, perhaps from twenty to a hundred pounds weight, which being rolled down the eſcarpe, invariably precipitate all who may be in the line of their deſcent; ſuch a defence is not to be overcome ſo long as vigilance is maintained, and a ſupply of ſtones is at hand.

In India, (as well as in other parts of the world,) ſmall forts are often eſcarped on this principle; there the ſtones held in preparation for defence, all along the interior of the parapet, are deſignated "Mut-wallahs," (*i. e.* drunken men,) in alluſion to the manner in which they roll, and in which thoſe whom they overſet are tumbled down to the plain below.

ESCARS, in *Geography*, a ſmall town of France, in the department of the Upper Vienne; 15 miles S.W. of Limoges, which, before the French revolution of 1789, conferred the title of count on the lords of the manor.

ESCARTELE', in *Heraldry*, quartered, or quarterly. See QUARTERING.

ESCATALENS, in *Geography*, a ſmall town of France, in the department of the Lot; 6 miles W. of Montauban.

ESCATARI, a ſmall iſland about 5 leagues N. of Louiſbourg, in the iſland of Cape Breton.

ESCATRON, a ſmall town of Spain, in the province of Aragon, above the confluence of the Martin and Ebro, nearly oppoſite to Rueda, between Saragoſſa and Mequinenza.

ESCAUT, The, more generally known in England by its Flemiſh or Dutch appellation of the *Scheldt*, or *Schelde*, was formerly a river of Auſtrian Flanders, and is now a river of France, which gives its name to one of the northern departments. It has its ſource in the department of the Somme, near Beaurevoir, a few miles to the north of Saint Quentin, a town of the department of the Aiſne; runs by Beauvoiſi, Catelet, Homécourt, Crévecœur, Cambray, Houdain, Bouchain, Neuville, Denain, Valenciennes, Fraine, and Condé, where it becomes navigable, after having received the Aiſne; it then flows to Mortagne, where it receives the Scarpe; from thence it goes on to Tournay, Gand, and Antwerp, where it is 701 mètres, or 360 fathoms wide, and 10 metres, or 30 feet deep at low water; the tide at high water riſes 15 feet. After having paſſed Antwerp, the Eſcaut branches out into two channels; the eaſtern one paſſes by Bergen-op-Zoom, the weſt channel, called the Upper Eſcaut, loſes itſelf between the iſlands of Zealand into the North ſea, near Fleſſingue or Fluſhing. From Antwerp to this place its courſe is 74 miles; it widens gradually, and has pretty nearly the ſame depth every where; but its bed is obſtructed by ſand-banks, which render its navigation difficult and dangerous.

The Eſcaut has a communication with the river Somme by means of a canal, part of which is under ground.

Escaut, *the department of the*, is the ninth department of the firſt region or United Countries (pays réunis) of France, and derives its name from the river Eſcaut (Schelde) which traverſes it from ſouth to north. It is compoſed of part of Auſtrian Flanders; its chief place is Gand. The limits of the department of the Eſcaut are to the north, the kingdom of Holland; to the eaſt, the departments of the Dyle and of the two Nethes, from which it is ſeparated by the Eſcaut; to the ſouth, the department of Jemmapes, and to the weſt, that of the Lys. Its principal rivers are the Eſcaut, the Lys, the Durenn, the Liévre, the Dender, &c.

There are ſeveral canals in this department; that which goes from Gand to Bruges, and from Bruges to Oſtend, is the moſt important. Another towards the north opens a communication between Rodenherpen and Sao-de-Gand; a third one, near Morbeck, communicates by one of its branches with Axel, and by the other with Hulſt. There are alſo ſeveral leſſer canals for the purpoſes of irrigation, or of draining low marſhy grounds.

The ſoil is in general fertile, and produces all ſorts of corn and vegetables, chiefly hemp, flax, and hops. It abounds in game. Domeſtic fowls and ſweet water fiſh are plentiful. The chief manufactures are thoſe of linen yarn, linen cloth, cobalt, Pruſſian blue, ribbands, woollen cloth, earthenware, glaſs, writing paper. There are alſo ſeveral paper mills, ſugar-houſes, ſalt-works, and bleaching grounds.

The territorial extent of the department of the Eſcaut is $2888\frac{1}{2}$ ſquare kiliometres, or $159\frac{3}{4}$ ſquare leagues; its population 595,258, or 3720 inhabitants to the ſquare league. The whole department is divided into four diſtricts, Gand, Audenaërd, Termonde, and l'Ecluſe; 41 cantons, and 338 communes. The average contribution of every individual to the expences of the ſtate is about 9*s.* 2*d.* ſterling annually. Herbin Statiſtique de la France.

Escaut *and Meuſe, the department of the*, in Dutch the department of the Schelde and Maas, is one of the new diviſions of the kingdom of Holland, and is reported to compriſe the weſtern part of the ancient Dutch Brabant, Zealand, and the iſlands of the Maas or Meuſe. Middleburg is its chief place.

ESCH, a town of the duchy of Luxembourg, on the Sour; 7 miles W. of Dierich.

Esch, in *Ichthyology*, a name given by Hildegard and others to the fiſh we call the grayling, or umber, and the generality of authors, the thymallus. It is of the coregonous kind, and is diſtinguiſhed by Artedi by the upper jaw being longer, and the back fin containing twenty-three bones. The Germans call it *aſch*, and the Italians *temello*. See Salmo *Thymallus*.

ESCHALLOT, *Cepa Aſcalonica*, in *Botany*, a ſpecies of onion, cultivated in gardens for its uſe in cookery, and nearly reſembling the Welch onion. See Cepa.

ESCHAR. This term, in *Surgery*, implies a portion of fleſh, deadened by the application either of actual fire or cauſtic ſubſtances. In caſes of violent burns we frequently ſee eſchars produced; and whenever we wiſh to make a common iſſue, for the relief of any ſuch diſeaſe as a white-ſwelling, a caries of the vertebræ, &c. we cannot accompliſh our object better, than by forming an eſchar with the kali purum cum calce vivâ. The ſeparation of an eſchar, or its detachment from the living parts, is a work of nature, being chiefly effected by the action of the abſorbent veſſels, which remove the particles of matter, connecting the dead and living parts together, ſo as to looſen the eſchar, and allow it to be taken away, without pain, bleeding, &c.

ESCHARA, in *Natural Hiſtory*, the name of a ſpecies of coralline, &c. the characters of which are theſe: they are of a ſtony or coral-like hardneſs, and reſemble a woven cloth in their texture; and the microſcope ſhews us that they conſiſt of arrangements of very ſmall cells, whoſe ſurfaces appear much in that form. (See Millepora.) For other ſpecies, ſee Flustra and Madrepora.

ESCHAROPEPA, a word uſed by the old writers in *Medicine*, to expreſs a coarſe kind of barley-meal, which had been torrified over the fire.

ESCHAROTICS, in *Surgery*, are certain ſubſtances and applications which, when put on any part of the body, occaſion an eſchar, or ſlough. Although the ſtrict meaning of the word eſcharotic is the ſame as that of *cauſtic*, yet, modern practitioners uſually underſtand by the firſt term ſome application that is milder in its action, than ſuch ſubſtances as are denominated cauſtics. By the latter, a ſurgeon generally means the kali purum, with or without quicklime, or the argentum nitratum, antimonium muriatum, &c. But by eſcharotics he commonly implies applications like the cuprum vitriolatum, hydrargyrus præcipitatus ruber, &c.

The chief uſe of eſcharotics, in the practice of ſurgery, is to deſtroy excreſcences, funguſes, and high exuberant granulations. When mixed with ointment, ſo as to have their action weakened, they are alſo ſometimes employed for ſtimulating ſores, which are of an indolent nature.

ESCHATON, in *Muſic*, the difference between the dieſis enharmonica and the hyperoche; that is, what remains, after taking the difference between the ſemi-tone minor and dieſis enharmonica, from the latter. Henfling, in Miſc. Berolin. vol. i. p. 279, 280.

Thus the difference between the ſemi-tone minor and the enharmonic dieſis is $\frac{25}{24} : \frac{128}{125} = \frac{3125}{3072}$, and this taken from

from the diesis, is $\frac{128}{125} : \frac{3125}{3072} = \frac{393216}{390625} = 6\Sigma - f + m$, and is the *major residual*; which see. This interval is about $\frac{53}{100}$ of a comma, as will easily appear by logarithms. Mr. Hensling has taken notice of this interval. He calls it eschaton, from its being the least and the last interval that occurs in his system.

The word is Greek, εσχατον. See INTERVAL.

ESCHATON of Dr. Callcott's MSS., is an interval whose ratio is $\frac{16,677,181, \&c.}{16,777,216, \&c.} = 5\,\Sigma + 2\,f$, and is the *greater residual*, which see.

ESCHE, in *Geography*, a town of Switzerland, in the canton of Uri; eight miles S.E. of Altorff.

ESCHEAT, ESCHET, or *Echet*, formed from the French *eschoir*, or *échoir, to happen*, in *Law*, denotes an obstruction of the course of descent, and a consequent determination of the tenure, by some unforeseen contingency; in which case the land naturally results back, by a kind of reversion, to the original grantor or lord of the fee. (1 Feud. 86. Co. Litt. 13.) This was one of the fruits and consequences of feodal tenure: and is incident to tenure in socage, as well as to tenure in knight-service; except only in gavel kind lands, which are subject to no escheats for felony, though they are to escheats for want of heirs.

The civilians call such escheats, or forfeitures, *bona caduca*; and in the same sense, as we say the fee is escheated, they say *feudum aperitur*.

The word *escheata* sometimes also signifies a lawful inheritance descending on the heir. But then it is usually distinguished by the addition of *recta*; as *recta escheata*.

ESCHEAT is also used for the place or circuit within which the king, or other lord, hath escheats of his tenants.

ESCHEAT is also sometimes used for a writ, lying where the tenant having estate of fee-simple, in any lands or tenements holden of a superior lord, dies seised without heir, general or special: in which case the lord brings this writ against him that possesses the lands, after the death of his tenant; and thereby recovers the same in lieu of his services.

ESCHEATOR, an officer who anciently took care of the king's escheats in the county, and certified them into the exchequer, or chancery.

He was appointed by the lord treasurer; held his office only for one year; nor could any person be escheator above once in three years. But this office, having its chief dependence on the court of wards, is now out of date.

ESCHEFELD, in *Geography*, a small town of Saxony, near Wolfftitz, in the circle of Leipzick, remarkable for its quarries of beautiful jasper, known by the name of Bandstein von Gnandstein.

ESCHEL, in *Mineralogy*, a term used by the smalt-workers, to express a sort of grey substance resembling ashes, which is usually mixed with the smalt when in fusion. This is carefully separated from it before it is powdered for use, otherwise it would debase the colour. Phil. Trans. N° 396.

ESCHELLON, or EÇHELLON, in the military acceptation, is a term borrowed from the French language, in which it signifies a ladder; alluding to the regular and parallel gradations of any series of lines, more or less inclined from any given base line. Thus if we suppose in *fig.* 1. *Plate* I. *Tactics*, the line A B to be divided into any given number of equal parts, as 1, 2, 3, 4, 5, 6, and suppose the left end of each division to be moveable on a pivot, the other end swinging round at pleasure, we shall find that those several divisions are capable of being moved forward, at the assumed angles from the base line A B.

Now it is necessary to be well understood, that, according to the military step, the number of files from any given pivot will determine the number of paces to be taken to make a wheel, corresponding with a right angle: thus when the 8th file from the pivot makes eight paces in wheeling, the whole of the division performing such evolution will make a wheel equal to the quarter of a circle, because all distances from the centre must invariably correspond with the quarter of a circle, of which such distances are respectively radius.

But the eçhellon movements are never understood to amount to the quarter of a circle; that being considered a full wheel, changing from line into column: yet the eçhellon is itself a species of column, disposeable with equal promptitude either to flank or front; thus affording peculiar advantage, while it gives at the same time a parallel movement of a line, broken for the moment, into small portions, towards any object obliquely situated towards either flank; in front or rear. These important advantages have not been overlooked by modern tacticians, who have amply availed themselves of the mutability thus afforded: consequently we find the eçhellon adopted in the existing code of evolutions, on an unlimited scale.

It being ascertained that the eighth file, by moving forwards eight paces in a regular curve on the given pivot, makes a wheel of one quarter of a circle; it is obvious, that any intermediate part, of which one pace is the multiple, may be wheeled, by taking the desired number of paces; thus, four paces will make an octave, or the eighth part of a circle, which is the most frequent declination from the base line; two paces will give the sixteenth of a circle, or the fourth part of a quadrant; and thus of any number.

Let us suppose it requisite to change the front of a battalion to a new position, forming, as nearly as the eye could estimate, an angle of 75° from the base line A B. Now, as each step of the eighth file gives a change of front equal to about eleven degrees, it is obvious, that seven ordinary paces will rather exceed the given angle; therefore, if very great precision should be indispensable, the eighth file should make six long, and one short pace, which would throw the whole battalion into eçhellon at such an angle as would allow the several divisions to march with a full front to their positions in the new line. This is a most important object; because it admits the utmost freedom of individual movement, and avoids that oblique tendency which must be resorted to whenever such full frontage cannot be preserved.

Eçhellon may be formed towards either flank; whether to the rear or to the front; the open column may be readily formed by wheeling so as to complete the quarter of a circle, including the original portion, and adding it to the supplement: both wheels being in the same direction. Thus if only the eighth of a circle was wheeled into eçhellon, another wheel, of another eighth, will be needful to bring the corps into open column.

To form the line from eçhellon; either a back wheel may be made equal to the wheel forward: thus, if a battalion has broken into eçhellon by wheeling an octave *to* the right, it will, by wheeling *back* an octave *on* the right of divisions, be instantly formed into line. In this instance the right flank gives the point d'appui. But if the left is to give it, there the whole of the divisions must wheel *forward* on their left pivots, as many degrees as were included in the original wheel to the right. If the first wheel was only the

16th

16th part of a circle to the right, the complementary wheel to the left muft be equal to only one fixteenth. In faying this, it is neceffary to be underftood, that all the divifions are fuppofed to be of equal ftrength; otherwife it will be indifpenfably neceffary that the refpective pivots, which are to guide the alignement, be properly dreffed; that is, cover correctly, before any wheel is made under their guidance.

Eçhellon divifions do not always move with a full front towards that point on which the wheel is made; on the contrary, it is often expedient to wheel to the right, when the new front is towards the left. This is done for the purpofe of giving the flanks of the divifions a proper direction, that they may refpectively march by files, towards their ftations in the new line; and is particularly neceffary in broken ground, as well as in countries covered with wood. The feveral leaders of files muft, in this cafe, be extremely correct in maintaining their original direction; attending to their feveral pivot-men, if fuch be in fight: where that guide cannot be afforded, the greateft care muft be taken to obferve any two diftant objects that may be in the given direction; fo as to proceed, as nearly as poffible, to the appointed fpot.

From the foregoing it will be collected, that, while *direct* changes of front are made by full wheels (*i. e.* the quarter of a circle,) to either right or left, oblique changes are effected by means of a due degree of parallelifm, produced in confequence of wheeling in any proportion lefs than the quarter of a circle. Therefore, as the code of regulations now in ufe for the movements of battalions properly inculcates, the eçhellon pofition and movements are not only neceffary and applicable to the immediate attacks and retreats of great bodies; but alfo to the previous oblique or direct changes of fituation, which a battalion, or a more confiderable corps, already formed in line, may be compelled to make, to the front or the rear, or on a particular fixed divifion of the line.

When a battalion marches in eçhellon its route muft be on the reverfe principles of Marquois's parallel rule, which confifts of a fcale, having a triangular piece fliding at liberty along its edge, as fhewn in *fig.* 2. In that the inclined plane A B even follows a line not perpendicular to its front, and this is the main diftinction between the eçhellon movement and the oblique-ftep; the former may continue for any diftance, rather giving eafe, than proving unufually fatiguing, to the men; whereas the oblique-ftep is peculiarly diftreffing, if kept up for a length of time; while it befides poffeffes the great difadvantage of gaining but little ground. In the above figure the line A B may proceed the whole length of C D, without gaining ground towards its oppofite, or exterior flank B; becaufe it is, in a manner, fixed by the inner flank A, which may be faid to run in a groove on the line B C; whereas if we applied the eçhellon movement to the line A B, that is perpendicular to its own front, its courfe would be according to A E, B F, and ground would be gained to its right, as well as to its front, in exact proportion to the angle D A B; if that be fmall, there will be a greater tendency to the front of the line C D, than towards its left flank, and *vice verfâ*; ever carrying in mind, that fo foon as the wheel amounts to a quarter of a circle, the term eçhellon is annulled.

We fhall here exhibit the ufe of an eçhellon movement as applicable to the reinforcing of a line advancing at the *debouchure* of a *detroit*; where, in confequence of the regular expanfion, it becomes neceffary to keep adding to either, or perhaps to both flanks, in order to prevent the enemy from penetrating; fo as to attack the rear. It may be expedient to obferve that not only companies, but whole battalions, may form in eçhellon; and that it is an evolution fuited equally to cavalry and to infantry. When a park of artillery has to flank an enemy, in a pofition where the proper line cannot be affumed, fo as to bring the feveral guns to a line perpendicular to the direction of their fire, they muft then, properly fpeaking, be individually in eçhellon. Thus when guns are mounted in *barbet*, (*i. e.* where there are no embrafures, the muzzles traverfing over the parapet,) whenever the object does not bear at right angles with the face of the battery, each gun is obliqued, and the fhots fired from the whole would reprefent the movements of divifions thrown into eçhellon. *Fig.* 3. fhews a line forming as the army iffues from a detroit, the feveral battalions compofing it being allowed to reinforce the centre until due fpace be gained for the whole to wheel into eçhellon. Now it will be feen, that each battalion formed in column, in by files, fucceffively affumes a pofition perpendicular to that line; but, that when fpace admits, the wheel is made, whereby each divifion is directed towards the poft it will occupy on the flank, as the expanfion takes place. Here S S is the line, and O P the battalion deftined to cover the right flank; its feveral divifions, being thrown into eçhellon, muft in their progrefs fall into their refpective pofts, at the new pofition *a a* one after the other, filling up the augmenting fpace with celerity and exactnefs. It is, however, to be underftood, that each, as it approaches its fituation in line, muft accelerate or retard its pace according to circumftances; fince it cannot be expected that the ground will expand with perfect regularity.

In cafe of an attack, in which the enemy may fucceed in getting round the flank, thofe divifions clofe to that flank muft wheel back into line; leaving to two or three of the rear divifions to join on their flank in the direction of the eçhellon front; thus forming a re-entering angle, effectually cutting off the enemy's progrefs, and fubjecting him to a concentrated fire; as fhewn by the dotted pofitions at E. The dotted lines emanating from the feveral eçhellons fhew their direction when marching: their prolongation would fhew how they would fall in on the flank, fo as gradually to extend the front; compleating the new line *a a*. When neceffary, the fame operation is performed towards the left.

It has been obferved that the eighth file gives a determinate meafurement, in regard to the wheel of divifions into eçhellon; it is therefore expedient, when the given direction is afcertained, to caufe the eighth file to ftep out the required diftance, (fay four paces for the eighth of a circle,) obferving, that his advance muft be on a wheeling principle: that is to fay, curved; the pivot being confidered as the centre, and the diftance between that and the eighth file being radius. Each divifion thus fending forth its eighth file, the whole are ordered to wheel until thofe files are reftored to their places in their divifions: during the wheel of the divifions, each muft neceffarily remain motionlefs; that all may drefs by them; fo as to give a true parallel throughout the line of eçhellon.

ESCHENAU, in *Geography*, a town of Germany, in the archduchy of Auftria; eight miles S. of St. Polten.

ESCHENBACH, a town of Germany, in the circle of Bavaria, and Upper Palatinate; 34 miles E.N.E. of Nuremberg.

ESCHENBERGA, a fmall town of Germany, in the duchy of Saxe Gotha, with a population of 504 inhabitants, remarkable for its trade in madder. It was anciently of more importance.

ESCHERSHEIM, a town of Germany, in the circle of the Upper Rhine, and county of Hanau-Munzenberg; 10 miles

10 miles W. of Hanau, and 3 N.N.W. of Francfort on the Main.

ESCHEVIN, or Echevin, *Scabinus*, in the French and Dutch *Polity*, a magiſtrate elected by the inhabitants of a city to take care of their common concerns, the good order, conveniency, and decoration of the city, &c.

At Paris there is a prevot and four eſchevins; in moſt other cities a maire, or mayor, and eſchevins. In Languedoc, Provence, and Dauphiné, they are called *conſuls*; at Thoulouſe *capitouls*; and *jurats* at Bourdeaux.

Anciently, the eſchevins were the aſſeſſors and counſellors of the comites, or judges of cities; on which account they were called, in ſome places, *pairs*, *pares*; they even took cognizance of petty cauſes themſelves.

Du-Cange obſerves, that the judges, and their aſſeſſors, who were choſen by the inhabitants, were called *ſcabini*, eſchevins, and their college, *ſcabinagium*, or *eſchivinage*. He adds, that ſome authors call them *paciarii*, becauſe their office and juriſdiction extended to the ſecuring peace in their city and banlieue, called *pax villæ*.

In Holland, the *ſcabins*, or eſchevins, judge of all civil affairs at firſt hand. They alſo take cognizance of criminal matters; and if the criminal confeſs himſelf guilty, they can ſee their ſentence executed without appeal. They can even give torture. The number is not the ſame in all cities; at Amſterdam there are nine, at Rotterdam ſeven, &c.

ESCHLBERG, in *Geography*, a town of Germany, in the archduchy of Auſtria; 14 miles S.W. of Freuſtadt.

ESCHLKAMP, a town of Germany, in Lower Bavaria; 3 miles E. of Furth.

ESCHRAKITES, or Esrakites, a ſect of philoſophers, among the Mahometans, who adhere to the doctrines and opinions of Plato.

The word is derived from the Arabic שרק, *ſchraka*, which in the fourth conjugation אשרק, *aſchraka*, ſignifies *to ſhine*, *glitter like the ſun*; ſo that Eſchrakite ſeems to import *illumined*.

The Eſchrakites, or Mahometan Platoniſts, place their higheſt good and happineſs in the contemplation of the Divine Majeſty; deſpiſing the groſs imaginations of the Alcoran touching Paradiſe. See Mahometanism.

They are very careful in avoiding all vice; they preſerve an equal and eaſy temper, love muſic, and divert themſelves with compoſing little poems, or ſpiritual ſongs. The ſheics, or prieſts, and the chief among the preachers of the imperial moſques, are Eſchrakites.

ESCHWEGE, in *Geography*, a ſmall town of Germany, in the landgraviate of Heſſe Caſſel, which now forms part of the new kingdom of Weſtphalia. It is ſituated on the Werra, 33 miles E. of Caſſel, near a lofty hill called the Meiſner, which has ſome coal-mines. Eſchwege is a place of high antiquity.

ESCHWEILLER, a ſmall town of France, in the department of the Roer, chief place of a canton, in the diſtrict of Aix-la-Chapelle, with a population of 1713 individuals. The canton has 18,588 inhabitants, diſperſed in 28 communes.

ESCHYLUS. See Æschylus.

ESCHYNOMENOUS Plants. See Æschynomenous.

ESCLAIRCISSEMENT, or Eclaircissement, a French term, which we find retained in ſome late Engliſh writers; it properly ſignifies the act, or effect, of clearing a thing, or rendering it more bright and tranſparent; being formed from the verb *eſclaircir*, to clear, &c.

It is chiefly uſed in a figurative ſenſe, for an explanation of an obſcurity or difficulty. The eſclairciſement of difficult paſſages in the bible, is to be ſought for from ſimilar paſſages, or paſſages of the like kind occurring in other places.

ESCLAME, in the *Manege*, an obſolete French word, formerly uſed to ſignify a light-bellied horſe.

ESCLATTE', in *Heraldry*, is applied to a thing violently broken. Thus a bend or rather partition, eſclatté, is repreſented torn, or broken off, like a ſhield ſhattered with the ſtroke of a battle-ax.

ESCOBAR, Anthony, ſurnamed *De Mendoza*, in *Biography*, a Spaniſh Jeſuit, who flouriſhed in the beginning and middle of the ſeventeenth century. The opinions which he maintained have been cenſured by more modern writers; and the principles of his morality have been expoſed by Paſchal in his "Lettres Provinciales," and by other authors of leſs note. He left behind him many works, among which are "Theologia Moralis;" "Commentaria in Vetus et Novum Teſtamentum;" and "Examen y Pratica de Confeſſores." Moreri.

ESCOL, in *Ancient Geography*, a valley or torrent of Paleſtine, in the ſouthern part of the tribe of Judah; mentioned in the book of Numbers.

ESCORT, in *Military Affairs*, ſignifies that guard granted, either under military authority, or of military perſons, for the ſafe conveyance of perſons, property, &c. from one place to another. This may be ſaid to diſtinguiſh an eſcort from a convoy; the latter being generally applicable to ſuch extenſive affairs as relate rather to the guarding of ſupplies, &c. on their way to an army, or to a fortreſs. The extent of an eſcort is uſually proportioned either to the dignity of the perſon attended, if it be meant as a compliment; or, if of treaſure, according to the ſum, and the dangers lying in the way. In ſome caſes, eſcorts are taken only from particular corps; as, for inſtance, thoſe which attend upon his majeſty, which are ſelected from certain regiments only, unleſs on extraordinary occaſions. When an eſcort is employed on ſuch an occaſion, its commander is uſually placed under the orders of the perſon to be guarded; but when treaſure, priſoners, &c. are in queſtion, the commander is in every reſpect paramount; he being reſponſible for the ſafe arrival, and the delivery, of whatever is under his charge. Such is the ſtrictneſs with which the reſponſibility of an eſcort is upheld, that a few years back, when a deſerter who was under charge of a guard made an attempt to abſcond, one of the party fired at him, but unhappily miſſing the fugitive, killed an unfortunate paſſenger in the ſame ſtreet; the man who fired was conſidered to have done no more than his duty. We naturally view ſuch an occurrence with much concern, and commiſerate the ſufferer; but when we contemplate what might have been the ſituation of the ſoldier, had he omitted to do his beſt towards preventing the eſcape, though we cannot exactly applaud his conduct, we muſt aſſuredly ſee much in extenuation of the manſlaughter.

When travelling any diſtance, and that ſpeed is eſſential, it is uſual to relieve the eſcorts, when convenient, at certain ſtages. In ſuch caſe, it behoves the commander of each party to be very careful in examining every matter previous to taking charge. If there be treaſure, or other valuables, &c. under ſeal, the impreſſions ſhould be minutely inſpected; and if the articles, or packages, be numerous, but more eſpecially if ſubject to damage, he ſhould cauſe the whole to be counted, and aſcertain, in the preſence of the perſons from whom he receives them, the exact ſtate and appearance, noting every point worthy of obſervation in the way-bill, and exclusively giving a receipt, in which all casualties or deficiencies should be fully described. This inspection should always be made in the presence of others of his own party, and it would not be amiss were he to cause them to attest the condition in which the articles should be, at the time of his receiving charge. Should any accident take place while under his own protection, the hour, the place, and the cause, ought to be in like manner noted, so soon as possible, under the certificate of credible persons on the spot; or at least of some of his own party. By such precautions much imputation will be avoided; while at the same time a character for correctness, and for assiduity, will be gained.

ESCOT, L', in *Geography*, a small town of France, in the department of the Lower Pyrenées; 6 miles S. of Oleron, remarkable for a cooling mineral spring.

ESCOUADE, or SQUAD, is usually the third or fourth part of a company of foot; so divided for mounting guards, and for the more convenient relieving of one another. It is equivalent to a brigade of a troop of horse. See BRIGADE.

ESCROL, or SCROLL, in *Heraldry*, a long slip, as it were, of parchment, or paper, wherein a motto is placed.

Leigh observes, that no person, under the degree of a knight, might, long after king Henry V. place his crest on a wreath, as is now usually done, but only on an escrol.

ESCROW, in *Law*, a deed delivered to a third person, to be the deed of the party making it upon a future condition when such thing is performed; and then it is to be delivered to the party to whom made. It is to be delivered to a stranger, mentioning the condition; and has relation to the first delivery. 2 Roll. Abr. 25, 26. 1 Inst. 31. See DEED.

ESCU, or ECU, the French crown, of sixty sols, or three livres. The escu was thus called, because the escutcheon, or arms of France, which they call escu, was struck thereon. See COIN.

ESCU, *Emaux de l'*. See EMAUX.

ESCUAGE, or SCUTAGE, an ancient kind of knight's service, called also "service of the shield;" the tenant holding by which was obliged to follow his lord to the Scottish or Welsh wars, at his own expence. But personal attendance being inconvenient, the tenants compounded for it by a pecuniary satisfaction, which was levied by assessments at a certain rate for every knight's fee; and thus it became a pecuniary in lieu of a military service. The first instance that occurs was in 5 Hen. II. on account of his expedition to Toulouse; it afterwards became more general and oppressive; so that king John was obliged to consent, by his Magna Charta, that no scutage should be imposed without consent of parliament; but the clause was omitted in the charter of Hen. III. which directs, that it should be taken as it is used to be in the time of Henry II. or in a reasonable and moderate manner. However, it was afterwards enacted by stat. 25 Edw. I. cap. 5 and 6. and many subsequent statutes, that the king should take no aids or tasks but by the common assent of the realm; and it appears that scutages were the ground work of all succeeding subsidies, and of the land-tax of later times. Blackst. Com. vol. ii. p. 74.

ESCUAGE was also a reasonable aid, demanded by the lord of his tenants, who held of him by knight's service. See AID.

"Concesserunt domino regi ad maritandum filiam suam de omnibus qui tenent de domino rege in capite de singulis scutis 20 solidos solvendos." Matt. Paris, anno 1242.

ESCULAPIUS. See ÆSCULAPIUS.

ESCULENT, in *Gardening*, is a term frequently applied to such roots or plants as are replete with nutritious matter, and consequently proper for being eaten as a food. Carrots, parsnips, turnips, cabbages, and various others of a similar nature, are of this kind.

ESCULUS, in *Botany*, a name given by many authors to the phagus, or sweet oak, called also the esculent oak.

ESCULUS, or *Æsculus*. See ÆSCULUS.

ESCURA, in *Geography*, a province of the empire of Morocco, called by Leo Africanus *Ascora*, which, together with that of Ramna, formerly composed only one government. It has been divided to keep the people of these countries, so near to the mountains, more easily in subjection. Ramna and Escura have the province of Morocco to the south, that of Duquella to the west, the river Morbeya to the north, and mount Atlas to the east.

ESCURIAL, by the Spaniards written *Escorial*, a term that denotes the place of residence of the kings of Spain. Escurial originally signifies a little village in Spain, situated in the kingdom of New Castile, 22 miles to the N.W. of Madrid, on the side of a chain of mountains, called by some the Carpetane, or Carpentanian mountains, and by others the Pyreneans, as being the branch of the Pyrenean ridge, and environed by wood-lands and green fields. Here king Philip II. built a stately monastery of the order of St. Jerom, held by the Spaniards for one of the wonders of the world, and called the Escurial. It was begun in 1557, and finished in about twenty-two years, at the expence of six millions of piastres.

Fa. Francisco de los Padros, in a description thereof, intitled "Description breve del Monasterio de S. Lorenzo el real del Escorial, &c." assures us it was built by that prince in memory of the battle of St. Quintin, gained on the day of St. Laurence, Lorenzo, a famous Spanish saint, and at his intercession; accordingly the plan of the work resembles a gridiron, the instrument of the saint's martyrdom.

The king and queen have their apartments there; the rest being possessed by the monks. Whence many of the great transactions of that court are dated from the Escurial.

This superb palace is a long square, 740 by 580 Spanish feet, besides 460 for what may be termed the handle of the gridiron. The height of the roof is 60 feet; and at every angle is a square tower, 200 feet high. In the west front there are 200 windows, and 366 in the east.

The Escurial has a very fine church, the dome of which is 330 feet, supported by four rows of pillars, and paved with black marble, containing 40 chapels, and 48 altars. To this church Philip IV. annexed a beautiful mausoleum, called the Pantheon, or Rotondo, built on the plan of that temple at Rome, 36 feet in diameter, and incrusted with marble; in which the kings and queens of Spain, who leave any posterity, are interred; the rest being laid in another vault of the same church, together with the infantas, and other princes.

The palace possesses every convenience and ornament that can render a place agreeable in so hot a climate; such as an extensive park, groves, fountains, cascades, grottos, &c. The adjacent country contains specimens of all the mineral substances, stones, earths and vegetables, which are found in other parts of the kingdom. The library belonging to this palace is said to consist of 30,000 volumes, contained in two magnificent apartments, each 194 Spanish, or somewhat more than 182 English feet in length. In the lower room are chiefly printed books; and in this is deposited the famous

famous MS. of the four gofpels, written in gold letters, faid to be a work of the 11th century. Over thefe are collected 4300 MSS., of which 567 are Greek, 67 Hebrew, 1800 Arabic, the latter of which are well defcribed in a catalogue publifhed by Cafiri. In the middle of the lower room is a temple, with a great variety of figures, containing 1448 ounces of filver, and 43 of gold, befides rich gems. In every part of the convent of the Efcurial, are feen the works of the beft mafters, and fome of them moft capital performances. The beft of the pictures are collected in five principal apartments; the great ftaircafe is beautiful, adorned with frefco-paintings of the battle of St. Quintin, by Luca Jordano. The fituation of the Efcurial, as a refidence, is not pleafant: expofed, as it is, to the full ftroke of the meridian fun, and raifed up near to regions covered with eternal fnow; without fhelter and deftitute of fhade, it has no local charms at any feafon of the year. (Townfend's Travels, vol. 2.) Part of this fuperb palace was burnt in 1671.

ESCUROLLES, in *Geography*, a fmall town of France, in the department of the Allier, chief-place of a canton, in the diftrict of Gannat, with a population of 1042 individuals. It is 6 miles N. of Gannat. The canton contains 15 communes, and 11,408 inhabitants, on a territorial extent of 237½ kiliometres.

ESCUTCHEON, or SCUTCHEON, in *Heraldry*, the field or coat, wherein the bearing, or arms, of any perfon are reprefented.

The word efcutcheon is formed of the French *efcuffon*, and that from the Latin *fcutum*, fhield; which was the place arms were originally borne on, before ever they came on banners; and ftill, wherever they are placed, it is on fomething reprefenting the form of a fhield. The Latin *fcutum*, no doubt, came originally from the Greek, σκυτος, *leather*, wherewith the fhields were ufually covered. See SHIELD.

The efcutcheon is of a fquare figure, excepting the bottom part, which is ufually a little rounded, ending in a point in the middle.

Till within a few hundred years, the efcutcheons of the French and Englifh were triangular; thofe of the Spaniards are ftill quite round at bottom, without any point; thofe of the Italians are oval; and thofe of the Germans in form of a catoozes.

The ancient efcutcheons were generally couched, or inclined; and they only began to place them upright, when crowns, &c. were put over them by way of creft.

In France *efcuffon*, efcutcheon, was formerly reftrained to a fhield, or coat, pointed at bottom; by which it was diftinguifhed from the efcu, which was quite fquare, and was only allowed to be borne by the counts and vifcounts. Thofe of the inferior quality were confined to the efcuffon or pointed efcu.

The feveral parts or points of the efcutcheon have their proper names: the point A, for inftance, is the dexter chief point; B the middle chief; and C the finifter chief point; D is the honour point; E the feffe point; F the nombril point; G the dexter-bafe; H the middle; and I the finifter bafe point. See *Plate* of *Heraldry*.

The dexter fide of the efcutcheon anfwers to the left hand, and the finifter fide to the right hand of the perfon that looks on it.

The efcutcheon is differently denominated, according to its divifions. It is called dextered, when the perpendicular line that divides it is to the right of a third part of the efcutcheon; finiftered, when on the left; tierced in pale, when this line is double, and divides the whole efcutcheon into three equal parts; paled, when increafed to the number of fix, eight, or ten. A horizontal line makes the chief, when at one third part from the top; the plein, when at a third from the bottom; and when double, in the middle at an equal diftance from both extremes, it makes the feffe, and the tierced in feffe: when it is multiplied, it denominates it feffed; when there are eight or ten equal fpaces burrelle. A diagonal from the dexter point of the chief to the finifter of the bafe, makes it tranché; the contrary doublé; if it be double at equal diftances the firft makes bandé, and the tierce in bend; and the other barre, or tierce in bar; increafing the number of the firft makes bandé, and cotticé; and increafing that of the fecond barré, and traverfe.

ESCUTCHEON *of pretence*, is an inefcutcheon, or little efcutcheon, which a man who has married an heirefs, and has iffue by her, may bear over his own coat of arms, and in it the arms of his wife; and, in this cafe, the furviving iffue will bear both coats quarterly.

ESCUTCHEON, in *Sea Language*, a name fometimes given to the compartment for the names or arms of the owner, or of the perfon whofe title the veffel affumes. It is ufually fixed on the middle of the fhip's ftern; and is more peculiar to the French, and other foreigners, than to Englifh-built veffels. Falconer.

ESCUTCHEON, *Secret*, is a contrivance to be placed before a lock, which clofes up, and conceals the key-hole, and renders it inacceffible for any perfon except the owner, who is acquainted with the fecret.

The marquis of Worcefter appears to have invented fome fecret efcutcheons, for in his "Century of Inventions," publifhed in 1663, at N° 72, after having fpoken of three kinds of locks invented by him, fays, "an efcutcheon to be placed before any of thefe locks with thefe properties:

"The owner, though a woman, may with her delicate hand vary the ways of coming to open the lock ten million times beyond the knowledge of the fmith that made it, or of me who invented it."

Many attempts have been made to form a machine equal in its properties to the defcription here given; and from thence, it is probable, arofe the kind of padlocks which have been long made in this country, in great numbers, which having feveral letters on different rings, can only be opened when a certain fet of thofe letters is arranged in one order; but this was in no degree equal to the end propofed; for befides the workman who made it, being at all times informed of the pofition the letters muft be in, and, confequently enabled to open it, the letters and rings admitting of no variation of place, at the will of the owner; referving, at the fame time, a power of opening the locks; whenever the proper arrangement became known, the fecret was divulged, and all fecurity at an end; but by the improvement lately made by Mr. Marfhall (for which the Society of Arts rewarded him with ten guineas,) the letters or figures allowing an almoft infinite variety of changes, the owner may, in one minute, alter the fecret in fuch a manner, that even the maker would be as unlikely to open it, as he would be of gaining the higheft prize in a lottery, by the chance of a fingle ticket. Thus this kind of efcutcheon is infinitely more fecure than any hitherto in ufe, efpecially as the alteration of the letters may be made every day for years, without recurring to their firft ftate; and as the owner may at one time chufe to truft a friend, or a domeftic with the fecret, fo that they might have recourfe to his valuables, &c. he may alfo at another time wifh to exclude them from that privilege, which this contrivance renders very eafy to be done. As this improvement relates only

to

to the efcutcheon, it is obvious that every attempt to pick the lock it covers, or to open it by means of falfe keys, is prevented; a circumftance of no fmall importance, when locks of a curious conftruction, and when a number of fine wards are made ufe of.

The efcutcheon for which the bounty was given is referved in the repofitory of the fociety for the infpection of the public.

Figs. 2, 3, 4, 5, 6, 7, 8, and 9, *Plate* XII. *Mifcellany*, reprefent this contrivance: *fig.* 3. is a view from behind the machine, fuppofing it to be firft removed from the door. *Fig.* 2. is an elevation of the machine, as it appears upon the door; A B C D is a brafs box, faftened over the key hole; it has a fquare hole through it, covered by a fmall door E; this door is kept fhut by a pin fixed into a fmall lever *a*, *fig.* 3, which enters a projection from the fide of the door, and thus prevents it being open, unlefs the lever is firft drawn back; a fpring *b* is applied behind the lever to force it outward, and another at E always preffes againft the door, and acts to throw it open as foon as the lever *a* is drawn back, which is accomplifhed by means of a pin, which comes through a groove in the plate; this pin is faftened in a fquare bar F, *figs.* 2 and 5. (fhewn feparately in *fig.* 4.) on the front of the plate. The fmall perfpective, *fig.* 8. reprefents two brafs cocks *d*, *d*, which fupport the ends of a cylindric wire *g*, in which is a groove for the bar F to flide backwards and forwards; thefe cocks are fcrewed to the plate within-fide, as fhewn at *d d*, *figs.* 2, 3, and 5, and come through an opening in the Plate; fo that the bar F is in front of the plate; the wire *g* is the common axis for five fmall rollers *a*, *e*, *f*, *m*, *o*, the ftructure of one of thefe is explained by *figs.* 5, 6, 7, and 9; *h* is a circular piece of brafs which fits upon the centric wire: this, as is fhewn in the fections, *figs.* 5 and 9, is thicker at the outfide than the middle; and the front view, *figs.* 6, 7, fhew how a recefs is cut, communicating with the centre hole; now when the five rollers are turned round upon the central wire *g*, fo that the receffes are all brought into the front, the projecting teeth *x*, *x*, of the flider F will meet with no obftruction, and may be drawn back fo as to open the efcutcheon; but when any of the rollers are turned round, fo that the thin parts near the centre are brought between the teeth of the flider, then the flider cannot be withdrawn. The pofition of the roller, when the flider is at liberty, is known by bringing five of the letters which are engraven on the outfide of the rollers uppermoft, and it is in thefe letters that the fecret confifts. But to render the combination of letters variable, the letters are not engraved upon the outfide of the rollers themfelves, but upon a thin brafs hoop *e*, which is fitted on round the roller; a fpring *n* is faftened to the roller, and preffing upon the infide of the hoop caufes fuch a friction, that they go together in general; but when the fecret is to be changed, the flider F muft be drawn partly back, fo that its teeth *x* come in the way of the thin parts of the rollers, and they cannot, therefore, be turned round; the outfide hoop *l* is then forced round upon the infide one, and a frefh letter brought oppofite the recefs; by this operation the fecret is altered, and the efcutcheon cannot be opened till the fame combination is produced. Each roller has four letters upon it, in all twenty letters, and the combinations which they are capable of are fo numerous, that the chance is ftrongly againft any perfon not acquainted with the fecret opening it.

ESCUTCHEON-*grafting*. See GRAFTING.

ESDEN, in *Geography*, a town of Germany, in the kingdom of Weftphalia, and bifhopric of Liege; 3 miles S.S.W. of Stecklim.

ESDRAELON, or ESDRELA, in *Ancient Geography*, a village of Paleftine, in the tribe of Iffachar, the fame as Jezreel, 10 miles from Scythopolis, according to the old Itinerary. (Jofh. xix. 18.) It gave name to a plain, which extended eaft and weft from Scythopolis to mount Carmel; called likewife the "Great Plain," the "Valley of Jezreel," and the "Plain of Efdrela,"

ESDRAS, See EZRA. We have four books of fcripture under the name of Efdras; of which, only the two firft are acknowledged as canonical; and they were formerly reckoned by the Hebrews as one, according to St. Jerom. The firft of thefe is allowed to be the work of Ezra; for he relates events of which he was witnefs, and often fpeaks in the firft perfon. Some, however, have fuppofed that the fix firft chapters were compofed by a more ancient writer; and they allege, that the author of thefe chapters was at Jerufalem in the time of Darius the fon of Hyftafpes. (Ch. v. 4.) From this paffage it is inferred that the writer was then at Jerufalem; but Ezra did not come thither till the reign of Artaxerxes, as appears by the beginning of the 7th chapter. To this argument it is replied, that Ezra fpeaks in the name of the Jews, and that it is ufual for hiftorians of a country to fpeak in the firft perfon in the name of their own nation, although the hiftorians themfelves had no participation in the events which they record. Another difficulty occurs in explaining the genealogy and number of thofe who returned from Babylon to Jerufalem under Nehemiah, mentioned in the fecond chapter, and related in the fame manner, though with fome additions and alterations in the 9th chapter of Nehemiah. Some fuppofe that Nehemiah tranfcribed this out of the book of Ezra, adding the names of thofe perfons who came to Jerufalem in the fecond return from the captivity. Others, on the contrary, imagine that Ezra copied the paffage from Nehemiah, fince mention is made in it of Nehemiah. Others pretend that the genealogy of Ezra was afterwards corrected from that of Nehemiah. However, none of thefe conjectures are reconcileable with the differences that occur in the two genealogies. But after all, there is no neceffity for fuppofing that one of thefe authors tranfcribed from the other, for they might both of them have written thefe genealogies: Ezra having furvived the fecond tranfmigration made under Nehemiah, and not having written his book till the latter end of his life. The fecond book under the name of Ezra, is attributed to Nehemiah; though fome inconfiderable particulars have been added to it, which cannot belong to Nehemiah: fuch as the mention of the high-prieft Jaddua, and king Darius. (Neh. xii. 22.) This Jaddua is Jaddus, in whofe time Alexander the Great came to Jerufalem; and Darius is Darius Codomannus, overcome by Alexander 100 years after Nehemiah. The firft of thefe two books contains the hiftory of the deliverance of the Jews from the captivity of Babylon, and of their re-fettlement in Judea, from the firft year of Cyrus to the 20th of Artaxerxes Longimanus; and the fecond begins at the 20th year of the fame prince, to the reign of Darius Nothus. The chronology of this fpace of time depends on the duration of the reigns of the kings of Perfia.

The third book, under the name of Efdras, is thought by the Greeks to be canonical. Its author is not known, but he is fuppofed to have been an Hellenift Jew. The book is the fame in fubftance as the firft of Efdras, but interpolated; and in different parts of it we have a fummary repetition of the two laft chapters of the fecond book of Chronicles, as well as of the books of Ezra and Nehemiah. Againft its authority there are feveral material objections, for which we refer to Arnald's excellent Commentary on the Apocrypha. p. 122.

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The fourth book of Efdras is written with fufficient art, as if Efdras himfelf had compofed it; but the marks of falfhood are difcernible in it. Neither the Synagogues, nor the Greek or Latin church ever unanimoufly received it as canonical; though fome of the fathers have cited it, and the Latin church has borrowed fome words out of it. It is not now extant in Greek; and it never was in Hebrew. It feems moft probable that the author was a Jew, converted to Chriftianity, who, in hopes of converting others, compofed this work under the name of a writer, for whom the Jews had the higheft efteem. And there feems good reafon for concluding that the author lived in the times of the firft heathen perfecutions, from many paffages encouraging faith, and a fpirit of conftancy under perfecution.

ESEBON, a name given, by fome of the chemical writers, to common fea falt.

ESENS, in *Geography*, a town of Germany, in the kingdom of Weftphalia, and county of Eaft Frifeland; 24 miles N.N.E. of Emden.

ESFARAIN, a town of Perfia, in the province of Chorafan; 80 miles E. of Afterabat.

ESGUEVA, a river of Spain, which runs into the Pifuerga, at Valladolid.

ESGUEYRA, or Esgueria, a town of Portugal, in the province of Beira, containing about 1600 inhabitants; 8 miles S. of Aveiro.

ESH, in *Rural Economy*, a term provincially employed to denote the afh-tree.

ESHANESS, in *Geography*, a cape on the weft coaft of Main-land, the largeft of the Shetland iflands. N. lat. 60° 38'. Long. 1° 7' E. of Edinburgh.

ESHCOL. See Escol.

ESHTAOL, in *Ancient Geography*, a town of Paleftine, in the tribe of Dan, which belonged firft to Judah. According to Eufebius it was 10 miles diftant from Eleutheropolis, towards Nicopolis.

ESHTEMOTH, a city in the fouth of Judah, which, according to Eufebius, was a large town in the diftrict of Eleutheropolis, north of that city. It was ceded to the priefts. 1 Chron. vi. 57.

ESI, in *Geography*, a town of Italy, in the ftate of the church, and marquifate of Ancona; 11 miles S.S.W. of Ancona.

ESK, South and North, rivers of Scotland, which defcend from the Benakinnan mountains on the north border of Angus. The former runs S.E. and E. by Cortachie, Tannadyce, Brechin, and falls into the German ocean below Montrofe, to which town it is navigable from the tide-way in the German ocean. (See Canal). The direction of the latter is E. and S.E. through a narrow valley, till it reaches the ftrath lying between the Grampians and the fea. In the lower part of its courfe it forms the common boundary of Angus and Kincardine.

Esk, a river in Cumberland, which is navigable from the Solway firth up to the town of Longton.

ESKARMAKRUN, a town of Perfia, in the province of Chufiftan; 90 miles S. of Sufa.

ESKE, a river in the Eaft Riding of Yorkfhire, which is navigable only from the fea up to Whitby-bridge. See Canal.

Eske, a river in Cumberland, which is navigable from the fea near Ravenglafs to Mulcafter. Near to Ravenglafs it is joined by the Irt river.

ESKER, a river of European Turkey, which runs into the Danube; 20 miles W. of Nicopolis.

ESKI-Baba, a town of European Turkey, in Romania; 30 miles S.E. of Adrianople.

ESKIER, a town of Arabia, in the country of Yemen; 60 miles N. of Aden.

ESKIJALFA, a town of Perfian Armenia, in the country of E. van; 120 miles S. E. of Erivan.

ESKI-HISAR, a town of Afiatic Turkey, in the province of Natolia; 16 miles W. of Mogla.

ESKI-HISSAR, a town of Afiatic Turkey, in the province of Natolia, formerly Laodicea, now almoft a heap of ruins; 8 miles N. of Degnizlu.

ESKIMAUX, or Esquimaux. See Esquimaux and Labrador.

Eskimaux *Bay*, a bay on the fouth-coaft of Labrador. N. lat. 51° 30'. W. long 57° 50'.

Eskimaux *Iflands*, a clufter of fmall iflands in the gulf of St. Lawrence, near the fouth-coaft of Labrador. N. lat. 50° 15'. W. long. 63'.

ESKISADRA, a town of European Turker, in the province of Romania; 48 miles E of Filippopoli.

ESKISHEHR, a town of Afiatic Turkey, in the province of Natolia, on the river Sakharia; 116 miles S.E. of Conftantinople. N. lat. 39° 48'. E. long. 32° 58'.

ESLA, a river of Spain, which runs into the Duero, between Zamora and Miranda de Duero.

ESLINGEN, a town of Germany, in the circle of Suabia, which, till the peace of Luneville, was a free imperial city. It now belongs to the king of Wirtemberg, and is fituated on the Necker, 30 miles N. E. of Tubingen, and 6 miles S. E. of Stutgard.

ESMONA, or Azemona, in *Ancient Geography*, a town of Arabia Petræa, which was one of the ftations of the Ifraelites in the Defert. The book of Jofhua afcribes it to the tribe of Juda, fo that it is probably the fame with *Efem*.

ESMOUTIER, in *Geography*, a fmall town of France, in the department of the Upper Vienne; 21 miles E. of Limoges.

ESNA, in *Ancient Geography*, a town of Paleftine, in the tribe of Juda. Jofh. ch. 15.

ESNECY, *Æfnecia*, *dignitas primogeniti*, in *Law*, a private prerogative, allowed to the eldeft coparcener, where an eftate has defcended to daughters for want of heirs male, to chufe firft after the inheritance is divided. Fleta, lib. v. cap. 10. "Jus efneciæ *is* jus primogenituræ," in which fenfe it may be extended to the eldeft fon, and his iffue, holding firft. In the ftatute of Marlbridge, cap. 9. it is called "initia pars hereditatis."

ESNEH, Esné, or *Afna*, in *Geography*, one of the moft important towns in Upper Egypt, feated on the left of the Nile, in N. lat. 25°. E. long. 49° 15'. This town is governed by an Arabian prince and by a Cachef, dependent on the Bey of Girgé. The Mahometans have feveral mofques here, and the Copts a church, that is ferved by two priefts. According to the defcriptionof Abulfeda, which correfponds in a great degree to its prefent ftate, Efné is remarkable for its public baths and its commerce: it is built on the weftward of the Nile, between Affouan and Cous, but nearer to the latter. The Copts are faid to be its founders. The well-cultivated territory abounds in grain and palm-trees. Situated on the edge of a rich country it is fhaded by groves of orange-trees loaded with fruits and flowers, and immediately furrounded with gardens amply ftocked with fruit-trees. It prefents to view feveral ancient monuments conftructed by the Copts, and fuperb ruins. This town, formerly called *Latopolis*, revered Minerva and the fifh *Latus*. (Strabo, l. 17.) It contains within its boundary an antique temple, enclofed on three fides by thick walls. Six large fluted columns, crowned by a capital, ornamented with the palm leaf, form the façade of it; eighteen others fupport the roof; which is compofed of large fquares of marble; the building is furrounded by a frieze, and innumerable hieroglyphics cover its exterior afpects. Thofe of the infide, executed with greater care, mark the progrefs made by the Egyptians in fculpture. Thefe hieroglyphics contain, among other fubjects, a zodiac and large figures of men with crocodiles' heads; the capitals, though all different, have a very fine effect; and as an additional proof that the Egyptians borrowed nothing from other people, it is remarked, that they have taken all the ornaments, of which thefe capitals are compofed, from the productions of their own country, fuch as the lotus, the palm-tree, the vine, the rufh, &c. The portico of this temple is reprefented by M. Denon, (Travels in Egypt, vols. 2. and 3.) as the moft perfect monument of ancient architecture. Denon has given a plan and elevation of this portico, and delineated the varieties of its capitals, and part of the fculptures on the cieling; but he was furprifed that, after all his refearch, he could find no reprefentation of the fifh *latus*, from whofe name the town was called *Latopolis*. At prefent this temple is foiled by the ordure of the cattle kept there by the Turks, who convert the moft beautiful monuments of ancient Egypt into ftables. About a league to the weft of Efné is another temple, on the walls of which is carved in feveral places a woman feated, reprefenting an Egyptian deity called "Neith," to whom the ancient Greeks gave the name of Minerva. The columns of this temple, as fome have conjectured, gave to the Greeks the idea of the Corinthian order; the capitals being ornamented with a foliage very much refembling the Acanthus. Several animals painted on the cieling have preferved their colours. To the fouth of Efné are feen the ruins of a monaftery founded by St. Helena, and near it the burying place of the martyrs, adorned with tombs crowned by cupolas, fupported by arcades. The inhabitants of Efné having revolted againft the perfecution of Dioclefian, this emperor deftroyed the town, and put them to the fword. This place, confecrated by religion, is become a celebrated pilgrimage among the Copts, who repair hither from the moft diftant provinces of the kingdom. In the chain of mountains, which ftretches to the eaftward of the Nile, and nearly oppofite to Efné, are quarries of a foft ftone, called "Baram," which hardens in the fire, and is ufed in the manufacture of kitchen utenfils. Savary's Letters, &c. vol. ii.

ESOCHE, from ἐσω, *within*, and ἐχω, *to have*, in *Surgery*, a tubercle within the anus.

ESOPUS. See Kingston.

ESOTERIC. See Exoteric.

ESOX, in *Ichthyology*, a genus of the abdominal kind, diftinguifhed by the following effential particulars. The head flattifh above; mouth and throat large; jaws toothed, unequal, the upper one flat, lower punctated; tongue broad, loofe; palate fmooth; eyes round, moderate fize, and lateral; noftrils double, near the eyes; gill-covers large, aperture ample, with from feven to twelve rays; body elongated, covered with hard fcales; above convex, and compreffed at the fides; lateral line ftraight, neareft the back, and fcarcely vifible; dorfal and anal fin very fhort, and generally placed oppofite.

Species.

Lucius. Snout depreffed; jaws nearly equal. Linn. Fn. Suec. Art. Gen. Rondel. *Brochet*, Bell. *Pike*, Penn. Donov. Brit. Fifhes.

The pike is an inhabitant of moft of the lakes of Europe, and the north of Afia, and alfo of many of the larger rivers in Lapland, Siberia, and countries adjacent. It grows to a confiderable fize, thofe of four or five feet in length not being uncommon in the northern regions, and fometimes even they attain to the length of eight feet or more. The pike is highly prolific, and from its extreme voracity as well as cunning, is called the wolf, or the fox of fifhes; it fubfifts on fifhes, on frogs, ferpents, and other reptiles, and on the young of fwans and other aquatic fowl, and is reputed fo undaunted in its attacks that it will even contend with the otter for its prey. This fifh fpawns in fpring between the months of February and May. The colours vary in brightnefs at different feafons; in general the upper part is olivaceous green, with the back nearly black, and the whole fpotted with yellow, whitifh, or orange, according to the health of the fifh. The belly white, and the fins beautifully variegated with vivid colours and fpots of blackifh purple. The jaws contain a formidable armament of teeth difpofed in longitudinal rows. The longevity of the pike is well known to be very great; but what credit ought to be repofed in the affurances of fome writers, that it lives to the age of two or three hundred years, muft remain for others to determine. Their multiplication is immenfe; in the northern parts of Ruffia, and in Siberia, where they are taken in the greateft plenty, they conftitute an article of commercial importance, being prepared by means of falting and drying, for exportation.

Viridis. Green; lower jaw longer, fcales thin. Gmel.

This is regarded by Bofc as a variety only of the common pike, (Efox lucius,) the accuracy of which opinion appears rather uncertain, as we may perhaps be unacquainted with the fpecies or fifh intended by Gmelin; the reference of the latter author to the Acus maxima fquamofa viridis for the fame fifh is fuppofed to be incorrect.

Sphyræna. Dorfal fins two, the firft fpinous. Linn. Arted. *Sea pike or Spit-fifh*, Charlt.

There is fome remote refemblance between this fifh and the common pike, from which among other particulars it is diftinguifhed by having the lower jaw advanced, the body more flender, the tail furcated, and the back furnifhed with two dorfal fins inftead of one. The rays of the firft dorfal fin are fpinous, and are defcribed both by Linnæus and Artedi as five in number, but according to Bloch thefe amount to only four. The fifh is blueifh above, beneath white; the pectoral, ventral, and anal fins red. It grows to the length of two feet, and inhabits the Atlantic and American feas The flefh is in efteem.

The Barracauda pike of Shaw's Gen. Zool. defcribed after Catefby, appears very clofely allied to the preceding, if it be not the fame; the character "brown, elongated, whitifh beneath, with two dorfal fins and forked tail," differs from that fifh only in having the upper part brown inftead of blueifh. It is found in the Weft Indies, and grows to the length of eight or ten feet.

Becuna. Silvery-blueifh, marked on each fide by a row of deep-blue fpots, with two dorfal fins, and forked tail. Shaw. Gen. Zool. *Sphyræna becuna*, Cepede.

This accords fo nearly with the Efox fphyræna that we cannot fupprefs our fufpicions of its being the fame. The only authority on which it is defcribed is a drawing by Plumier; this, indeed, reprefents a fifh of fomewhat more elongated form, in which the fides are marked with a feries of blue fpots not obfervable in the former. If it prove diftinct it is certainly very analogous. It is defcribed as a native of the American feas.

Aureo-viridis. Body golden-green, with two dorfal fins, a fpine before the firft; lower jaw longer. *Sphyræna aureo-viridis*, Cepede. *Gold-green pike*.

Defcribed and figured by Cepede from the drawings of Plumier; the body is deep, as in the fparus, the head fharp pointed;

pointed; fcales middle fized; tail forked and lunated. The fpecies inhabits the American feas.

Vulpes. Dorfal fin in the middle of the back; the gill membrane three-rayed. Gmel. *Vulpes bahamenfis*, Catefby. *Fox pike.*

Refembles the common pike, but is more flender in proportion towards the tail, the colour brown above, beneath paler. Native of Carolina and the Weft Indies.

Synodus. Dorfal fin in the middle of the back: gill membrane five rayed. Gmel. *Synodus*, Catefby.

Clofely allied to the former, and inhabits the fame feas, and according to Cepede the Mediterranean alfo. The body is marked with dufky bands; abdomen filvery; fins ftriped with black.

Hepsetus. Lateral line filvery. Gmel. *Argentina pinna dorfali pinnæ ani oppofita*, Linn. Amœn. Acad. *Piquitinga*, Marcgr. Inhabits America.

Marginatus. Dorfal and anal fins oppofite; lateral line filvery; lower jaw fix times as long as the upper. Forfk. Fr. Arab.

This and the preceding are fuppofed to be the fame. The latter is defcribed by Forfkal as an inhabitant of the Red fea; its length about a fpan and a half; the body linear, tapering each fide, and covered with broad lax, entire fcales, the colour brown above, beneath white; the anal fin fmall, triangular, glaucous, and yellow without; dorfal yellow externally; tail bilobate, the upper lobe pale yellow, the pofterior edge brown.

Chinensis. Head flender, lower jaw longer; eyes large and protuberant. *Sphyræna chinenfis*, Cepede.

Slightly defcribed by Cepede from the manufcripts of Commerfon as a native of the Indian feas. The general colour is faid to be green with a filvery hue, and the fcales of the middle fize.

Chilensis. Jaws equal; lateral line blue. Molina. *Chili pike.*

Native of the Chilefe feas. Length from two to three feet; body round, covered with bony angular deciduous fcales, above golden, beneath filvery; flefh white, and excellent.

Argenteus. Brown variegated with yellowifh characters. Gmel. Forfter, &c. *Silver pike.*

Inhabits frefh waters of New Zealand and other iflands of the fouthern ocean.

Brasiliensis. Lower jaw very long; body ferpentine. Linn. Muf. Ad. Fr.

Thefe are feveral figures of this fifh in different authors, moft of which are defective in one particular or other. Nieuhoff omits the anal and ventral fins, Valentyn and Renard conftitute two fpecies of the fame fifh; and in other reprefentations the dorfal fin is omitted. Linnæus erroneoufly refers to the Timucu of the Brafilians as being fynonymous; the fifh fo named by thefe people has both the jaws elongated, and ending in a point, and is fuppofed to be the fpecies Belone. Gmelin adopts the fame mifreference. The length of this fifh is from twelve to fifteen inches; the upper part of the body green, beneath yellow, and the back marked with about fix broad and equidiftant bands of fufcous. The fpecies inhabits the Brafils, and is efteemed a delicacy for the table.

Gymnocephalus. Jaws equal; gill-covers very obtufe; head naked. Linn. *Naked-headed pike.*

Native of India, according to Linnæus, who fpeaks of it as being the fize of the fand launce.

Malabaricus. Two canine teeth in each jaw; gill-membrane with five rays. Bloch.

Found in the rivers of Malabar. The length is about twelve inches: its form fomewhat refembling that of the common pike. The colour above greenifh-blue, beneath yellow; fins yellow; at the bafe purplifh, and marked with feveral diftinct bands of brown. The lower jaw is rather longer than the upper, and the tail is rounded.

Chirocentrus. Breaft armed on each fide by a fpine over the ventral fin; lower jaw longer. Cepede.

Defcribed from the manufcripts of Commerfon. Its form refembles in fome refpects that of the common pike. The fpine is faid to be ftrong, and flightly curved; its length about two-thirds that of the fin, of which it appears to be the firft ray.

Belone. Each jaw long and fubulate. Gmel. *Sea pike, gar-fifh, or fea needle*, Penn. Donov. Brit. Fifhes.

Length from eighteen inches to three or four feet, of a very flender eel like form, with long projecting fnout, the back fine green; belly filvery. It is a common fpecies in all the European feas; migrating annually in large fhoals from the depths of the ocean to the fhore. They appear on our coafts in the fpring, commonly announcing the arrival of the mackarel, but remain with us for a much fhorter period than that fifh. They depofit their fpawn clofe to the fhore among the rocks and fea weeds, where the young are hatched, and after a certain time retire. We have feen the fry of this fifh on our coafts during the fummer months. As an article of food the gar-fifh is held in far lefs eftimation than the mackarel, to which its flavour in fome degree approaches. By many people the flefh is confidered unwholefome, and even poifonous; arifing, no doubt, from the fingular circumftance of the bone becoming of a fine grafs green colour in boiling. This fpecies grows to the length of eight feet. Donov. Brit. Fifhes.

Saurus. Jaws fubulate, and flighty curving upwards, lower one longeft; above and beneath fpurious fins near to the tail. *Maxillis fubulatis fuafcendentibus, inferiore longiore, caudam verfus fupra infraque pinnulis fpuriis.* Donov. Brit. Fifhes. *Saurus*, Rondel. *Skipper*, Ray. *The faury*, Penn. &c.

The obfcurity that prevailed refpecting this curious fifh till within a very recent period, induced us to enter on the details of its general defcription with rather more than ordinary minutenefs: the writer of this article has already treated at fome length on the Efox faurus in his work on Britifh fifhes lately publifhed, and conceives a repetition of the following obfervations fubmitted on that occafion may not prove altogether unacceptable.

Our countryman Ray appears to be the firft writer who defcribes this rare and curious fpecies of efox as a native of Britain; he fpeaks of it as a Cornifh fifh, under the provincial name of fkipper. Rondeletius and Gefner previoufly mention it as a fcarce kind among the fifhes of the Mediterranean. In 1769 the fame fifh was again introduced to notice by Mr. Pennant in his tour of Scotland, and afterwards in his Britifh Zoology, wherein we are informed, that vaft numbers of them were thrown afhore on the fands of Leith, near Edinburgh, after a great ftorm in November, 17'8. In the fummer of 1800 a fingle fpecimen was taken near the ifle of Portland, in Dorfetfhire, after a hard ftorm; an account of which, accompanied with a figure of the fifh in its natural fize, is given by the Rev. Mr. Rackett, in the third volume of the Linnæan Tranfactions. "This fifh (Mr. Rackett obferves) appears to be rare on the Dorfet coaft. Of the fifhermen in this part, only one was acquainted with it, and called it a fkipper, the name under which, according to Ray, it was known in his time on the coaft of Cornwall. This writer adds that the fpecies has not been noticed by Linnæus, Gmelin, nor Bloch; and that Pennant

nant has given a very indifferent figure of it in his Tour in Scotland, and has made ufe of the fame plate in his Britifh Zoology." See Linn. Tranf. 3. p. 60.

It is altogether fingular that this fifh has no place in either edition of the Linnæan Syftema, not even that by Gmelin; it is inferted by Dr. Turton in his tranflation on the authority of Pennant. The length of this fpecies is about eighteen inches: the body of a long and flender form; not like that of an eel, as writers defcribe, but agreeing precifely with that of the common gar-fifh (Efox belone). The fnout is fubulate, fine, toothlefs, and curving upwards. The jaws are of unequal length, the lower being longeft, and bending upwards at the tip, in which refpect it differs from the figures of Mr. Pennant and Mr. Raekett, in both which the jaws appear ftraight and of equal length. Neither do the jaws, when clofed, exhibit that remarkable hiatus or gaping fhewn in thofe two reprefentations; there is a kind of flexuofity in the fhape of the mouth, when open, which might excite fuch an idea, but upon gently clofing it the curvature in the form of one jaw will be found to correfpond with the future of the other; fo that the character "maxillis medio hiantibus," affigned to it, is by no means applicable. Dr. Shaw mentions in the Gen. Zool. that "in a fpecimen figured in the work of Cepede, the jaws are reprefented upwards, contrary to what has hitherto been obferved; the fpecimens figured in the work of Mr. Pennant, as well as that of Rondeletius, and the drawing by Mr. Rackett, have the jaws ftraight." This is certainly true, and it is therefore to be prefumed that the examples from whence the figures of the latter mentioned writers have been taken muft have fuftained injury, or been mifreprefented; for it is clear Cepede is right in reprefenting the jaws curving upwards: it is indeed evident, from the comparative fhortnefs of the jaws in the figure by Pennant and others, they could not be perfect, the beak in the fifh itfelf being nearly twice the length delineated by either. Dr. Shaw has alfo been apparently mifled to the perfuafion that the fkin of this fifh is reticulated by fine fins decuffating each other at equal diftances, which is not by any means the natural appearance of the fifh, and the figure in the Britifh Zoology is ftill more erroneous, as it appears entirely fmooth, and deftitute of fcales.

Some mifunderftanding feems to prevail likewife as to the colour of the fifh. Mr. Pennant defcribes it as having the back dufky, and the belly bright and filvery, in which particulars he is followed by Dr. Shaw, who remarks that the colour of the whole animal is dufky above, and filvery beneath, with dufky or blueifh brown back. This is not, however, correct, the true colour of the back of the fifh is a moft lovely azure blue, changeable to green, and gloffed with purple and yellow, and the lower parts filvery. The body has a fmooth appearance, the fcales with which it is covered being thin and glabrous: the lower part of the body from the gills to the tail is marked with a longitudinal carina or keel, which terminates at the latter part in a fomewhat protuberant manner.

The fpecies may be readily diftinguifhed by the pinnules or fpurious fins on the body near the tail, in which particular it agrees with the fcomber or mackarel genus; thefe have been varioufly mifreprefented; in the fifh itfelf they amount altogether to twelve in number, five of which are difpofed above and feven beneath; and it is alfo neceffary to add that they are perfectly detached from each other. The flefh, in point of flavour, refembles that of the mackarel.

Osseus. Upper jaw longer; fcales bony. Linn. *Efox maxilla fuperiore cauda quadrata*, Arted.

Native of North America and Afia, and has been found in Europe. (Donov. Brit. Fifhes.) The fpecies is from two to three feet in length, and is covered with rhombic fcales.

Cepedianus. Snout long, jaws fpatulate; fcales bony. *Le pifofleus fpatula*, Cepede. *Efox cepedianus*, Shaw.

The principal difference between the two laft mentioned fifhes feems to confift in the fnout being fhorter in proportion in E. cepedianus than the other. There is likewife another pike of the fame bony fcale kind, which has the jaws rather fhorter than either, and bears the name of Leverianus. We are not entirely fatisfied that the three laft mentioned differ fpecifically from each other.

No fmall degree of uncertainty feems to prevail throughout this tribe of fifhes independently of thofe laft adverted to; the fpecies fynodus, hepfetus, vulpes, and marginatus, appear to be imperfectly underftood: barracuda, viridis, and becuna, are perhaps more doubtful, as are alfo chirocentrus, and chinenfis; and it will have been obferved that the true characters of the fpecies faurus were not till lately afcertained.

The viper-mouthed pike (Efox ftomias), and vipera marina of Catefby, is diftinguifhed by having four of the teeth much larger than the reft: this is a very extraordinary fifh, and ought, in our opinion, to conftitute a new genus.

ESPADACINTA, in *Geography*, a town of Portugal, in the province of Tras-los-Montes, fituated on the Duero, and borders of Spain; 34 miles S.W. of Miranda de Duero, and 28 N. of Almeida.

ESPAGNAC, John-Baptist-Joseph de Sahuguet-Damarzil, Baron d', in *Biography*, a military writer, was born in the year 1713 at Brive la-Gaillarde. At the age of nineteen he entered the army, and became celebrated for great fkill and prowefs. In 1742 he was aid-de-camp in the war of Bavaria, and was afterwards employed by marfhal Saxe as aid-major general and colonel of a regiment of grenadiers. In 1780 he was raifed to the rank of lieutenant-general, and died at Paris in 1783. As an author he attained a good fhare of celebrity by his "Campaigns of the King in 1745—48," which were publifhed in four octavo volumes. He publifhed alfo "Effays on the Science of War," 3 vols. 8vo. "An Effay on the great Operations in War," in 4 vols. 8vo; "A Supplement to the Reveries of Marfhal Saxe," in 2 vols. 8vo. 1773. He likewife drew up "The Hiftory of Marfhal Saxe," in 3 vols. 4to. in which are detailed plans of his battles and marches, together with thofe particulars of the life of that general, as render it a work of confiderable intereft to literary as well as to military men." Nouv. Dict. Hift.

Espagnac, in *Geography*, a fmall town of France, in the department of the Lozere; 12 miles S. of Mende.

ESPAGNE, John d', in *Biography*, a French proteftant divine in the feventeenth century, was born at Dauphiné, and became minifter of the French church in London, an office which he fuftained during the reigns of James I. and Charles I. He publifhed feveral fmall tracts, which were afterwards collected and publifhed at Geneva and the Hague, in three and in two volumes 12mo. about the year 1670. He alfo publifhed a work, which he dedicated to Charles I., entitled "Erreurs Populaires en points Generaux qui concernent l'Intelligence de la Religion." Of this and of fome other of his pieces Bayle fpeaks in terms of commendation. Moreri. Bayle.

Espagne, in *Geography*. See Epaigne.

ESPAGNET, John d', in *Biography*, who flourifhed in the 17th century, was prefident of the parliament of Bourdeaux. As a literary character he publifhed a work entitled "Enchiridion Phyficæ Reftitutæ," which was afterwards

wards tranflated into French under the title of "La Philofophie des Anciens retablie en fa Pureté." This may be regarded as the firft book that appeared in France, in which there is a complete fyftem of phyfics contrary to that of Ariftotle; though the author pretended that he had merely re-eftablifhed the ancient philofophy. He publifhed alfo a work concerning the philofoper's ftone, entitled "Arcanum Hermeticæ Philofophiæ Opus." Alfo an old MS. entitled "Le Rozier des Guerres," found at Nerac in the king's clofet, and attributed, though erroneoufly, to the pen of Lewis XI. To this work he added a treatife of his own, upon the education of a prince. In publifhing the "Rozier des Guerres," he followed the original with the utmoft exactnefs, becaufe, fays he, "this little tract feemed to me fo good, that I would not embellifh or difguife it, but have left it in its native fimplicity: and though the language of it is not in ufe in this age, yet it may be underftood, being fo full of good fenfe and meaning, that with all its jargon it may filence the affected language of the court and bar. I have alfo carefully preferved the fpelling, becaufe in adding or diminifhing a letter, a word is often changed, and of old made new." Bayle.

ESPAIN, Saint, in *Geography*, a fmall town of France, in the department of Indre and Loire; 15 miles S.E. of Chinon.

ESPALIER Trees, in *Gardening*, are fuch fruit trees of low growth as are trained to treillages or framed woodworks made for the purpofe, in ranges, fo as to conftitute a fort of hedge. They are ufually planted in fingle rows along the borders, on the fides of the principal walks, in the main divifions of the garden, affording fhelter to other plants as well as ornament to fuch parts.

The forts of fruit trees moftly employed in this way are thofe of the apple, pear, and plum kinds; but many others may be managed in this method where variety is wanted; as the quince, cherry, almond, apricot, mulberry, and filbert. And it is neceffary, with a view to beauty and uniformity, to manage them in fuch a manner as to have them that are nearly of the fame growth in the fame range or line of planting.

The forts of apples moft adapted to this ufe are thofe of the golden and other pippin kinds, the nonpareil, rennet, and ruffet; but many others may be cultivated in this way.

In the pear kind, the jargonelle, blanquette, bergamot, burre du Roy, &c: the melting pears being always better in this way than thofe of the breaking kind. On ftrong moift foils thofe grafted on quince ftocks are the beft, but on dry ones thofe on free ftocks.

Trees intended for this ufe fhould be grafted or budded within a few inches of the furface of the ground, that branches may be thrown out regularly from the bottom upwards, to furnifh and fill the treillage; and the more effectually to accomplifh the purpofe, the firft fhoots from the grafts, &c. fhould be cut off, or headed down within a few inches of the grafts, in the fpring feafon, when they have had one year's growth. The branches or fhoots thus produced, whether the trees are in the nurfery, or planted out as efpaliers, fhould, in the latter part of the fummer, or beginning of autumn, be trained both ways laterally in their advancing growth, to ftakes put down for the purpofe, or the efpalier frames. In this way the trees acquire a proper form, thofe in the nurfery being thus trained and kept for fale. A fecond heading down in the upper branches may likewife be practifed when neceffary, in order to fill up the middle, and completely cover the frames.

When thefe trees have been thus trained for three or four years in the nurfery-ground, they are generally in a proper fituation for being planted out as efpaliers in the borders or other parts along the fides of the walks in the garden or pleafure ground, a fufficient breadth being allowed for the borders according to the fize or extent of fuch grounds, as fix, eight, ten, or more feet.

Befides this, there is another method fometimes practifed in forming efpalier trees, which is that of, after heading the firft fhoots down as above, training the fide-fhoots horizontally in the direction of the frames, and the middle one upright, forming the lateral fhoots, which it throws out horizontally on each fide; and, if they are not thrown off fufficiently low, heading the upright one down, by which lateral branches will be fent off, fo as to range with regularity at the diftance of fix or feven inches, one above another, on each fide, from the bottom to the top. In this way the trees have a very neat appearance.

In planting the trees out, when they are of the apple or pear kind, on dwarf ftocks, the diftance in the rows fhould be fifteen, eighteen, or twenty feet; and when on free ftocks, not lefs than twenty or thirty; and for free growing trees confiderably more. For plums, the diftance fhould be eighteen feet or more; and for cherries, apricots, almonds, and mulberries, it fhould never be lefs than fifteen. Confiderably lefs diftance will, however, be fufficient for filberts, efpecially in the poorer forts of foil.

When thefe trees have been planted, it is the ufual practice to put fticks down in a line to train them to for the two or three firft years; but it has a much neater appearance to have the treillage fixed down to train them to at once.

Frames for this ufe are made in different ways, according to the tafte of the perfon who has them; but the moft ufual forts are thofe conftructed of three or four inch fquare pieces of oak timber for the pofts, with rails of deal carried from poft to poft, at the diftance of every ten or twelve inches from the bottom to the top. Between thefe rails thin upright pieces are again fometimes fixed at the fame diftances, for particular purpofes. The whole fhould be well painted over in oil fome time before the trees are to be trained to it. This laft is performed either by tying the branches to the trellis by ofier twigs, woollen-yarn, or other fimilar fubftances, or by nailing them in the manner of wall-trees. In whichever way it is done, the greateft exactnefs and regularity fhould be obferved in laying in and directing the fhoots, that they may have a neat regular appearance. The manner of performing the future pruning and managing of thefe trees will be explained when we come to fpeak of the nature of pruning in general. See Pruning *of Fruit Trees*.

Thefe forts of trees are chiefly advantageous in admitting the branches to produce fruit fpurs on both fides, which is not the cafe with wall-trees; in taking up but little room in the garden; in not being fo injurious to the crops that are near them; in affording fruit of a finer flavour, from the more free admiffion of air and fun, and in the fruit not being fo liable to be blown down and injured as in other cafes.

ESPALION, in *Geography*, a fmall town of France, in the department of the Aveyron, chief place of a diftrict of the fame name, with a population of 2622 inhabitants. It is fituated on the river Lot, 18 miles N.E. of Rhodez, and has fome manufactures of coarfe woollen cloth. The canton has a territorial extent of 167½ kiliometres, 12 communes, and a population of 9139 individuals.

As chief place of a diftrict, Efpalion has a fub-prefect, a court of juftice, and a regifter office. Corn, wine, and madders, grow in its neighbourhood, and the whole diftrict contains 9 cantons, 101 communes, and 58,855 inhabitants, on a territorial extent of 1630 kiliometres.

ESPAMISCACK,

ESPAMISCACK, a lake of Lower Canada; 74 leagues N.E. of Quebec. N. lat 50°. W. long. 68°.

ESPAQUE, a town of Perfia, in the province of Segeftan; 54 miles S.W. of Kin.

ESPARCET, in *Agriculture*, a name fometimes given to faintfoin. See SAINTFOIN.

ESPARRAGOSA, in *Geography*, a town of Spain, in the province of Eftremadura; 35 miles E.S.E. of Merida.

ESPARRAGUERA, a town of Spain, in the province of Catalonia; 15 miles N.N.W. of Barcelona.

ESPARZA, a town of Spain, in Navarre; 22 miles E. of Pamplona.—Alfo, a town of North America, in Mexico, and province of Cofta-Rica.

ESPEJA, a town of Spain, in the province of Cordova; 17 miles N.N.E. of Montilla.

ESPELETTE, a fmall town of France, in the department of the Lower Pyrenées, chief place of a canton in the diftrict of Bayonne, with a population of 1200 individuals. Its canton has a territorial extent of $237\frac{1}{2}$ kiliometres, 7 communes, and 7861 inhabitants.

ESPEN, ZEGER BERNARD VAN, in *Biography*, was born at Louvain in the year 1646. After going through the ufual courfe of ftudies at the univerfity, with much credit to his talents and diligence, he was admitted to prieft's orders in the year 1673, and had, within two years of this time, the degree of doctor of laws conferred upon him. From this period till the year 1702, he lived in the college of pope Adrian VI., where he performed the duties of profeffor, and applied himfelf to the ftudy of thofe works which have rendered his name illuftrious. He obtained fo much refpect by his various writings that he was confulted from every quarter: by the tribunals of juftice, by the bifhops, and by feveral fovereign princes. His principal work was entitled "Jus Ecclefiafticum Univerfum." Befides this, he is well known for other treatifes, "De peculiaritate et Simonia;" "De Officiis Canonicorum;" "Tractatus Hiftorico-Canonicus in Canones;" "De promulgatione Legum Ecclefiafticarum," and many others, all of which were collected and publifhed in 4 vols. folio, in 1753, at Paris. When he was in his 65th year, he was deprived of fight by a cataract, which was not removed for two years; during this time, however, he neither loft his cheerfulnefs, nor remitted his application. His manner of living was at all times frugal, and very fimple, his temper was benevolent, modeft, and humble. He was eminent for piety towards God, and for his candour and good-will towards men. He neverthelefs had made himfelf enemies, by the integrity and independence of his mind; fome of whom, to render Efpen obnoxious to the ruling powers, had forged a treatife, containing fome things very offenfive, in a religious and political point of view, which they attributed to him; but he luckily detected the impofture, and punifhed the agents. On other accounts, he met with fevere and unmerited perfecution, and in one inftance, after a variety of proceffes, fentence was pronounced againft him, without any declaration refpecting the definitive judgment of the court. Under thefe circumftances, believing that it was intended to put him under an arreft, he withdrew to Maeftricht, and afterwards to Amersfort, in the province of Utrecht, where he died in 1728, in the 83d year of his age. He left behind him, which was afterwards publifhed, a learned treatife, entitled "Commentarius in Canones Juris Veteris ac Novi," and other differtations, which are faid to contain difcuffions on fome of the moft important points in moral philofophy, as well as the canon and civil laws. Moreri.

ESPENCE, CLAUDE DE, was born at Chalons fur Marne in the year 1511. He received his education at different colleges in Paris, to the principal of which he was chofen rector at a very early age. When he was about thirty years old, he took his doctor's degree, foon after which he was invited by the cardinal of Lorrain to refide in his houfe, to manage the ecclefiaftical concerns of which he had the care. In the year 1544 he accompanied the cardinal on an embaffy to Flanders, to negociate a treaty of peace between Francis I. and the emperor Charles V. He was afterwards felected by the king to affift at the ecclefiaftical conference, to confider the queftions proper to be propofed for difcuffion at the council of Trent; and in 1547 he was deputed by Henry II. to attend the council of Trent, which was then transferred to Bologne. Some years afterwards he was employed in negociating at Rome in favour of the French court, where his talents, as a diplomatic minifter, produced fuch an impreffion in his favour, that the pope, Paul IV. wifhed to attach him to his interefts by making him cardinal. He declined the intended honour, and having finifhed the bufinefs on which he was fent to Rome, he returned to his native country, where he appeared with high reputation at a meeting of the States at Orleans in the year 1560. In the following year he was appointed a member of the conference at Poiffy, where he attached himfelf to the Calvinifts, which was highly difagreeable to the Catholic divines, by whom he was likewife fufpected of being the author of a treatife on Image Worfhip, which occafioned him fome trouble with the faculty. After this, he paffed his life in retirement, devoted to his ftudies, till he died at Paris in the year 1571. His works are chiefly theological; the moft important are his "Commentaries on the Epiftles of St. Paul to Timothy and Titus;" in thefe, feveral queftions relative to hierarchy and ecclefiaftical difcipline are difcuffed. Moft of his treatifes were written in the Latin language, in the knowledge of which he was fuppofed to excel his contemporaries. He was one of the moft learned, judicious, and moderate ecclefiaftics of his time. He was very converfant in the canons and difcipline of the church; and not lefs celebrated for his knowledge of profane literature. He was attached to the Catholic religion, but was a decided enemy to every fpecies of perfecution and intolerance. Moreri.

ESPER, JOHN FREDERIC, was born at Droffenfeld, in Bayreuth, in 1732. He ftudied very diligently at Erlangen, where he applied himfelf chiefly to theological purfuits, but at the fame time made himfelf well acquainted with natural hiftory and botany, of which he afterwards became a teacher. He died of a fever in July 1781, leaving behind him a confiderable reputation as a naturalift, particularly in that department which relates to the zoolites in the principality of Bayreuth. In this place are a number of large fubterranean caverns, partly infulated, and partly connected with each other, which contain immenfe numbers of bones of various animals, thrown together in heaps to a confiderable height, and covered with the earth arifing from decompofed animal bodies. The entrance to thefe caverns is highly picturefque, but almoft as foon as a perfon enters them he is furrounded by darknefs, and the paffage becomes ftill more difficult and narrow, till the eye at laft is ftruck by the immenfe extent of an awful arch, which on every fide prefents fiffures and clefts, ftrewed with the fragments of once living bodies, which excite the idea of a repofitory of the dead. With the aid of an ingenious apothecary of Erlangen, Efper undertook an examination and defcription of thefe curiofities, and publifhed the refult of his labours under the following title; "An accurate Defcription of the Zoolites of Unknown Animals, &c." This was publifhed at Nuremberg, in the year 1774, in folio, with fourteen illuminated plates. Efper was author likewife of various papers in the Tranfactions of the Friendly Society of the Searchers into Nature: and he wrote an account of "A Method of determining the Orbits of Comets, and other Celeftial Bodies without Inftruments, or Mathematical Calculations." Gen. Biog.

ESPERAZA, in *Geography*, a town of France, in the department of the Aude, and diftrict of Quillan; $2\frac{1}{2}$ leagues S. of Limoux.

ESPERNAY. See Epernay.

ESPERNON, a fmall town of France, in the department of Eure and Loire, on the river Guefle; 15 miles N.E. of Chartres, and 6 miles E. of Maintenon.

ESPESEL, a town of France, in the department of the Aude, and diftrict of Quillan; $2\frac{1}{2}$ leagues S.W. of Quillan.

ESPHLASIS, (from εσφλαομαι, *to recede inwards*,) in *Surgery*, a receffion of a part of the body inwards, in confequence of fome violent outward force.

ESPIERRE, a town of Savoy, in the county of Maurienne, on the river Arc; $3\frac{1}{2}$ miles S. of Argentina.

ESPIERS, in *Geography*, a town of Flanders; 8 miles N. of Tournay.

ESPINAL. See Epinal.

ESPINAR, a town of Spain, in Old Caftile; 18 miles S.S.W. of Segovia.

ESPINHAL, a town of Portugal, in the province of Beira; 18 miles S E. of Coimbra.

ESPINOSA de los Monteros, a fmall town of Spain, in Old Caftile; fituated in a pleafant valley, watered by the river Trueva, among the mountains of Burgos, about 15 leagues N.W. of Miranda, in the north corner of the province.

Espinosa, a town of Spain, in New Caftile; 44 miles S.W. of Toledo.

ESPIRITU Santo, the largeft and moft wefterly of the New Hebrides iflands, in the South Pacific ocean, about 57 miles in length, and 30 in breadth.—Alfo, a province of Brafil, which is chiefly productive of fugar.—Alfo, a town of Brafil, feated in a fertile country on the fea-coaft, with a fmall caftle and harbour. S. lat. 20° 10'. W. long. 41°.—Alfo, a river of Brafil, which runs into the Atlantic.—Alfo, a town on the fouth coaft of the ifland of Cuba; 55 miles S. W. of Bayamo.—Alfo, a bay on the weft coaft of Eaft Florida. N. lat. 27° 36'. W. long. 82° 54'. It has a good harbour and fafe anchorage; but the land about the fea-coaft is very low. Several low, fandy iflands and marfhes, covered with Mangrove bufhes, lie before the main land. This bay abounds in the fummer with fifh, which may be taken with a feine, in quantity fufficient to load a fhip, if the climate would admit of curing them, in a few days.—Alfo, a lake towards the extremity of the peninfula of Eaft Florida, fouth from the chain of lakes which communicate with St. John's river.

Espiritu *Santo, Ilhas del*, iflands fituated on the S. W. of Providence in the Weft Indies. See Andros *iflands*.

ESPLANADE, in *Fortification*, called alfo the glacis; a part which ferves the counterfcarp, or covert way, for a parapet; being a declivity, or flope of earth, commencing from the top of the counterfcarp, and lofing itfelf, infenfibly, in the level of the champagne.

Esplanade alfo fignifies the ground which has been levelled from the glacis of the counterfcarp to the firft houfes; or the vacant fpace between the works and the houfes of the town.

The term is alfo applied, in the general, to any piece of ground which is rendered flat, or level, and which before had fome eminence that incommoded the place.

ESPLEES, Expletiæ, from *expleo*, in *Law*, the products which ground or land, &c. yield; as the hay of the meadows, the herbage of the pafture, corn of the arable, rents, fervices, &c. and of an advowfon, the taking of tithes in grofs by the parfon; of wood, the felling of wood; of an orchard, the fruit growing there; of a mill, the taking of toll, &c. Thefe and fuch like iffues are termed efplees. And it is obferved, that in a writ of right of land, advowfon, &c. the demandant ought to allege in his count, that he or his anceftors took the efplees of the thing in demand; otherwife the pleading will not be good.

Sometimes this word hath been applied to the farm, or land, &c. themfelves. "Dominus E. habebit omnia expletias & proficua de corona emergentia." Plac. Parl. 30 Ed. I.

ESPOSENDA, in *Geography*, a town of Spain, in the province of Galicia; 12 miles S. W. of Orenfe.

ESPOSENDE, a fmall port town of Portugal, in the province of Entre Minho, at the mouth of the Cavado, three leagues S. of Viana. Its fhallow harbour is flightly protected by a fort, 22 miles N. of Oporto.

ESPRIT, James, in *Biography*, was born at Befiers in the year 1611. Having paffed through his initiatory ftudies, to which he had applied himfelf with great diligence, he was introduced to the duke de la Rochefoucault, who brought him acquainted with the chancellor Seguier, who not only allowed him a penfion from his own private purfe, but procured for him a penfion of two thoufand livres, on an abbey and a brevet of counfellor of ftate. Through fome fecret enemies he incurred the difpleafure of the chancellor, and withdrew to the feminary of St. Magloire, where he became acquainted with the prince of Conti, and at that time had ferious thoughts of entering the church. This prince was fo charmed with the converfation of M. Efprit, that he gave him handfome apartments in his own hotel, and a penfion of a thoufand crowns. In a fhort time afterwards Efprit gave up all thoughts of the ecclefiaftical life, and determined to marry. On this occafion he received fome handfome prefents from the prince, to whom he became fo much attached that he followed him, in 1766, to his government of Languedoc, and became his moft confidential friend and advifer. After the death of his patron, he devoted the whole of his time to the education of that prince's children. He himfelf died at the place where he was born in 1678. As a literary man he left behind him "Paraphrafes on fome of the Pfalms;" and a treatife, entitled "La Fauffeté des Vertus humain," in two volumes, which was publifhed the fame year in which he died, and which was intended as a commentary on the maxims of his firft patron the duke de la Rochefoucault, to fhew the fallacy of the virtues that are merely human, and the reality of Chriftian virtues. By the abbé Olivet and others he is fuppofed to have been the tranflator of Pliny's panegyric on Trajan. Efprit was a member of the French academy, and in its infancy was confidered as one of its fhining ornaments. Moreri.

Esprit, *Saint*, in *Geography*, a fmall town of France, in the department of the Landes, chief place of a canton in the diftrict of Dax, with only 589 inhabitants. Its canton has a population of 10,161 individuals, difperfed in eight communes, on a territorial extent of $147\frac{1}{2}$ kiliometres.

ESPOUSALS, Sponsalia, in *Law*, a contract or mutual promife between a man and a woman to marry each other. Marriage or matrimony is faid to be an efpoufal de prefenti.

ESPRONCEDA,

ESPRONCEDA, in *Geography*, a town of Spain, in Navarre; 11 miles W.S.W. of Eftella.

ESQUADRILLE. See QUADRILLE.

ESQUADRON. See SQUADRON.

ESQUERDES, in *Geography*, a town of France, in the department of the ftraits of Calais, and diftrict of St. Omer; one league S. of St. Omer.

ESQUIAVINE, in the *Manege*, an old French word fignifying a long and fevere chaftifement of a horfe in training him.

ESQUILIÆ, or ESQUILINUS MONS, in *Ancient Geography*, one of the feven mountains on which Rome was feated, where was anciently one of the gates of the city, now the gate of St. Laurence, to whofe magnificent church it leads. This gate feems to have been anciently called "Libitinenfis," on account of the dead bodies that were carried through it, in order to their being interred in the "Campus Efquilinus," which was the general buryingplace of the common people. The name of Efquilinus was varied, for facility of pronunciation, from Exquilinus, a corruption of Excubinus, *ab Excubiis*, from the watch that Romulus kept in this place. It was taken in by Servius Tullius, who had his royal feat upon this hill. Varro will have the Efquiliæ to be two hills. To the eaft, it has the city walls; to the fouth, the via Labicana; to the weft, the valley lying between Mons Cœlius and Mons Palatinus; to the north, Mons Viminalis; and is in compafs between three and four miles. It is now called "Il Monte de Santa Maria Maggiore." One of the 14 regions or wards, inftituted by Auguftus, was denominated "Efquilina." It contained 15 ftreets, eight luci, fix temples, five ædes, 75 public baths, 18 granaries, 22 mills, and 180 great houfes; and its circuit was 15,950 feet.

ESQUIMAUX, the inhabitants of the coafts of Labrador and Hudfon's bay, who differ, in feveral characteriftic marks, from the inland inhabitants of North America. That the Greenlanders and the Efquimaux agree in every circumftance of cuftoms, and manners, and language, which are demonftrations of an original identity of nation, was difcovered near half a century ago. Crantz, in his "Hiftory of Greenland," (vol. i. p. 262.) informs us, that the Moravian brethren, who, with the confent and furtherance of fir Hugh Pallifer, then governor of Newfoundland, vifited the Efquimaux, or the Labrador coaft, found that their language, and that of the Greenlanders, do not differ fo much as that of the high and low Dutch. Mr. Hearne, in 1772, traced this unhappy race farther back, towards that part of the globe, from whence they had originally coafted along in their fkin-boats, having met with fome of them at the mouth of the Copper-mine river, in the latitude of 72°, and near 500 leagues farther weft than Pickerfgill's moft wefterly ftation in Davis's ftrait. Their being the fame tribe, who now actually inhabit the iflands and coafts on the weft fide of North America, oppofite to Kamtfchatka, is a difcovery, the completion of which was referved for captain Cook. The reader of his third voyage will find them at Norton found, and at Oonalafhka, and Prince William's found; that is, near 1500 leagues diftant from their ftations in Greenland, and on the Labrador coaft. And left fimilitude of manners fhould be thought to deceive us, a table exhibiting proofs of affinity of language, drawn up by captain Cook and inferted in the appendix to the work juft cited, will remove every doubt from the mind of the moft fcrupulous inquirer after truth. See *New* BRITAIN and LABRADOR.

ESQUIMAUX *Bay*. See ESKIMAUX.

ESQUINANCY, in *Medicine*, from the French *efquinancie*; whence our more common term *quinfy*. See CYNANCHE.

ESQUIRE, a title of diftinction, next below that of knight, and above that of a fimple gentleman.

The origin, both of the name, and the thing, efquire, is very obfcure. The Englifh denomination is confeffedly borrowed from the French, *efcuyer*; and that from the Latin *fcutum*, fhield, as fome will have it; or, as others, from *fcutarius*, or *fcutiger*, fhield-bearer; or from *fcuria*, ftable; or from *equifo*, groom. So many different opinions of the formation of the word have given rife to as many about the primitive office of efquires; unlefs, perhaps, the latter hath given occafion to the former. Pafquier, in his Recherches, liv. ii. chap. 15. maintains the title of efquire, *efcuyer*, *fcutarius*, to be very ancient. From the time of the declenfion of the Roman empire, he obferves, there were two extraordinary kinds of foldiery in the Roman army: the one called *gentiles*, and the other *fcutarii*.

Ammian. Marcellin. lib. xiv. cap. 7. and lib. xvi. cap. 4. fpeaks of thefe *fcutarii* as men of redoubted prowefs, and even deemed invincible: it is added, that Julian the Apoftate fet a mighty value on thofe troops, when he was among the Gauls; and hence, probably, it was, that the Gauls, or perhaps only the Franks, finding the braveft among the Roman forces were called *gentiles*, and *fcutarii*, gave the like names to the boldeft and braveft among themfelves; fuch, according to that curious antiquary, is the original of efquires.

Efquire, however, afterwards came to be ufed in a fomewhat different fenfe; *viz.* for a gentleman who attended a knight in the wars, and on other military occafions; bearing his fhield, *fcutum*, before him (whence he was called *fcutarius*, *fcutiger*, or *fcutifer*), as alfo his lance, and other weapons; whence his other Latin appellation, ufual among us, *armiger*, q. d. *armour-bearer*. And hence likewife it is, that, in all our ancient romances, the hero is conftantly attended by a gentle and trufty *'fquire*.

After all, the moft probable derivation of *efcuyer* is not from *efcu*, *fcutum*, as is the common opinion; but from *equus*, horfe; the primitive efquires being no other than what the Latins call *equifons*, who had the care and intendance of the equerries, or ftables, only.

Be this as it will, the title efquire, *armiger*, as now eftablifhed among us, is next below that of knight, *eques*. They who bear this title are all younger fons of noblemen, and the eldeft fons of fuch younger fons; the eldeft fons of knights, and their eldeft fons fucceffively; both which fpecies of efquires fir Henry Spelman entitles *armigeri natalitii*; the four efquires of the king's body, now difufed, and efquires created by the king, by putting about their necks a collar of SS's, and beftowing on them a pair of filver fpurs, letters patent, or other inveftiture, and their eldeft fons. Laftly, divers others, in the fuperior public offices, are reputed efquires, or equal to efquires; as fheriffs of counties, ferjeants at law, juftices of peace, mayors of towns, counfellors at law, lieutenant-colonels, majors, captains, &c. during the time of their commiffion. Laftly, the heads of fome ancient families are likewife efquires by prefcription. To thefe may be added the efquires of knights of the Bath, each of whom conftitutes three at his inftallation; and all foreign, nay Irifh peers; for not only thefe, but the eldeft fons of peers of Great Britain, though frequently titular lords, are only efquires by the law, and muft be fo named in all legal proceedings. See GENTLEMAN.

ESQUISSE, in the French *Painting*, a term fignifying the firft flight fketch or draught of a picture; the firft

 thought

thought of a defign drawn haftily with a crayon; or in colours, on paper, canvas, or the like, in order to be finifhed, and painted, or engraven afterwards.

He had not the trouble of making a finifhed and correct defign, but went to work upon the efquiffe.

The word is formed of the Italian *fchizzo*, a fplafh; becaufe an efquiffe of a painting only reprefents, as it were, fplafhes, or dabs, of colours.

ESQUIVO. See Essequibo.

ESRAKITES. See Eschrakites.

ESS, in *Agriculture*, a term made ufe of in fome places to fignify afhes.

ESSA, in *Ancient Geography*, a town of Paleftine, on the other fide of Jordan, according to Jofephus, who fays that it was taken by Alexander, king of the Jews.

ESSACHORDO. See Hexachord.

ESSÆANS. See Esseni.

ESSAORE, in *Geography*, a town of Egypt; three miles S.S.E. of Achmim.

ESSARS, Les, a town of France, in the department of La Vendée, and diftrict of La Roche-fur-Yon; 3 leagues N.E. of La Roche.

ESSART, or Assart. See Assart.

Du-Cange derives the word from fome of the barbarous Latin words, exartus, exartum, effartum, affartum, fartum, and fartus; which all fignify a foreft cut down, or dug up; though Spelman choofes to deduce it from the Latin *exertum*, torn up, or unrooted. Others from *farrire*, to weed; and others, laftly, from *exaro*, I plow; whence *exarare;* and, by contraction, *exartum*. In our ancient law-books, "exartum facere in fylva," is to effart a place in a foreft. To effart, is to grub up, or extirpate bufhes, trees, old roots, ftumps, or the like; in order to fit the ground for tillage.

Essarts, *Les*, in *Geography*, a fmall town of France, in the department of La Vendée, chief place of a canton in the diftrict of Montaign, with a population of 2089 individuals, 24 miles W. of Mauléon. Its canton contains 9 communes, and 9043 inhabitants, on a territorial extent of 242½ kiliometres.

ESSATUM, a word ufed by fome of the chemical writers to exprefs the medicinal power or fanative property refiding in fimple medicines.

ESSAY, a trial, or experiment, to prove whether a thing be of the requifite quality or goodnefs.

The word is French, *effai;* which fome authors derive farther from the Latin *examen*.

Essay is alfo ufed for an attempt, or tentative, to learn whether or not a thing will fucceed.

Effays of machines fhould be made in large; it is not enough that they fucceed in little.

Essay, in *Monafteries*, is particularly ufed for a trial which a perfon makes of the monaftic life, in a fecular habit.

This effay is of one, two, and, in fome monafteries, of three months. The effay is not reckoned in the noviciate. See Probation.

Essay, or *Affay*, or fimply *Say*, in *Coinage*. See Assay.

Essay, in matters of learning, is a peculiar kind of compofition; whofe character is to be free, eafy, and natural; not tied to ftrict order, or method, nor worked up, and finifhed like a formal fyftem.

The matter of an effay is fuppofed to confift principally of fudden and occafional reflections, which are to be wrote much at the rate, and in the manner, a man thinks; fometimes leaving the fubject, and then returning again, as the thoughts happen to arife in the mind.

At leaft, this has hitherto been the practice; and Montagne, who has acquired no fmall reputation by this way of writing, feldom keeps many lines to the fubject he propofes; though it is our opinion, that lord Bacon, in many of his works, is a better pattern in the effay kind. Mr. Locke, however, and a few other authors, ufe effay in a ftricter fenfe: the Effay of Human Underftanding, every body knows, is a regular, artful, and laboured work; though perhaps fo called to guard againft too fevere ftrictures, by pleading the title.

Essay-*hatch*, is the miners term for a little trench or hole, which they dig to fearch for fhoad, or ore. See Tin.

Essay-*mafter*. See Mint, and Assay.

ESSE, in the *School Philofophy*, is ufed in the fame fenfe with effence; principally for that which is actual, or actually exifting.

The word is pure Latin; being the infinitive of the verb *fum*, I am; whence *effe*, to be.

From effe arifes *effatum*, a barbarous term, now almoft obfolete, fignifying that which is ended with effence, or nature; or affected with the virtue, or efficacy, of another. Some diftinguifh effe into *real* and *intentional;* and, again, into *effatum* and *volitum*.

ESSEDARIUS, among the Romans, a gladiator, who fought in a car or chariot. See Hift. Acad. Infcrip. vol. ii. p. 376. feq.

ESSEL, or Ebstel, in *Geography*, a town of Germany, in the circle of Weftphalia, and county of Verden; 2 miles N. of Verden.

ESSEN, a fmall town of Germany, in the circle of Weftphalia, remarkable for its manufactures, chiefly of fwords and fire arms; but more particularly for a rich abbey, which, until the peace of Luneville in 1801, was a free imperial abbey. It was fecularized, and its poffeffions, together with the town and its territory, were given to Pruffia as an indemnity for her loffes on the right fhore of the Rhine. After the peace of Tilfit in 1807, when Pruffia loft all her dominions beyond the Elbe, Effen was added to the grand duchy of Berg and Cleves, which now belongs to the eldeft fon of the king of Holland. There are other towns of this name in the circle of Weftphalia.

ESSENBACK, a town of Denmark, in Jutland; 4 miles from Randers.

ESSENBERG, a town of Germany, in the circle of Weftphalia, and county of Meurs, near the Rhine; 3 miles E. of Meurs.

ESSENCE, a term much ufed among the fchoolmen; and denoting what the Platonifts called the idea of a fpecies. The word *effentia* is faid to have been made by Cicero; but his authority could not give it currency, until long after his time. It came at laft to be ufed, and the fchoolmen fell into much the fame opinions concerning effences, as the Platonifts held concerning ideas. The effences of things were held by many to be uncreated, eternal, and immutable. Mr. Locke diftinguifhes two kinds of effence, the real and the nominal. By the former he means the conftitution of an individual, which makes it to be what it is. This effence moft begin and end with the individual to which it belongs. It is not therefore a Platonic idea. But the latter or nominal effence, fo called by Mr. Locke, is the conftitution of a fpecies, or that which makes an individual to be of fuch a fpecies; and this is nothing but that combination of attributes which is fignified by the name of the fpecies, and which we conceive without regard to exiftence. The effence of a fpecies is, therefore, what

what the Platonifts called the idea of the fpecies. The nominal effence depends on the real effence; thus, the nominal effence of gold, is that complex idea which the word gold reprefents; *e. gr.* a body, yellow, heavy, malleable, fufible, and fixed; but its real effenec is the conftitntion of its infenfible parts, on whieh thofe qualities, and all its other properties depend; whieh is wholly unknown to us.

In philofophy, the effence of a thing is defined to be, that whereby a thing is diftinguifhed from every other thing. The Cartefians hold the effence of matter to confift in extenfion; and, on that principle, deny that there is any fuch thing as mere fpace, or vacuity; but the hypothefis is falfe, as will be fhewn under the articles MATTER, SPACE, VACUITY, PLENUM, &c.

Gaffendus, and moft of the corpufcular philofophers, hold the effence of matter to confift in folidity, or impenetrability, refiftance, or, more adequately, in a folid impenetrability refifting the touch; which it muft be allowed, of all the properties of matter, feems to have the faireft title to it.

The fchool philofophers give us two fignifications of the word effence; the firft denotes the whole effential perfection of a being, and, confequently, its entity, with all its intrinfie, or effential, and neceffary attributes, taken together; in which fenfe, effence may be defined to be, all that whereby a thing is, and what it is. In which cafe the effence of a thing is to the thing itfelf, what humanity, *e. gr.* is to man.

The fecond fignification of effence is, that whereby it denotes the principal, and moft intimate, of all the attributes of a thing; or that which agrees to every fuch thing, and fuch alone, and that always, and in fuch manner, as that the mind, with all its attention, cannot perceive any thing prior thereto; by which, effence is diftinguifhed from the effential attributes, *i. e.* from fuch as flow from its effence, or firft attribute. Thus, the effence of the human mind is commonly fuppofed to confift in the power of thinking; becaufe all its other perfections feem to pre-fuppofe this; but this pre-fuppofes none. And thus the powers of underftanding, doubting, affenting, willing, &c. do all flow from the power of thinking; and cannot exift without it, though this may without any of them.

It muft be allowed, however, that the effential properties of a thing do fo clofely cohere, nay, and inhere, in the effence itfelf, that it is fcarcely poffible to diftinguifh the one from the other. Hence, what fome urge, that, fetting afide all the attributes and properties of a thing, and what remains is its effence, is a mere chimera. For fet afide, *e. gr.* from the mind, the powers of underftanding and willing, with the reft of its attributes, and what will there remain to call its effence?

It is greatly difputed, in the fchools, whether the effences of created things be eternal? or whether the effences, as well as their exiftence, had their origin in time? The Cartefians hold, that the effences of things depend abfolutely on the free concurring will of God.

ESSENCE, *Effential oil, Effential falt.* The effence of a vegetable, according to the old chemifts, was, that one of its proximate elements, in which refided the quality of tafte or odour, which peculiarly diftinguifhed it from other vegetables, and rendered it efpecially applicable to pharmaceutical purpofes. Thus the fragrance of orange peel, of pepper-mint, of cinnamon, was found by experience to be feparable from the other parts of the vegetable, by means of diftillation, &c.; the refult of this procefs was a fmall portion of highly fragrant oil, in which was contained the entire odour that had been naturally difperfed through the whole mafs: hence the oil thus procured obtained the name of "effential oil." Again, moft four vegetables, as forrel, lemons, &c. owe this quality to the prefence of an acid, which, when feparated from the other vegetable principles, affumes a cryftalline appearanee, and was known by the name of their effential falt. The fame appellation was alfo given to all thofe vegetable principles which, when pure, are capable of cryftallizing, whether they were acid to the tafte or not. Thus fugar was ranked among the effential falts. The term, however, is at prefent obfolete. Effential oil ftill retains its place in chemical nomenclature, and we refer the reader to the article OILS, *effential,* for a particular account of their fpecies and properties.

ESSENCE *of Rofes.* See ROSES.

ESSENCE, *Ward's.* See WARD'S *Medicines.*

ESSENCE *of Wine,* a term ufed by Paracelfus, and fome of the German chemifts fince his time, to exprefs what is called fometimes the philofophical fpirit of wine, or the fpirit of wine of the ancients. It is not a diftilled fpirit like what we call fpirit of wine, but approaches more to what Stahl has greatly recommended to the world, under the name of concentrated wine, or wine whofe ftrength has been reduced to a fmaller compafs, by feparating its aqueous parts only by freezing. Stahl recommends the immediately expofing of wine to the frofty air on this occafion; but the procefs ordered by Paracelfus for the preparation of this liquor is more tedious. He orders that the fineft and beft flavoured wine be chofen; that it be put into a glafs, filling it up three parts in four: and the neck being then fealed hermetically, it is to be put into horfe-dung for three months, and then expofed to the frofty air for a month, after which the ice is to be thrown away, and the liquid part, which is the effence, preferved. Shaw's Chemical Effays.

ESSENDO *Quietum de Tollonio,* in *Law,* a writ to be quit of toll, and lies for citizens and burgeffes of any city or town that by charter or prefcription ought to be exempted from toll, where the fame is exempted of them. Reg. Orig. 258.

ESSENEUX, in *Geography,* a town of the Netherlands, in the duchy of Limburg, fituated on the Ourt; 9 miles S. E. of Liege.

ESSENI, ESSENES, or *Effæans,* an ancient fect among the Jews.

As to the etymology of the name, critics have been much divided. Philo derives it from οσιος, *holy*; Epiphanius from ישי, *Jifhai, Jeffe,* the father of David; Salmafius from a city called *Effa,* mentioned by Jofephus; whence he apprehends the fect firft fprung; Godwin derives it from the Syriac word אסא, *afa,* whieh fignifies *to heal*; becaufe Philo calls one branch of the Effenes Therapeutæ; and Serrarius enumerates at leaft a dozen different etymologies. Philo in Tract. Omnis probus Liber. Oper. p. 678. Colon. Allobr. 1613. Epiphan. Hæref. xix. lib. i. Salmaf. Plin. exercit. in Solin. cap. 35. Serrar. Trihæres. Jud. lib. iii. cap. 1. p. 106. 110. edit. Trigland. 1703. The principal ancient writers, who give any confiderable account of the Effenes, are Jofephus, Philo, and Pliny. Jof. de Bell. Jud. lib. ii. cap. i. cap. 8. & 12. and Antiq. lib. cxiii. cap. 9. 13. 19. lib. xviii. cap. 1. & cap. 2. & alibi. Philo, ubi fupra, & De Vita contemplativa, p. 688. ed. col. Allobr.

As to the origin of this fect, Pliny afferts, without mentioning his authority, that it had fubfifted for feveral thoufand years. The moft probable opinion is, that this fect was formed by Jewifh exiles, a little before the time of the Maccabees, who were forced to fly from the perfecution of their enemies into caves and deferts. The firft Effenes we read of are mentioned in the fourth book of Maccabees, under the name

name of Hasdanim, and by Josephus; both which accounts agree that they were already settled in Judæa, in the time of Jonathan, the brother and successor of Judas Maccabæus, about a hundred and fifty years before Christ. Josephus states that their number in Judæa was about four thousand, meaning, as Dr. Lardner (Works, v. i. p. 128.) suggests, those of them, that entirely rejected marriage. Philo says, that in Syria and Palestine there were about 4000 of them, but he makes the number in Egypt much greater. Philo says, that they sacrificed no living creatures, and that they shunned cities. Josephus says that they sent presents to the temple, but offered no sacrifice there. They seem therefore not to have exposed themselves much to public view, nor would they admit a man of another sect into the apartments in which they lived. Some have expressed their surprise, that no mention should be made of this sect in the New Testament. This proceeded, as some imagine, from their retired mode of living, by reason of which they never came under our Saviour's observation, as the Pharisees and Sadducees often did. Others suppose, that, being very honest and sincere, without guile or hypocrisy, they gave no reason for that reproof and censure, which the others very justly merited. It should be considered that it was the design of the evangelists to write the history of our Saviour's ministry, and not that of the Jewish sects. Prideaux observes, that almost all that is peculiar in this sect is condemned by Christ and his apostles. Prid. Conn. vol. iii. p. 384. However, it has been supposed, that they are referred to by the apostle Paul in his epistle to the Colossians, ch. ii. 18. 21. 23.

Josephus, making mention of the several sects among his countrymen, distinguishes three; *viz.* the Pharisees, Sadducees, and Esseni; which last he prefers to the two former, as to their manner of life. He assures us, farther, that they were Jews, by original; from which it should appear, that St. Epiphanius was mistaken in ranking them among the Samaritans.

In effect, the Esseni appear to have been true Pythagorean philosophers, in every thing that related to their manner of living; for they greatly affected solitude and retirement; and avoided all conversation with women, to devote themselves more entirely to the contemplative life. Grotius will have the Esseni the same with the ancient חסידים, *Hasidim*, or *Hasidæi*; thus called, according to Philo, from their singular piety, humility, and devotion. Among these, Gale observes, it was, that the Hebrew philosophers chiefly flourished. Porphyry is very prolix in his praises of the Esseni: Ειϛι τοινυν οι Εσσαιοι Ιȣδαιοι μην το γενος φιλαλληλον, &c. He represents them as despisers of pleasures, riches, glory, and delicacy; and strenuous retainers to continency, austerity, study, &c. He adds, they decline marriages, and adopt and educate other people's children in the principles of religion and philosophy; they are all on a level, hold every thing in common, neither buy nor sell, &c. By long habit, they arrived at such a degree of patience, that Porphyry assures us, flames and tortures had not the least effect on them. They scorned to intreat their tormentors; nor ever shed a tear; but would smile under all their agonies, &c. As to their learning, Philo Judæus, in his treatise, That every good Man is free, tells us, that they despised logic, as useless to the acquiring of virtue; physics they left to the sophists and disputants, as judging it to transcend the human faculties; and applied themselves wholly to morality. Porph. de Abstin. lib. iv. § 11. seq. Gale Philos. Gener. lib. i. cap. i. § 11.

Both Josephus and Philo give a surprising account of their austere way of life, which the curious reader may see at large in Prideaux's Conn. ubi supra. Their houses were mean; their cloaths made of wool, without any dye; they never changed their cloaths or shoes till they were quite worn out; their food was plain and coarse, and their drink water; they neglected all bodily ornaments, and would by no means anoint themselves with oil, according to the fashion of those times. They lived in sodalities, and had all their goods in common; their morals were very exact and pure, and they kept the Sabbath more strictly than any of the Jews. Before any of them were admitted to the common table, they bound themselves by a solemn oath to observe the rules of the society, which were very strict and exemplary.

Some have said that the Essenes, as well as the Pythagoreans, prohibited oaths; that they used only inanimate sacrifices, and that they not only worshipped towards the rising sun, but worshipped the sun itself. But it has been urged, that neither of these charges seem to be well founded; or at least, that it is difficult to reconcile them with their known veneration for the writings of Moses, and other instances of their conduct. Pliny, and others on his authority, have asserted, that they wholly declined marriage; and Pliny (lib. v. cap. 17.) with more wit than justice, says, that for several thousand of years, this people is perpetually propagated without any being born among them, so fruitful and prolific unto them is the repentance of others. But Josephus informs us (De Bell. Jud. lib. ii. cap. 1.) that there is one sort of Essenes, who agreed with the others, except in the article of marriage. For they reckoned, that those that do not marry cut off a great part from the number of the living, and that thus the whole race of mankind would soon be extinguished. Accordingly they made choice of those women, who, after three years trial, were found fit to bear children, and never cohabited with them after they were known to be with child; consulting the propagation of their species, and not their own gratification in this business.

With respect to the religious opinions of the Essenes, they believed the existence of angels, the immortality of the soul, and a future state of rewards and punishments, but denied the resurrection of the body. They maintained, that fate governs all things, and that nothing happens to man but by its appointment.

The Esseni seem to have been, among the Jews, what the most retired and austere monks are, or were, among the Christians: which was what gave them their denomination of Ιȣδαικοι ασκηται, *Jewish ascetics*.

Many Catholic writers have even deduced the origin of monks from them; building, principally, on what Philo relates of them, who divides them into two branches, or sects; the one who married, and the other who lived in celibacy.

Josephus seems likewise to have had an eye to these two sorts of Esseni. Serrarius, who has wrote very amply on the subject, follows Philo in making two classes of Esseni. The first are those whom he calls *Practici*, and who lived in community; the second, those called *Theoretici*, who lived in solitude, and led a life of pure contemplation. He adds, that Josephus only makes mention of the first; omitting the contemplative kind, whom Philo calls *Therapeutæ*, and who were principally found in Egypt. See THERAPEUTÆ.

Eusebius holds, that the Esseni, called *Therapeutæ*, were real Christians, or Jews converted by St. Mark, who had embraced this kind of life. Scaliger, on the contrary, maintains, that these Therapeutæ were no Christians, but real Esseni, who made profession of Judaism; however, he he allows of the two kinds of Eſſeni above-mentioned. But Valeſius, in his notes on Euſebius, abſolutely rejects any ſuch diſtinction: he denies that the Therapeutæ were any real Eſſeni; and that chiefly on the authority of Philo himſelf, who never calls them Eſſeni, and who places the Eſſeni in Judæa and Paleſtine; whereas the Therapeutæ were ſpread throughout Greece, Egypt, and other countries.

Some traces of the Eſſenes are found under the emperor Trajan, and under Juſtinian; but they were much degenerated from their primitive purity both of doctrine and manners; and the ſect about that time became extinct. Though the Therapeutæ, as well as the Eſſenes, were ſtrictly Jews, and not Chriſtians, it is not impoſſible, that ſome of them, becoming Chriſtians, might ſtill affect their former recluſe way of living; and being imitated by others, laid the foundation of monkery among Chriſtians.

ESSENIAS, Andrew, in *Biography*, a learned Dutch divine, was born at Bommel in the year 1618. He was educated chiefly at Utrecht, was admitted to the exercise of the miniſtry in the year 1639, and in the following year took the degree of M. A. He obtained ſome preferment, and took his doctor's degree in the year 1645. Soon after this, he was choſen paſtor of the principal church at Utrecht, and in 1653 was appointed profeſſor of theology at that univerſity. He died in 1677, leaving behind him many works, that were very highly eſteemed by his contemporaries. He was what the world has uſually denominated an orthodox divine, and wrote againſt Crellius, and others among the Unitarians. One of his largeſt publications was "A Syſtem of Divinity," in 2 vols. His moſt popular piece was entitled "A ſhort View of Theological Controverſies, with an Index to Scripture Paſſages." This has gone through many editions. Moreri.

ESSENTIA Dulcis, in *Chemiſtry*, a name given by Kunkel, and ſome others of the German authors, to a menſtruum, of which they relate wonderful effects; but the preparation of which ſeems hitherto a ſecret. They ſay this menſtruum has nothing acid or corroſive in it, but that it approaches to the nature of ſpirit of wine, yet that it is capable of diſſolving the moſt denſe metals, and of converting any of them into a pure white ſalt, which has all their virtues, but nothing of that vitrolic acrimony, which they have when prepared in the common way. The ſalts of mercury and of gold thus prepared have great praiſes beſtowed on them, and are ſaid to cure epilepſies, the venereal diſeaſe, and many other diſtempers, without any violence or danger. Kunkel, De Salis Metal. See Metal.

ESSENTIAL, ſomething that is neceſſary to conſtitute a thing, or that has ſuch a connection with the nature and reaſon of a thing, that it is found, or ſuppoſed, wherever the thing itſelf is.

Thus, it is eſſential to God to be juſt. Mr. Locke has laboured to overturn that great principle of the Carteſians, that thinking is eſſential to the ſoul.

The heart, brain, and ſpinal marrow, are parts ordinarily ſuppoſed eſſential to life, or without which life cannot be; yet we have inſtances, in hiſtory, of children being found, and alive, without almoſt any of thoſe parts. See Brain, &c.

Essential *characters*, in *Natural Hiſtory*, or *Diagnoſtics*, are ſuch particulars as mark or diſtinguiſh a plant or animal from all others in the ſame genus or order. Mr. William Martin, in his "Outlines of the Knowledge of Extraneous Foſſils," p. 189, ſtates the principles under five heads, which ſhould direct the choice of parts of a foſſil animal or plant, to be conſidered as its diagnoſtic or eſſential characters. See Reliquia.

Essential *oils*. See Oils.

Essential *properties*, are ſuch as neceſſarily depend on and are connected with, the nature and eſſence of any thing, ſo as to be inſeparable from it; in diſtinction from *accidental*.

Essential *ſalts*, are thoſe prepared from decoctions, or thoſe which are found cryſtallized in the juices and infuſions of plants; in contradiſtinction to thoſe made by incineration. See Salt.

Essential *Fever*, *Form*, *Mode*, *Part*, *Perfection*. See the ſubſtantives.

ESSEQUEBO, or Esquivo, in *Geography*, one of the four provinces into which the Dutch poſſeſſions in Guiana are divided; the other three being Surinam, which is the chief ſettlement, Berbiſche or Berbiz, and Demerara. This ſettlement derives its name from that of the large river on which it is ſituated, and which at its diſcharge into the Atlantic is 3 leagues wide. The productions of this country are ſugar, coffee, and cotton. See Guiana, Surinam, Berbische, and Demerara.

ESSERA, a river of Spain, which runs into the Cinca, in Arragon.

ESSERA, Essere, or *Sere*, in *Medicine*, a generic denomination, uſed by the Arabian phyſicians, and compriſing ſeveral popular eruptions, and raſhes, which appear on the ſkin: eſpecially the eruption of the ſummer ſeaſon, in warm climates, which has been termed the Prickly-*heat*, the Nettle-*raſh*, the Prurigo of Dr. Willan's claſſification; &c. See theſe articles. See alſo Willan on Cutaneous Diſeaſes, genus Lichen.

ESSERUM, in *Geography*, a ſmall town of Denmark, in the iſland of Zealand, in the diſtrict of Cronburg, and the herred of Holboe. Before the Reformation it was remarkable for a rich monaſtery of Bernardines, founded in 1150, in an extremely pleaſant country, watered by lakes abounding in fiſh. But Eſſerum is now much more intereſting for a royal ſtud of horſes, and for having conſtantly flocks of the moſt renowned foreign ſheep, Spaniſh and others, which are diſtributed among the farmers to improve the Daniſh breed. In the beginning of the year 1800, there were at Eſſerum 652 choice ſheep, of which 223 ewes, and 33 rams, were Spaniſh of the beſt Merino breed. Catteau Tableau des Etats Danois, vol. ii. p. 147.

ESSES, in *Military Language*, are fixed to draught chains, made in the form of an S; one end of which is faſtened to the chain, and the other to hook to the horſe's harneſſes, or to a ſtaple; they ſerve likewiſe to lengthen and piece chains together.

ESSEX, in *Geography*, the name of one of the Engliſh counties, which has for its boundaries the German ocean and river Thames to the eaſt and ſouth; the counties of Suffolk and Cambridge to the north; and thoſe of Middleſex and Hertfordſhire on the weſt. The area of land thus encompaſſed meaſures about ſixty miles in length from eaſt to weſt, by fifty from north to ſouth: its circumference being about 225 miles. It is divided into 20 parts, of which fourteen are hundreds, five half hundreds, and one a royal liberty. Theſe are ſubdivided into about 400 pariſhes and townſhips, and twenty-five towns; containing, according to the late official report, 39,398 houſes, and 226,437 inhabitants. When the Romans invaded Britain, this diſtrict, with that now denominated Middleſex, were inhabited by a claſs or tribe of the Britons, called Trinobantes, or Trinovantes, who poſſeſſed, according to Cæſar, and ſome other ancient writers,

ters, two confiderable cities or fortified towns; one, the fite of modern London; and the other, that of Colchefter in this county. This tribe was the firft to fubmit to and become vaffals to the Romans, who, to keep them in fubordination, eftablifhed five military ftations within this diftrict. Thefe were Durolitum, Cæfaromagus, Canonium, Camalodunum, and Ad Anfam. Thefe ftations were all feated on the road which formed the fifth Iter from Londinium to Venta Iceno-rum, Caftor in Norfolk. Camalodunum was unqueftionably the principal ftation in Effex, and though its fite has been much contefted by different writers, an attentive examination of the feveral places affigned, combined with a knowledge of the antiquities difcovered in the vicinity of each, will admit little doubt of Colchefter being the real fituation. Effex formed a feparate and diftinct kingdom during a certain period of the Saxon Heptarchy, and was called Eaft-Seaxa; but the times of its eftablifhment and termination are not precifely authenticated. Turner ftates that this diftrict, and Eaft Anglia, were originally occupied by the Saxons at nearly the fame period; and that Erkenwin was the firft king of the former; commencing his reign in 527, and dying in 587.

By the Domefday book it appears, that ninety land-owners of this county were deprived of their lands by the Conqueror, during whofe reign the whole civil and ecclefiaftical eftablifhment of the kingdom, and of each county, underwent very confiderable changes. Effex was now governed and tyrannized over by Norman barons, who conftructed caftles on their eftates to fecure themfelves, and to awe their dependant vaffals. In the civil wars between the houfes of York and Lancafter, and in thofe of Charles's time, this county fuffered greatly from the interference of the De Vere's in the former, and during the long fiege of Colchefter in the latter. Formerly there were twelve caftles, or fortified buildings in this county; two of which, Landguard fort, and Tilbury fort, were denominated royal caftles, as built for national fecurity: the others were baronial refidences, *viz.* Colchefter, Hadleigh, Canfield, Hedingham, Clavering, Raleigh, Ongar, Plefhy, Stanftead-Montfichet, and Walden. Thefe formidable fortreffes, though once the pride of the nobility, and the terror of the peafantry, are moftly rafed to the ground; the only parts remaining being their high keeps and wide foffes. At Colchefter, Hadleigh, Hedingham, and Walden, fome parts of the walls ftill remain. Effex compofes part of that tract of country on the eaftern fide of England which forms the largeft connected fpace of level ground in the whole ifland; not one lofty eminence or rocky ridge being found in feveral contiguous counties. The furface of Effex is not, however, totally flat, having many gentle hills and dales; and towards the north-weft, whence moft of the rivers proceed, the country rifes, and prefents a continued inequality of furface. The moft level tracts are thofe of the fouthern and eaftern hundreds. The fea-coaft is broken into a feries of iflets and peninfulas, deeply cut in by arms of the fea, and exhibiting evident tokens of the force and effects of that reftlefs element. Extenfive falt marfhes border moft of the coaft, the greater part of which is protected by embankments. The banks of the Thames, and the lower part near the fea, are likewife low and marfhy. This county lies under a proverbial imputation of being particularly unhealthy; but this character can only apply to a fmall part of it; as the middle and northern diftricts are juftly noted for a dry foil, and a wholefome clear air. That part known by the name of the hundreds of Effex, bordering on the fouth coaft, from its low and marfhy fituation, and expofure to the eafterly winds and fea fogs, is certainly inimical to health, and many intermitting fevers proceed from thefe caufes.'

The principal productions of this county are wheat, barley, oats, beans, peas, turnips, tares, rape, muftard, ryegrafs, and trefoil. Many diftricts on the eaft fide are extremely productive: wheat is not unfrequently found to rife to a load an acre; oats, (particularly the Poland,) to eleven or twelve quarters; beans and other corn in proportion. Among the more rare plants cultivated in Effex, are thofe of coriander, teafel, and carraway; many acres are alfo appropriated to the produce of hops, and various horticultural plants and roots. The latter are confined to the vicinity of large towns, and to the lands adjoining to the metropolis. Almoft every fpecies of foil is to be found within the limits of Effex, from the moft ftubborn to the mildeft loam. The north-weft fide is characterized by a chalky fubftratum; but the eaft and fouth fides abound with marfhy and boggy land, having abundance of gravel intermixed. Of wafte lands and forefts, Meffrs. Griggs (in their "General View of the Agriculture of Effex,") computed the county to contain fifteen thoufand acres; the greater part of which, they obferve, is capable of producing corn. Since their report, however, many diftricts have been inclofed and cultivated. Though Effex is not highly celebrated for its dairies, yet thofe in the parifh of Epping and its vicinity are famous for the richnefs of their cream and butter. The butter is moftly fent to London, where it bears a high character and price. Few counties have lefs minerals than Effex; which is alfo nearly exempt from quarries, or any mafs of rocks. In confequence, the houfes are almoft wholly built with brick; and many of them are fingular and curious fpecimens of brick-architecture. In conftructing the caftles, the monaftic buildings, and many of the old manfion-houfes, the builders have endeavoured to render them not only durable monuments of their fkill, but alfo examples of their tafte, difplayed by a variety of ornaments in the cornices, doors, pilafters, and particularly in the chimnies. Some mineral waters rife in the county, but few have obtained much repute; that of Tilbury is occafionally reforted to, and found to be impregnated with fome earthy and muriatic falts.

The principal rivers, properly belonging to this county, are the Colne, the Blackwater or Pant, the Clelmer, the Crouch, the Ingerbourn, the Roding, and the Cam. Befides thefe, Effex partakes of other rivers, which ferve as natural boundaries, and irrigate and fertilize its land: thefe are the Thames, the Lee, or Lea, the Stort, and the Stour.

In the early periods of our hiftory, it is reafonably prefumed, that the whole, or the greater part of Effex, was one extenfive foreft. During the Britifh and Roman governments, many parts muft have been cleared for ftations, roads, and cultivation: yet in the time of king Stephen it appears that the principal portion of the county was either foreft, or fubject to foreft laws. In his reign, however, a large tract in the north-eaft part of the county was difafforefted, and cultivated; and the remaining part, north of Stane-ftreet, was difafforefted by king John. Henry the Third, in the twelfth year of his reign, directed perambulations to be taken of Waltham foreft, in order to afcertain its extent and value; and about the fame time had large tracts cleared for the plough. This judicious plan was purfued by Edward the Firft, in the twenty-fixth and twenty-eighth years of his reign: yet much foreft land ftill remained; and Paul, vifcount Bayning, with many other gentlemen of the county, purchafed of the crown, and difafforefted

feveral

feveral parts of it. Thefe proceedings, combined with the more equitable decifions of fubfequent monarchs, occafioned the forefts to contract their boundaries, and be lefs injurious to the public. While the forefts continued in the crown, and were under the local government of arbitrary forefters and ftewards, the fubject, whofe eftate was contiguous, fuffered repeated oppreffions. The grievance was partly redreffed in the perilous reign of king John, when the barons compulfively procured from that monarch the "Charter of Forefts," by which many of thefe royal diftricts were difafforefted, and ftripped of their oppreffive privileges; while more lenient regulations were adopted in the government of thofe that remained. The forefts of Epping and Hainault ftill retain the name, and fupport a few deer, &c. The office of chief forefter for Effex was deemed highly honorary, and was generally beftowed on fome illuftrious perfon. The ftewardfhip was alfo an office of great confequence, and was ufually enjoyed by fome of the nobility. It continued in the De Veres, earls of Oxford, for many generations, but was taken from them by Edward the Fourth, on account of their adherence to the Lancaftrian party. On the acceffion of Henry the Seventh, it was reftored by grant to John, earl of Oxford. The fteward had power to fubftitute a lieutenant, one riding forefter, and three yeomen-forefters, in the three bailiwicks of the foreft. He alfo had many lucrative privileges, and was keeper of Havering at Bower, and of the houfe and park there.

Previous to the diffolution, Effex contained forty-feven religious houfes: of thefe, two were mitred abbies; fix common abbies; twenty-two priories; three nunneries; three colleges; two præceptories of templars; and nine hofpitals.

Effex is included in the diocefe of London, and contains three archdeaconries and fifteen deaneries; it returns eight members to parliament, *viz.* two for the county, two for Malden, two for Harwich, and two for Colchefter; it is in the home circuit; pays twenty-four parts of the land-tax, and fupplies 960 men for the militia.

Essex, one of the moft populous and beft cultivated counties in Maffachufetts, in the United States of America; bounded N. by North Hampfhire, E. and S. by the ocean, and the town of Chelfea in the county of Suffolk, and W. by Middlefex county; 38 miles long and 25 broad; of a triangular fhape, Chelfea being the acute point. It is fubdivided into 22 townfhips, containing 7644 houfes, and 61,196 inhabitants, about 135 to each fquare mile. The firft fettlement in Maffachufetts proper was made in Salem, the capital of this county, in 1628, and it was made a fhire in 1643, being one of the three into which the colony was divided. Effex county pays about ⅟₇th part of the ftate-tax, elects fix fenators for the government of the commonwealth, and two reprefentatives in the legiflature of the United States. The principal towns are Salem, Newbury-port, Gloucefter, Marblehead, Beverly, Newbury, and Ipfwich; and in it are two academies, one at Byefield, and another at Andover. The face of the county is agreeably variegated with hills, vales, plains, and woods; the land is generally fruitful, but more fuited to the culture of barley than moft other parts of the ftate; it has quarries of marble and limeftone, and the coaft is indented with a number of good harbours. The north part of Effex county is interfected by Merrimack river; and between it and the North Hampfhire line is a ftrip of land three miles wide, divided into the towns of Methuen, Haverhill, Almfbury, and Salifbury, containing 1429 inhabitants. The chief ifland on the coaft of this county is Plum ifland.

Essex, a county in Upper Canada, bounded on the E. by the county of Suffolk, on the S. by lake Erie, on the W. by the river D'Etroit to Maifonville's mill, thence by a line running parallel to the river D'Etroit and lake St. Clair, at the diftance of four miles, till it meets the river Thames, and thence up the faid river, to the N.W. boundary of the county of Suffolk. This county fends one reprefentative to the provincial parliament.

Essex, a county in Virginia, bounded E. and N.E. by Rappahannock river, which divides it from Richmond county; about 55 miles in length and 12 in breadth, and containing 3741 free inhabitants, and 5767 flaves.

Essex, a county in New Jerfey, fituated in the eaftern part of the ftate, and feparated from Staten ifland by Newark bay. It is about 25 miles in length and 16 in breadth, and has three townfhips, *viz.* Newark, Elizabeth-town, and Acquackanack, containing 22,269 inhabitants, of whom 1521 are flaves. The foil is fertile, and its productions find a ready fale in the city of New-York. This county comprehends feven Prefbyterian churches, three for Epifcopalians, one for Anabaptifts, and two for Dutch Calvinifts.

Essex, a county of New-York, having on the north Clinton county, on the fouth Wafhington county, and on the eaft lake Champlain, which feparates it from Vermont.

Essex, a county in Vermont, bounded N. by Canada, and E. by Connecticut river, containing 1429 inhabitants.

Essex, a townfhip in Chittenden county, in Vermont, containing 729 inhabitants, and lying between Jericho on the S.E. and Colchefter on the N.W.

Essex *Valley Mountains*, mountains of the ifland of Jamaica; 10 miles S.S.E. of Lacovia.

ESSEY, a town of France, in the department of Orne, and diftrict of Alençon; 3 leagues N.E. of Alençon.

ESSLISORS. See Elisors.

ESSOIGN, or Essoin, in *Law*, an excufe for him who, being fummoned to appear and anfwer to an action real, or to perform fuit to a court baron, &c. cannot attend, becaufe of fome legitimate hindrance.

The word is formed of the French *effoine*, or *exoine*; and that from the barbarous Latin *effonia*, or *exonia*, which fignifies the fame.

The caufes that ferve to effoin, are various; yet they may be reduced to five heads. The firft is, *effoin de ultra mare*, when the party is beyond fea; by which the defendant fhall have 40 days: the fecond, *de Terra Sancta*, when on an expedition in the Holy Land, and the defendant fhall have a year and a day; the third, *de malo veniendi*, when he is infirm of body, and cannot come; which is alfo called the common effoin; the fourth, *effoin de malo lecti*, when the defendant is fick a-bed, and may by writ be viewed by four knights; the fifth, *de fervitio regis*, when he is in the king's fervice. Befides thefe, there are feveral other excufes to fave a default in real actions, as conftraint of enemies, floods of water, &c. 2 Co. Inft. 125.

Essoign *day of term*, is the firft day of that term when the court fits to take effoigns, or excufes, for fuch as do not appear according to the fummons of the writ; *e. g.* the octave of St. Hilary, or the eighth day inclufive after the feaft of that faint; which falling on the 13th of January, the octave, therefore, or firft day of Hilary term, is the 20th of January. But the perfon fummoned hath three days grace beyond the return of the writ, in which to make his appearance; and if he appear on the fourth day inclufive, the *quarto die poft*, it is fufficient.

Essoign *de malo villæ*, is when the defendant is in court the firft day, but gone without pleading; and being afterwards furprifed with ficknefs, &c. cannot attend, but fends two effoigners, who openly proteft in court that he he is detained by ficknefs in fuch a village, that he cannot come *pro lucrari et pro perdere;* and this will be admitted: for it lieth on the plaintiff to prove, whether the effoign is true or not.

Essoigns, *Clerk of the.* See Clerk.

ESSOMMES, in *Geography*, a fmall town of France, in the department of the Aifne, on the river Marne; 3 miles S.W of Château Thierry.

ESSONE, a river of France, in the department of Seine and Oife, which has its fource near Pithiviers in the foreft of Orleans, flows by Ferté Alais, receives the Juine near Saint Vrain, 3 miles above Villeroi, and falls into the Seine near Corbeil. It has lately been rendered navigable.

ESSONNE, a fmall town of France, in the department of Seine and Oife, near the river Effone, 24 miles S. of Paris, and 24 miles N. of Fontainbleau, remarkable for its manufactures of gunpowder and of writing paper.

ESSORANT, from the French *efforer*, to air, in order to dry, in *Heraldry*, a term ufed to exprefs a bird ftanding on the ground with the wings expanded, as if it had been wet, and were drying itfelf.

ESSOYES, in *Geography*, a fmall town of France, in the department of the Aube, chief place of a canton in the diftrict of Bar-fur-Seine, with a population of 1585 individuals, 15 miles S.W of Bar-fur-Aube. Its canton contains 21 communes, and 11,655 inhabitants, on a territorial extent of 375 kiliometres.

ESTABLISHMENT *of Dower*, in *Law*, is the affurance or fettlement of dower made to the wife by the hufband on marriage; and *affignment of dower* fignifies the fetting it out by the heir afterwards, according to the eftablifhment. See Dower.

Establishment *of Religion.* See Religion.

ESTACHE, is ufed in our *Old Writers*, for a bridge or ftank of ftone and timber.

ESTAFFLISCHEN, in *Geography*, a town of Poland, in the palatinate of Kalifh; 14 miles N.E. of Kalifh.

ESTAFORT, a town of France, in the department of the Lot and Garonne, and diftrict of Agen; 3 leagues S. of Agen.

ESTAGEL, a town of France, in the department of the Eaftern Pyrenées; 3½ leagues N.W. of Perpignan.

ESTAGNAC, a fmall town of France, in the department of the Charente; 33 miles E. of Angoulême.

ESTAIN. See Etain.

ESTAING, a fmall town of France, in the department of the Aveyron, chief place of a canton in the diftrict of Efpalion, with a population of 1075 individuals. It is fituated 18 miles N. of Rhodéz. Its canton contains 12 communes and 6700 inhabitants on a territorial extent of 195 kiliometres.

ESTAIRE, a fmall town of France, in the department of the North, on the river Lys, between Merville and Armentiéres; 15 miles W. of Lille.

ESTAMBOLIC, or Istambol-Antir, a town of Arabia, in the fheriffal of Mecca, near the coaft of the Red fea; 180 miles N.N.W. of Medina.

ESTAMPES. See Etampes.

ESTANDARD. See Standard.

ESTANFORDE, in *Geography*, a town of Flanders; 12 miles S.W. of Ypres.

ESTAPA, or Istapo, a town of North America, in Mexico, and province of Tabafco, fituated on a river of the fame name; 10 miles S.W. of Villa Hermofa.

ESTAPLES. See Etaples.

ESTAPO, a ftrong town of America, in New Spain, inhabited by Spaniards and native Americans, fituated at the mouth of the river Tlaluc. N. lat. 17° 30'. W. long. 103° 5'.

ESTARREJA, a town of Portugal, in the province of Beira; 18 miles S. of Oporto.

ESTATE, in *Law*, the title or intereft which a man hath in lands or tenements, &c. An eftate in lands, tenements, and hereditaments, fignifies (fays judge Blackftone) fuch intereft as the tenant hath therein; fo that if a man grants all *his eftate* in Dale to A. and his heirs, every thing that he can poffibly grant fhall pafs thereby. (Co. Litt. 345.) It is called in Latin *ftatus*, fignifying the condition or circumftance in which the owner ftands with regard to his property. For afcertaining this with accuracy, eftates may be confidered in a three-fold view: firft, with regard to the *quantity of intereft* which the tenant has in the tenement; fecondly, with regard to the *time* at which that quantity of intereft is to be enjoyed; and, thirdly, with regard to the *number* and *connexions* of the tenants.

I. The *quantity of intereft* which the tenant has in the tenement is meafured by its duration and extent. Thus, either his right of poffeffion is to fubfift for an uncertain period, during his own life, or the life of another man; to determine at his own deceafe, or to remain to his defcendants after him; or, it is circumfcribed within a certain number of years, months, or days; or, laftly, it is infinite and unlimited, being vefted in him and his reprefentatives for ever. This occafions the primary divifion of eftates, into fuch as are *freehold*, and fuch as are *lefs than freehold.* See Freehold.

Eftates of freehold, underftood as they are defined under that article, are either eftates *of inheritance*, or eftates *not of inheritance.* The former are again divided into inheritances *abfolute* or fee-fimple, and inheritances *limited*, one fpecies of which is ufually denominated fee-tail. See Fee, Fee-simple, and Fee-tail.

Of eftates of freehold, not of inheritance, but *for life* only, fome are *conventional*, or exprefsly created by the acts of the parties; others are merely *legal*, or created by conftruction and operation of law. As to eftates for life, exprefsly created by deed or grant; fee Life-estate. As to the eftate of tenant in tail after poffibility of iffue extinct; fee Tail and Fee-tail. As to tenant by courtefy, and tenant in dower; fee Tenant and Dower.

Of eftates that are lefs than freehold, there are three forts; *viz.* 1. Eftates for years; 2. Eftates at will; 3. Eftates by fufferance. For the two former, fee Lease; and for the latter, fee Sufferance.

Befides the feveral divifions of eftates above enumerated, in point of intereft, there is another fpecies which is called an eftate *upon condition;* being fuch whofe exiftence depends upon the happening or not happening of fome uncertain event, whereby the eftate may be either originally created, or enlarged, or finally defeated. (Co. Litt. 201.) Eftates upon condition are of two forts: 1. Eftates upon condition *implied;* 2. Eftates upon condition *expreffed:* under which laft may be included, 3. Eftates held in *vadio, gage*, or *pledge;* 4. Eftates by *ftatute-merchant* or *ftatute-ftaple;* 5. Eftates held by *elegit.* See thefe feveral articles.

II. Eftates, with regard to the *time of their enjoyment*, when the actual receipt of the rents and profits commences, may be confidered either in *poffeffion* or in *expectancy;* as to eftates in poffeffion, fometimes called eftates *executed*, whereby a prefent intereft paffes to and refides in the tenant, not depending on any fubfequent circumftance or contingency, as in the cafe of eftates *executory;* all thofe above-mentioned are of this kind; but the doctrine of eftates in expectancy contains, fays Blackftone, fome of the niceft and moft moſt abſtruſe learning in the Engliſh law. Of expectancies there are two ſorts; one created by the act of the parties, called a *remainder*; the other by act of law, and called a *reverſion*. See REMAINDER and REVERSION. See alſo EXECUTORY *Deviſe* and LIMITATION.

III. Eſtates conſidered with reſpect to the *number and connexions* of their owners, or the tenants who occupy them, whatever be their quantity or length of duration, and whether they be in actual poſſeſſion or expectancy, may be held in four different ways: *viz.* in *ſeveralty*, in *joint-tenancy*, in *coparcenary*, and in *common*. See SEVERALTY, JOINT-TENANCY, COPARCENARY and PARCENERS, and TENANTS *in common*.

With regard to the title to eſtates and the different modes of tenure; ſee TITLE and TENURE.

Eſtates are acquired divers ways, *viz.* by deſcent from a father to the ſon, &c. conveyance or grant from one man to another; by gift or purchaſe, deed, or will; and a fee-ſimple is the largeſt eſtate that can be in law. 1 Litt. 541.

Eſtates are real, of lands, &c. or perſonal, of goods and chattels; otherwiſe diſtinguiſhed into freeholds that deſcend to the heir, and chattels, which go to the executors. The word eſtate, generally, in deeds, grants, and conveyances, comprehends the whole, in which the party hath an intereſt or property; and will paſs the ſame. 3 Mod. 46.

ESTATE, *additions of*. See ADDITION.

ESTATE, *baſe*. See BASE.

ESTATE, *que*. See QUE *eſtate*.

ESTATE, or ſimple *State*, denotes alſo the empire, kingdom, provinces, or extent of lands under the government of any ſovereign.

The eſtates of the grand ſeignor, of the king of Spain, &c. are very extenſive; thoſe of the king of France were before the revolution compact, and well peopled. Italy was formerly cantoned out into a great number of petty ſtates. We ſay, miniſters of eſtate, ſecretaries of ſtate, &c.

ESTATE, or *State*, is alſo generally applied in the ſame ſenſe with claſs or order; thus, the lay part of his majeſty's ſubjects, or ſuch of the people as are not comprehended under the denomination of clergy, may be divided into three diſtinct eſtates or ſtates, the civil, the maritime, and the military. See each term.

ESTATE is more particularly applied to the ſeveral ranks or claſſes of a people aſſembled together, for concerting meaſures, reforming public abuſes, or compoſing the diſturbances of a ſtate. In England, the three eſtates, *viz.* king, lords, and commons, meet ordinarily in parliament. See PARLIAMENT.

ESTATES *General*. } See STATES *General*, &c.
ESTATES *of Holland*. }

ESTAVAYER, in *Geography*, a ſmall town of Switzerland, in the canton of Fribourg, pleaſantly ſituated on the eaſtern ſhore of the lake of Neufchatel, N. lat. 46° 46′.

ESTE, a town of Italy, in the Paduan; 11 miles S.S.W. of Padua.

ESTELLA, a handſome manufacturing town of Spain, in Navarre, with an univerſity in its neighbourhood, founded A.D. 1565. It contains ſeveral churches and convents, and 4500 inhabitants, defended by a caſtle, ſituated in a plain, watered by the rivers Ega and Ureder; 6 leagues S.W. of Pampeluna. The environs of this place are agreeable and fertile.

ESTELMUR, a town of Aſiatic Turkey, in the province of Caramania; 120 miles S. of Cogni.

ESTENIDE. See EKSENIDE.

ESTEPA, a town of Spain, in the province of Seville, or, according to ſome geographers, in that of Granada, celebrated for its olives and oil; 15 miles S. of Ecija.

ESTEPONA, a ſmall fiſhing town of Spain, ſituated near the coaſt in the province of Granada, between Gibraltar and Marbella. Its territory furniſhes abundance of wine.

ESTERLING, or EASTERLING. See STERLING.

ESTERNAY, in *Geography*, a ſmall town of France, in the department of the Marne, chief place of a canton in the diſtrict of Epernay, with a population of 835 individuals. Its canton has 23 communes and 6498 inhabitants, upon a territorial extent of 325 kiliometres.

ESTETE', in *Heraldry*, is uſed by the French to ſignify a beaſt whoſe head has been, as it were, torn off by force, and, conſequently, the neck left rough and rugged; in contradiſtinction to deffait, or decapité, where the neck is left ſmooth, as if the head had been cut off.

ESTEVE, M. in *Biography*, a writer on the theory of muſic, or rather of ſound or harmonics. He has attacked the demonſtration of the principles of harmony by Rameau, in which M. Laborde allows him to have reaſon on his ſide: however, as he does not build his ſcale by the triple progreſſion of Pythagoras, in the way which the abbé Rouſſier preſcribes, and without which ſeries of perfect fifth he thinks there never was nor ever can be any muſic fit to be heard, M. Eſteve has not been honoured with the ſeal of Meſſrs. Laborde and Rouſſier's approbation. He has, however, explained the cauſe of more and leſs perfection in concords, from the coincidences of vibration, which has been known ever ſince the time of Galileo, (ſee BASSE *fondamentale*), but never ſo clearly explained in France.

ESTHER, a canonical book of the Old Teſtament: denominated from a celebrated Jewiſh captive of that name, in Perſia, whoſe beauty preferred her to the bed of Ahaſuerus (ſuppoſed by ſome to have been Darius Hyſtaſpis, by others Xerxes, but probably Artaxerxes Longimanus, though Jacob. Capellus makes him to be Ochus, called in Perſia Achaſch-Veroſh), and the throne of Perſia; and who, in that quality, ſaved her countrymen, the Jews, from the death to which Ahaſuerus had doomed them, by the counſels of his favourite Haman; who wiſhed thus to be revenged on Mordecai for withholding from him that reſpect to which he conceived himſelf entitled. Mordecai informed the queen of the danger to which her nation was expoſed; and induced her to wait upon the king, and invite him and Haman to a ſumptuous banquet which ſhe had prepared. Haman was puffed up with this high honour, and thought himſelf ſure of accompliſhing his ample ſcheme of vengeance. During the interval, the king chanced to read the public records, which reminded him of Mordecai's having diſcovered a conſpiracy that had been formed againſt him. Determined to diſtinguiſh him by ſome ſignal token of favour, he ordered Haman to conduct Mordecai in triumph through the city. The queen having diſcovered to Ahaſuerus, that ſhe belonged to the Jewiſh nation, intreated juſtice againſt Haman on behalf of her people, for the deſtruction of whom he had obtained the king's decree. Ahaſuerus ordered Haman to be hanged on the gallows which he had erected for the execution of Mordecai; revoked the decree iſſued forth againſt the Jews, and granted another, by which he permitted them to avenge themſelves on their enemies on the day appointed. After the death of Haman, the king beſtowed his eſtates upon Mordecai, and admitting him into his confidence, as the acknowledged uncle of the queen, advanced him to a ſtation of high office and truſt in his court. The hiſtory of this tranſaction makes the ſubject of the book of Eſther. Eſther was of the tribe of of Benjamin, and a defcendant from one of thofe families, which had been carried into captivity by Nebuchadnezzar, king of Babylon, and afterwards fettled in the city of Shufhan. She was the niece of Mordecai, and her Jewifh name was "Hadaffeh."

The critics are divided about the author of this book: St. Epiphanius, St. Auguftine, and Ifidore, attribute it to Ezra; but Eufebius will have it to be of a later date. Some afcribe it to Joachim, high prieft of the Jews, and grandfon of Jofedek; others will have it compofed by an affembly, or fynagogue, of the Jews, to whom Mordecai wrote letters, informing them of what happened. Efth. ix. 29.

But the generality of interpreters, Hebrew, Greek, Latin, &c. afcribe the book to Mordecai himfelf; Elias Levita, in his Maff. Hamum. pref. 3. mentions this opinion as unqueftionable.

It is chiefly founded on that paffage, chap. ix. ver. 20. where it is faid, that "Mordecai wrote thefe things, and fent letters unto all the Jews, that were in all the provinces, &c." It is alfo fuppofed that queen Efther herfelf might have fome fhare therein: it being expreffed in the fame chapter, ver 29. that Efther and Mordecai wrote a fecond letter, by the king's authority, to ordain the folemnizing a yearly feaft, called *purim*, that is, *day of lots*, in commemoration of the Jews being delivered from the lots, or fortes, whereby they had been condemned.

Some will have this book to be deuterocanonical, or apocryphal; others contend for its being canonical, as far as chap. x. ver. 3. inclufive; and all the reft deuterocanonical. Of this fentiment are, St. Jerome, De Lyra, Dionyfius the Carthufian, Cajetan, and others. The council of Trent turned the fcale for its being canonical throughout; fo that the matter is determined for the Catholic countries.

But the Proteftants retain the old opinion, and only admit it as far as the third verfe of the tenth chapter; the reft, to the end of the fixteenth chapter, is thrown among the apocryphal books. See Canon and Apocrypha.

Esther *Town*, in *Geography*, a town of America, in the county of Lancafter, and ftate of Pennfylvania, fituated on the eaft bank of the Sufquehannah river, a little N. of Harrifburg.

ESTHIO'MENOS, (from ἐσθίω, *to eat*,) in *Surgery*, the difeafe called herpes exedens. Alfo any obftinate ulcer, which continues to eat away the parts.

ESTHONIA, in *Geography*, is the ancient name of the Ruffian government of Reval, on the fouthern coaft of the gulf of Finland, over-againft Finland Proper. In the year 1386 Efthonia was fold to the Teutonic order, and formed a part of Livonia; with which, after a feparation of a hundred years, when it was under the dominion of Sweden, it was united to the Ruffian territory.

Not only the government of Reval, but alfo the greater part of Livonia, or five circles of the government of Riga, are inhabited by Efthonians. In the former they probably amount to 180,000, in the latter to 257,000 individuals. The language, manners, complexion, dwellings, and hufbandry of the Efthonians prove their relationfhip to the Finns, who are one of the moft far fpread nations of the globe, extending from the fhores of the Baltic to the remoteft confines of Afia. In the Ruffian annals, where they act a confiderable part, as they, in common with the Novgorodian Slavi, founded the Ruffian ftate, the Efthonians are called *Tfchudes*. Tooke's View of the Ruffian Empire, vol. i.

ESTIÆA, Ἑστιεια, in *Antiquity*, folemn facrifices to Vefta, called in Greek ἑστια, of which it was unlawful to carry any away, or communicate any part to any befide the worfhippers. Potter, Archæol. Græc. lib. ii. cap. 20. tom. i. p. 396.

ESTIATORES, Ἑστιατορες, among the Athenians, perfons appointed by lot to provide an entertainment for the whole tribe. Befides thofe appointed by lot to this office, others voluntarily undertook it to ingratiate themfelves. Potter, Archæol. Græc. lib. i. cap. 15. tom. i. p. 86.

ESTIMIONE, in *Natural Hiftory*, a name by which fome call the *harmefion*.

ESTISSAC, in *Geography*, a fmall town of France, in the department of the Aube, chief place of a canton in the diftrict of Troyes, with a population of 1255 individuals. Its canton has 6089 inhabitants, difperfed in 10 communes, on a territorial extent of 200 kiliometres.—Alfo, a fmall town of France, in the department of the Dordogne, 18 miles N. E. of Bourdeaux.

ESTIVAL, a town of France, in the department of the Vofges, and diftrict of St. Diey; 2 leagues N. of St. Diey.

Estival *occident*. See Occident.

Estival *orient*. See Orient.

Estival *folftice*. See Æstival, and Solstice.

ESTIVAREILLES, in *Geography*, a town of France, in the department of the Allier, and diftrict of Montluçon; 5 miles N. of Montluçon.

ESTIUS, William, in *Biography*, a learned Dutch divine, was born at Gorcum in Holland in the year 1542. He received the early part of his education at Utrecht, and finifhed his ftudies in philofophy and theology at Louvain, where he afterwards became an inftructor. In 1580 he was admitted to the degree of doctor in divinity, and was fucceffively chofen profeffor of theology, in the univerfity of Douay; fuperior of that feminary, and afterwards its chancellor. He died in 1613 at the age of 71, while he was in the difcharge of the various duties of his laborious office at Douay, highly efteemed on account of his modefty, piety, and active virtues. He had ever been indefatigable in his ftudies, and zealous in promoting the interefts of thofe committed to his care. As an author his principal works are, "Commentarii in omnes S. Pauli et VII. Catholicas Apoftolorum Epiftolas," in two volumes folio. "Annotationes in præcipua ac difficiliora S. Scripturæ Loca." Another work is mentioned with much applaufe, it is a difcourfe "Contra Avaritiæ Scientiæ," intended to expofe thofe who lock up their learning in their clofets, and refufe to communicate it to the public by ufeful writings, or to individuals by well-timed and feafonable advice. The writings of Eftius are recommended by Du Pin as exceedingly ufeful to young theologians in their enquiries after truth. Moreri.

ESTOILE'. A crofs eftoilé is a ftar with only four long rays, in manner of a crofs; and accordingly broad in the centre, and terminating in fharp points.

ESTOILLE, Peter de l', in *Biography*, who flourifhed towards the clofe of the fixteenth century, was educated to the profeffion of the law, and became grand audiencer of the chancellery of Paris. He died in 1611, and after his death was publifhed from his manufcripts "A Journal of the reign of Henry III." which has paffed through many editions; of thefe the laft was edited by the Abbé Lenglet du Frefnoi in 5 vols. 8vo. The fame learned editor gave to the public "L'Eftoille's Journal of the reign of Henry IV." in four volumes, 8vo. This, as well as the other work, is enriched by fome curious pieces not to be found in the preceding editions. The ftyle and manner of thefe journals poffefs much fimplicity, exhibiting the air of truth,

truth, and affording a lively and accurate picture of the times. Moreri.

Estoille, Claude de l', fon of the preceding, was a poet, and admitted a member of the French academy in the year 1632. He was patronized as a dramatic writer by Richlieu, but his pieces were not well received by the public, though he is allowed to have had a talent at verfification, and a thorough knowledge of the rules of the ftage. He was a rigid cenfor of his own performances, and of thofe of others, and is faid to have occafioned the death of a young author by the feverity of his criticifm on a comedy put into his hands. He died in 1652 about 50 years of age. He had obtained, and richly deferved, the character of an honourable and truly independent man. In the earlier part of life, though ill provided for with refpect to fortune, he chofe to quit the capital with a wife whom he loved, rather than fubmit to the meanneffes which men of letters are too much inclined to practife in courting the opulent. Moreri.

ESTOPPEL, formed of the French *eftouper*, *oppilare*, *obftipare*, to ftop, or block up, in *Law*, an impediment, or bar of action, arifing from a man's own act, or deed; againft which a man is forbidden, by law, to fpeak, though it be to fay the truth. See Bar.

Goddard defines an eftoppel to be any bar, or hindrance, to one to plead the truth; and extends it not only to the impediment given by his own act, but by another's alfo. There are three kinds of eftoppel; *viz.* by matter of record, by matter in writing, and by matter in pais.

ESTOVERS, is ufed by Bracton, (l. iii. tr. 2. c. 18.) for that fuftenance which a man, committed for felony, is to have out of his lands, or goods, for himfelf and his family, during imprifonment.

In ftat. 6 Edw. 1. it is ufed for an allowance in meat, or cloaths. In fome manors the tenants have common of eftovers; that is, neceffary botes, or allowances, out of the lord's wood; in which laft fenfe, eftovers comprehends houfe-bote, hay-bote, and plow bote; fo that if a man have in his grants thefe general words, "de rationabili eftoverio in bofcis, &c." he may thereby claim all three.

Eftovers is alfo ufed for alimony, which if the hufband refufes to pay, there is, befides the ordinary procefs of excommunication, a writ at common law, "de eftoveriis habendis," in order to recover it.

ESTOURMELLES, in *Geography*, a town of France, in the department of the North, and diftrict of Cambray; 1½ league E. of Cambray.

ESTOUTEVILLE, a fmall town of France, in the department of the Lower Seine, 12 miles N. of Caudebec.—Alfo, a fmall town of France, in the fame department, 15 miles N. of Rouen.

ESTRAC, in the *Manege*, fignifies a horfe that is light bodied, lank-bellied, thin flanked, and narrow-chefted. See Belly.

ESTRADE, a French term, literally fignifying a public road, or highway. Hence the military phrafe, *battre l'eftrade*, to beat the eftrade, that is, to fend fcouts, or horfemen to get intelligence, to learn the difpofitions of the enemy, and inform the general of every thing likely to fall in the way. An army never marches without fending batteurs d'eftrade on every fide.

The word is formed of the Italian *ftrada*, ftreet, or road; which is derived from the Latin *ftrata*, a paved ftreet. Some derive it from *eftradiots*, who were cavaliers anciently employed in beating the eftrade.

Estrade is alfo ufed for a little elevation of the floor of a room, frequently encompaffed with an alcove, or rail, for placing a bed in; and fometimes, as in Turkey, only covered with fine carpets, for receiving vifitors of diftinction.

ESTRADES, Godfrey *Count of*, in *Biography*, was at an early age defigned for the profeffion of arms, and ferved under prince Maurice in Holland, with whom he acted as agent of the French court, and afterwards attained the high honour of marfhal of France. He was highly efteemed as a diplomatic character, and in the year 1661 went to England as embaffador extraordinary, where he maintained with fpirit the precedence of the crown of France to that of Spain. In the following year he went to Holland in the fame character, and concluded the peace of Breda. He was intrufted with the important negociation for a general peace at Nimeguen, and acquitted himfelf to the fatisfaction of all concerned. He fuftained with high reputation various other diplomatic characters, and in 1685 was nominated governor to the duke de Chartres, but died within a few months, at the age of feventy-nine. The count left behind him an abundance of MSS. concerning the different negociations in which he had been engaged: from thefe, which confifted of twenty-two volumes folio, a collection was publifhed in 1709, entitled "Letters, Memoirs, and Negociations of the Count d' Eftrades." An improved edition was publifhed in 1743 at the Hague, in 9 vols. 12mo.

ESTRANGEL, Estrangelus, in the Syriac *Grammar*. Eftrangel character, is a particular fpecies, or form, of Syriac letter; ferving as the majufcule letters in that language.

Abraham Ecchellenfis takes the eftrangel character for the true ancient Chaldee characters; and it is certain the Abyffinians, who call themfelves Chaldeans, ftill occafionally ufe the eftrangel character, if we may credit Hottinger, in his Thefaur. Philol. p. 286. Bifhop Walton, in his Prolegomena, gives us an eftrangel alphabet.

ESTRAPADE, in the *Manege*, is the defence of a horfe that will not obey, but to get rid of his rider, rifes much before, and while his forehand is yet in the air, yerks furioufly with his hind legs, ftriking higher than his head was before; and during his countertime goes back rather than advances.

ESTRAY, or Stray, fignifies any tame beaft, or fheep, oxen, fwine, and horfes, or fwans, found within a lordfhip, and not owned by any man; in which cafe being cried, according to law, in the church, and two market-towns adjoining, if it be not claimed by the owner, within a year and a day, it becomes the lord's of the foil where found. If the owner claims it within the year and day, he muft pay the charges of finding, keeping, and proclaiming; and he may feize it, without telling the marks, or proving his property, which may be done at the trial if contefted. If the beaft ftray within the year to another lordfhip, the firft lord cannot retake it. An eftray muft be fed and kept, uninjured, and without labour, till it is reclaimed, or the limited time expires.

ESTREAT, Extractum, in *Law*, is ufed for the true copy, or duplicate, of fome original writing, efpecially of amercements, or penalties, fet down in the rolls of a court, to be levied by the bailiff, or other officer, on every offender. Juftices, commiffioners, &c. are to deliver their eftreats into the exchequer yearly, after Michaelmas; and fines to have writs, which fhall be entered in the eftreat, in order as they are entered in the chancery rolls, &c. ftats. 51 Hen. III. ftat. 5. 16 Edw. II. All forfeited recognizances are to be firft eftreated in the exchequer by fheriffs of counties; on which procefs iffues to levy the fame to the ufe of the king. Stat. 22 and 33 Car. II. cap. 22.

Sheriffs'

Sheriffs' eſtreats muſt be in two parts, indented and ſealed by the ſheriff, and two juſtices of peace; who are to view them, and one of them is to remain with the ſheriff, and the other with the juſtices. Stat. 11 Hen. VII. c. 15. The eſtreats of fines, at the quarter-ſeſſions, are to be made by the juſtices; and to be double, one of which is to be delivered to the ſheriff by indenture. Stat. 14 R. II. c. 2. Fines, poſt-fines, forfeitures, &c. muſt be eſtreated into the exchequer twice a year, on pain of 50*l.* And officers are to deliver in their returns of eſtreats upon oath. Stat. 22 & 23 Car. II. c. 22. 4 and 5 W. & M. c. 24. It is the courſe of the court of B. R. to ſend the eſtreats into the exchequer twice a year, *viz.* on the laſt day of the two iſſuable terms; but in extraordinary caſes there may be a rule to eſtreat them ſooner. 1 Salk. 45.

Estreats, *Clerk of the.* See Clerk.

ESTREES, Francis-Annibal D', in *Biography*, was born in 1573, and educated for the church, in which he had the biſhopric of Noyon conferred upon him by Henry IV. at a very early age. When he was only twenty-one he reſigned his eccleſiaſtical preferment, on account of the death of his elder brother, and aſſumed the profeſſion of arms, in which he became diſtinguiſhed under the title of the marquis De Coevres. He was embaſſador extraordinary to Switzerland and the princes of Italy, in 1614. He was created marſhal of France in 1626, and in 1630 ſuccoured the duke of Mantua, who was beſieged in his capital. In 1636 he was deputed embaſſador extraordinary to Rome, a character in which he well ſupported the honour and intereſts of his crown in oppoſition to pope Urban VIII., with whom, and the nephews of the haughty pontiff, he was continually involved in quarrels. He was recalled by his own ſovereign, which he conſidered as an affront, and refuſed to appear at court, to give an account of his conduct. He died at Paris in 1670, at the great age of ninety-eight years, highly reſpected by his countrymen. At the deſire of cardinal Richelieu, he drew up "Memoirs of the Regency of Mary de Medicis," which was publiſhed at Paris in 12mo. in the year 1660. "A relation of the Siege of Mantua, in 1620," and "An Account of the Conclave, in which Pope Gregory XV. was choſen in 1621," have alſo been given to the public from his papers. Moreri.

Estrees, Cæsar d', ſon of the preceding, was born in 1628, and being brought up to the church, he was raiſed to the biſhopric of Laon in 1653. He was created cardinal by Clement X. in 1671; and at the death of that pontiff entered the conclave, and managed ſo as to put off the election five weeks, till the arrival of the other French cardinals. He was ſent into Bavaria to negociate the marriage of the dauphin in 1677, and afterwards went to Rome, on other important and difficult buſineſs. He ſupported the rights of the crown, and of the Gallican church in oppoſition to pope Innocent XI., whom he prevented from publiſhing any act infringing on both. He reſided many years at Rome, the ſole reſident on the part of France, and exerted much influence at the election of ſucceeding popes. On his return to France he was rewarded with the rich abbey of St. Germain des Pres, where he died in 1714, in his eighty-ſeventh year, greatly regretted, &c. leaving behind him a high character as a politician. Moreri.

Estrees-*Saint-Denis*, in *Geography*, a ſmall town of France, in the department of the Oiſe, chief place of a canton, in the diſtrict of Compiègne, with a population of 1040 individuals. The canton has a territorial extent of 150 kiliometres, with 20 communes, and 10,325 inhabitants.

ESTREMADURA, *i. e. Extrema Durii*, a province of Portugal, bounded on the north by Beira, on the eaſt and ſouth by Beira and Alentejo, on the weſt by the ocean; lying between 38° and 40° N. lat. and obliquely between 7° 10′ and 9° 30′ W. long.; being 140 miles from north to ſouth, and 70 in breadth; containing 5,440 ſquare miles, 8 juriſdictions, 400 pariſhes, and 350,760 inhabitants. Several diſtricts of this province are abundantly fertile, yielding grain, wine, oil, and fruits. The whole country is covered with flowers, and the bees produce a great quantity of honey. The manufacture of ſalt affords one of the chief articles of commerce. The principal towns are Liſbon, Leiria, Abrantes, Pombal, Alcobaca, Setuval. Thomar, Santarem, Alanquer, Torres Vedras, Cintra, and Caſcaes; and the chief rivers are the Tagus, or Tajo, and the Sador or Sado, ſometimes called Cadaon and Caldas.

Estremadura, a province of Spain, bounded on the N. by Leon; on the E. by New Caſtile; on the S. by Andaluſia; and on the W. by Portugal; lying between 38° and 40° N. lat.; and between 7° 10′ and 4° 40′ W. long.: being 140 miles from north to ſouth, and 90 — 1.0 from weſt to eaſt. This province was formerly a part of Portugal, but being ſeparated from that country, it is ſometimes called Eſtremadura of Caſtile. It is traverſed by the rivers Guadiana and Tajo, which divide it into three equal parts. Interſected by ridges of hills, it abounds in grain, fruits, and excellent paſtures; but good water is ſcarce, and the air in ſummer is exceedingly hot, inſupportable to ſtrangers, but to the natives not inſalubrious. The principal commerce conſiſts of cattle and fine wool; and the hills are covered with oaks, the acorns of which feed large herds of ſwine, that are black. The inhabitants are in general inclined to corpulency; and are conſidered as humane, affable, ſincere, ſtout, and brave. The principal towns are Badajoz, Placentia, Coria, Albuquerque, Caceres, Truxillo, Merida, Montejo, Xeres de los Cavalleros, Ellerena, and Zafra; and the chief rivers are the Guadiana, the Tajo, and the Alagon.

ESTREMERA, a town of Spain, in New Caſtile; 27 miles S.E. of Madrid.

ESTREMOZ, a fortified ill-built town of Portugal, in the province of Alentejo, containing three churches, ſix convents, two hoſpitals, and 6500 inhabitants; pleaſantly ſituated on a riſing ground in a fertile country; 7 leagues N.E of the capital; and famous on account of a victory gained by the Portugueſe over the Caſtilians, in the year 1663. In its vicinity there is excellent marble. The country on the weſt ſide of the town is pleaſant and well cultivated, abounding in orange gardens and laurels; but at ſome diſtance no traces of cultivation appear. This town has a manufacture of beautiful earthenware.

ESTREPAGNI. See Etrepagny.

ESTREPEMENT, in *Law*, an impoveriſhing or making of land barren, by continual plowing and ſowing, without due manuring, reſt, and other huſbandry.

The word is derived from the French *eſtropier*, to maim; or the Latin *extirpare*, to extirpate, root up.

Estrepement is alſo uſed for any waſte, or ſpoil, made by the tenant for life, upon lands or woods, to the prejudice of him in reverſion; as the cutting down of trees, or lopping them farther than the law allows, &c.

Estrepement is alſo a writ which lies in two caſes: the one, by the ſtat. of Glouceſter, 6 E. I. c. 13, when a man having an action depending, as a formedon, writ of right, or the like, ſues to inhibit the tenant from making waſte during the ſuit.

The other is for the demandant, who is adjudged to recover ſeiſin of the land in queſtion; and before execution,

 for

for fear of waſte to be made till he can get poſſeſſion, ſues out his writ.

ESTRICH, or Oestrich, in *Geography*, a town of Germany, in the circle of the Lower Rhine, and electorate of Mentz on the Rhine; 14 miles W. of Mentz.

ESTUCUA, a town of Mexico, in the province of Mechoachan; 58 miles W. of Mechoachan.

ESULA, or Æsulum, in *Ancient Geography*, a town of Italy, ſituated on a mountain, near the Tiber.

Esula, or *Æſula*, in *Botany*, a word ſaid to be of Arabian origin. See Euphorbia *Eſula*, and Apocynum *Venetum*.

ESULÆ Radix, in the *Materia Medica*, the name of a root of a plant of the ſpurge kind, ſometimes uſed in medicine. The root conſiſting of a cortical part, and an inner ſticky one, the bark only is uſed; and ſuch ſhould be choſen as is new dried, and of a reddiſh colour without and within, and ſuch as, when held in the mouth, affords a very diſagreeable taſte, with great acrimony. It is a very violent purge, and has been ſaid to have performed cures in dropſical caſes, when more gentle medicines have proved ineffectual. It is a good method to macerate it a day or two in vinegar before it is uſed.

ESURIS, in *Ancient Geography*, a town of Spain, ſuppoſed to be *Xeres*.

ESUS, or Hesus, in *Mythology*, a deity among the Gauls, to which they ſacrificed after victory whatſoever came alive into their poſſeſſion. They ſometimes ſprinkled the altars of this deity with the blood of their women and children.

ESZEK, in *Geography*, a town of Sclavonia, with a wooden bridge, built by the Turks over the Drave; 48 miles W.N.W. of Peter-Waradin, and 80 N.W. of Belgrade.

ETABLES, a town of France, in the department of the North Coaſts, and diſtrict of St. Brieuc; 2½ leagues N. of St. Brieuc.

ETAIN, or Estain, a ſmall town of France, in the department of the Meuſe, chief place of a canton in the diſtrict of Verdun, 18 miles N.E. of Verdun. It has a population of 2300 individuals, and its canton compriſes 30 communes, with 7125 inhabitants, on a territorial extent of 247½ kiliometres.

ETALLE, a ſmall town of France, in the department of the Forêts, chief place of a canton in the diſtrict of Neufchâteau, with a population of 1080 individuals. Its canton has a territorial extent of 280 kiliometres, and 13 communes, with 9013 inhabitants.

ETAMPES, a ſmall town of France, in the department of Seine and Oiſe, chief place of a diſtrict of the ſame name, with a population of 7786 individuals. It is ſituated on the left bank of the river Juine, at the confluence of two other rivulets, 36 miles E. of Chartres, ; 45 miles N. by E. of Orleans; and 40 miles S. of Paris. N. lat. 48° 25′. The canton contains 14,187 inhabitants, diſperſed in 15 communes, on a territorial extent of 192½ kiliometres.

As chief place of a diſtrict, Etampes has a ſub-prefect, a court of juſtice, and a regiſter office. There are ſome manufactures of hoſiery, woollen, and cotton yarn, and leather. The ſtockings, in particular, are known in the French trade by the name of ſtockings of Beauce, or Bas de Beauce, from the village where the beſt are made.

The ſoil of the diſtrict of Etampes is ſandy: it produces, however, ſome wheat, rye, barley, oats, and hemp. There are a few vineyards and ſome artificial meadows. The diſtrict contains 6 cantons, 111 communes, 1372½ kiliometres, and 58,890 inhabitants.

ETANGS, Les, a town of France, in the department of the Moſelle, and diſtrict of Boulay; 2½ leagues E.N.E. of Metz.

ETAPLES, or Estaples, a ſmall town of France, in the department of the Pas de Calais, chief place of a canton in the diſtrict of Montreuil, with a population of 1360 individuals. It is ſituated at the mouth of the river Canche, which forms a ſmall harbour, 12 miles N.E. of Boulogne, 168 miles N. of Paris. N. lat. 50° 30′ 44″. The canton contains 19 communes, and 7807 inhabitants, on a territorial extent of 232½ kiliometres.

ETAPPE, in *War*, an allowance of proviſions and forage made to the ſoldiers upon march through a kingdom, or province, to or from winter quarters.

Hence, he that contracts with the country, or territory, for furniſhing the troops in their march, is called etappier.

ETARRY, in *Geography*, a town of Hindooſtan, in the country of Bahar; 34 miles S.W. of Arrah.

ETAULIERS, a town of France, in the department of the Gironde, and diſtrict of Bourg; ſeven miles N. of Blaye.

ETASAGGAH, a town of Hindooſtan, in Bahar; 35 miles S.E. of Bahar.

ETAVERAM, a town of Hindooſtan, in the Carnatic; 10 miles E. of Coilpetta.

ETAYA, a circar of Hindooſtan, in the Soubah of Agra, bounded on the N. by Rohilla; on the E. by the circar of Pattan, Canoge an Corah, and on the S.W. by Jumna. Etaya is the capital.

Etaya, a town of Hindooſtan, in the country of Agra, on the N.E. ſide of the Jumnah, 52 miles S.E. of Agra. N. lat. 26° 45′. E. long. 79° 17′.

ETCH, in *Agriculture*, a term ſignifying the ſame thing as erſh. See Ersh.

ETCHAUK, in *Geography*, a town of Bengal, 22 miles N. of Ramgur.

ETCHING, in the *Polite Arts*, an important branch of that ſpecies of engraving which is performed with the view of delivering impreſſions on paper, by means of the rolling-preſs, is the ſuperaddition of the chemical proceſs of corroſion, to the art of drawing through etching-varniſh, (or etching-*ground*, as it is more frequently termed,) on plates of metal; though it has ſometimes been ſucceſsfully performed on other ſubſtances, and particularly on glaſs.

Etching is moſt frequently performed on plates of copper; and (though aqua-tinta be a ſpecies of etching, for which ſee Aqua-tinta) the means commonly employed, are lines drawn with a ſtylus, or ſteel-point, termed an etching-*needle*, which are afterwards corroded by aqua-fortis.

The etching-needle reſembles the dry point (ſee the article Dry-point) in all reſpects, excepting the ſuperior ſharpneſs of the latter, and that it need not be quite ſo long as dry-points are at the firſt. Of theſe needles, the artiſt ſhould provide himſelf with three or four, for etching finer or coarſer lines, of various dimenſions and different degrees of bluntneſs; that for the fineſt or moſt delicate lines being little leſs ſharp than the dry-point. That he may with certainty etch lines of ſimilar ſtrength and depth, where ſuch are required, as in covering a ſurface of an even tint, the extreme point of his needle ſhould be very delicately and gradually rounded off on a leathern ſtrop ſupplied with crocus-martis, or putty-powder.

The practitioner in etching ſhould, moreover, provide himſelf with a ſoft and large camel's-hair bruſh, wherewith occaſionally to ſweep the duſt, and eraſed etching ground, from the ſurface of his work: and an etching-board of from three to ſix inches in breadth, bevelled to an edge on one ſide, ſupported at the ends by ſmall bars of wood about one-third of an inch in thickneſs, and of ſufficient ſpan to ſtand as a bridge over the varniſhed plate, and prevent the engraver's hand from touching and marring his work, ſhould alſo be provided,

provided, and the copper-plate, being previoufly prepared, as fee COPPER-PLATE, he may proceed to lay his etching-ground in the following manner.

The plate is put upon a German ftove, or chafing-difh, and heated over the fire; or, if fmall, is held with a hand-vice, the polifhed fide being upwards, and heated with the flame of paper burning under it; when hot, it is rubbed over with etching varnifh (fuch as is defcribed in the fequel of this article) wrapped up in taffety, which fhould be gently paffed from one fide to the other in a right line, fo as to form feveral rows, till the plate is every where moderately covered; then with a *dabber*, formed of cotton, tied up in Perfian filk, let every part of the plate be beat gently, while the varnifh is in a fluid ftate; and in order to give it a fine grain, and that the varnifh may be equally fpread over the furface of the plate, continue to beat it with the dabber, after the plate is taken from the fire, till it attains a fomewhat harder confiftence in cooling; but the ufe of the dabber fhould be difcontinued long before the varnifh is cold, left it fhould be made to rife from the plate.

When the plate is thus uniformly and thinly covered with the varnifh, it muft be blackened whilft it is yet warm by a piece of flambeau, or of a large wax-candle, or taper, twifted together, till fix or more flames unite in one, which affords a copious fmoke; difpatch is of importance, that the varnifh may not grow cold during the operation, which fhould be performed, if poffible, at one heating of the plate, for repeated melting of the varnifh does it much damage. Large plates may be fufpended from the ceiling of a room by four cords and iron rings, with the varnifhed fide downwards, for the greater convenience of being blackened. Care fhould be taken that the flambeau or candles be kept at a proper diftance from the plate, that the wick may not touch and burn, or otherwife impair the varnifh. The varnifh may be made white, if that colour is preferred to black, by grinding white lead in water, and putting it into a glazed earthen difh, with a little good glue diffolved, and melting the whole together. This mixture is fpread with a brufh or pencil of hog's hairs thinly and evenly on the varnifh laid on the plate and fmoothed. The colour is then left to dry; if it fixes with difficulty on the varnifh, the compofition fhould be mixed with a drop or two of ox-gall.

When the copper-plate is thus varnifhed, and is quite cold, it remains to transfer from paper to the varnifhed plate, the tracing, or outline of the defign. If the outline be reduced from an oil or water-colour picture or other original of larger dimenfions than the intended etching, and be executed with lead pencil or red chalk upon drawing or writing paper, the method moft in ufe among Englifh engravers, is, to take the varnifhed plate and outline to the rolling-prefs printers, and (fuffering the latter to lie between wetted paper for a quarter of an hour or fo, that it may become fufficiently damp for the lead or chalk to be in a certain degree liquified, while the paper is fufficiently foftened to do no injury to the etching ground,) to pafs it through the prefs, the upper roller thereof being fupplied with blankets in the fame quantity, and the prefs adjufted to about the fame degree of preffure, as for printing. If this be carefully performed, the outline will appear at once transferred, and reverfed on to, the furface of the etching-ground, and the artift have nothing to do but to proceed with his etching. By thefe means the trouble both of retracing and *reverfing* (*i. e.* of changing the right hand view of his picture round to the left, and *vice verfâ*, the left to the right, as it would appear if reflected in a looking-glafs,) is faved to the engraver. The method formerly ufed,—which muft ever be ufed where no rolling prefs is at hand, and which is ftill believed to be generally practifed in the other countries of Europe—is, either to trace the outline of the defign on tranfparent paper, that by fimply turning the paper it may be feen in reverfe, or ufing thin drawing paper for the purpofe, to render it tranfparent afterwards by means of oil or varnifh. When this is thoroughly dry, a piece of fan, or other very thin, paper, of the fize of the outline to be traced, muft be evenly rubbed over on one fide with powdered red chalk or black lead, and interpofed between the outline and varnifhed plate, with the chalked or leaded fide downward, and both outline and tracing paper being ftretched tight over the varnifhed plate, and faftened by means of fmall bits of wax placed along the margin, a blunt etching-needle muft be carefully paffed over the feveral outlines with a moderate degree of preffure, which will occafion fo much of the powdered lead or chalk to adhere to the fmoked etching ground, as, when the papers are removed, will exhibit the outline or tracing of the whole defign in all its correctnefs.

Having proceeded through thefe introductory mechanical preparations, which require care and fome knowledge of drawing, the engraver's tafk as an artift, or man of tafte or genius, properly begins. Who fhall prefcribe laws to genius?—He may now exercife the knowledge he has previoufly ftored, and call forth his inventive powers. The forms of his objects muft now be feverally drawn, with fuch tafte and feeling as he may poffefs; and his fhadows, demi-tints, and lights, excepting fuch as he may prefer to leave to be executed by the graver or dry point, be hatched, by employing lines more clofe or more open, and preffing on his needles more lightly or more ftrongly, as a fkilful mufician preffes on the keys of his harpfichord, and as the feveral parts of his work may demand, varying his line with the nature of his object.

The characteriftic, or local advantage of etching, for certain purpofes, over lines cut with the graver, confifts in the unlimited freedom of which this mode of art is fufceptible. The etching-needle, meeting little refiftance from the varnifh, glides along the furface of the plate, and eafily takes any turn that the tafte of the artift may direct, or his hand accomplifh; and hence its peculiar adaptation to the expreffion of that clafs of objects which artifts term picturefque, fuch as trees, rocks, ruins, cottages, the fhaggy hair of animals, broken ground, or other rough and irregular furfaces.

It has formerly been much difputed among the curious, whether Germany or Italy had the honour of giving birth to the invention of etching, and with the view of afcertaining this point, the dates of the impreffions from the earlieft etchings by Albert Durer and Parmegiano have been affiduoufly fought for and compared. The writer of the prefent article conceives that fome portion, at leaft, of this difcuffion and refearch, might have been fpared, had the difputants reflected that etching, originally Etzen, is not an Italian but a German word, and how very unlikely it is that an Italian invention fhould have been denominated by a German word.

Although this art afforded means analogous to the objects themfelves, of drawing and characterifing all thofe objects, of which wildnefs and freedom, communicated by fpontaneous perception and feeling, is the foul, yet engraving with the graver had been previoufly invented, and in the beginning of the fixteenth century impreffions from fuch engravings had called forth the admiration of the tafteful. For thefe reafons, and from the prevalence of thofe habits, and prejudices of tafte and education, which hang like dark veils about the faculties of man, the extent and variety of energy of which etching was capable were not perceived, and

and probably are not even yet perceived; the means of engraving, or manual operation of the graver, was miftaken for the end; and hence a falfe criterion of merit obtained confiderable influence; connoiffeurs gravely put on their critical fpectacles in order to fee in what degree, and how dexteroufly, the etcher had imitated the clear and clean-cut lines of the graver; juft as the early printers with the letter prefs, merely endeavoured to imitate M.S. miffals and bibles, without perceiving the fuperior degree of perfection of which printing was fufceptible. The Sadelers, Le Boffe, and others run into this egregrious miftake, and the latter, who wrote a treatife on the art of engraving, lays it down as a principle, that the perfection of this mode of engraving confifts in the clofe fimilitude of etching to the work done by the graving-tool.

That the efforts of the moft tafteful, bold, and inventive among the engravers of our own country, have largely contributed to difpel thefe prejudices, will be feen towards the clofe of this article. At prefent we proceed with our account of the procefs of etching.

The forms of the feveral objects of which any given etching may confift, being drawn with requifite knowledge and care, and the chiarofcuro, and expreffion of the textures of the feveral fubftances introduced into the compofition, hatched with the degrees of tafte and truth, which the ability of the artift may enable him to difplay, the bufinefs of corrofion, which is technically called *Biting-in*, begins. For this purpofe a border of fuch wax as is of a moderate degree of hardnefs when cold, and of a moderate degree of tenacity whilft warm, muft be applied round the margin of the plate, in the form of a little wall or rampart, about an inch, or three quarters of an inch in height. This wax may be compofed of bees' wax, either tempered with common pitch, or with Venice turpentine and tallow, and at one of the corners a gutter, or fpout, fhould be formed for pouring the aquafortis conveniently off the plate. The plate being thus bordered, it is ufual further to fortify or fecure the work againft the egrefs of the aquafortis whilft biting, by turpentine-varnifh thickened with lamp-black, and applied with a hair pencil on the margin of the plate, and under the infide edge of the rampart of wax. This varnifh or compofition (which is called *ftop-ground*) being fufficiently dry, the aquafortis may be poured on the plate.

We are now arrived at a part of the procefs where experience, combined with chemical knowledge, is the only practical guide on which any thing like found reliance may be placed. Yet a few general rules may not be difpenfed with. The aquafortis may either be pure nitrous acid, diluted with pure water in the proportions of four or five parts water to one of nitrous acid for the more delicate parts of the etching, or it may be the double aquafortis of the fhops diluted with pure water in the proportions of two to one, or fometimes of equal parts, according to the degree of ftrength or delicacy of the fainteft parts of the work. Of aquafortis thus diluted, but which muft be gradually ftrengthened as the work proceeds, let a fufficient quantity be employed to rife, when poured on the plate, about half an inch above its furface. If all things have been rightly conducted, it will now be feen that the menftruum will foon exert its action in thofe lines or hatches where the artift has preffed hardeft on his etching-needle, and will gradually begin to corrode the more delicate lines. It may here be proper to obferve that a feather, or camel's hair brufh, fhould be ufed during the biting, to burft the fmall bubbles of fixed air which are liberated from the copper, and cleanfe away from the lines the verdigreafe which is generated during the operation of the aquafortis: by thus moving the aquafortis to and fro on the plate, it will exert its action uniformly over the whole etching.

In about a quarter of an hour, or when the effects of the aquafortis have become vifible in the more tender parts, it may be poured off, the plate wafhed with clean water, and dried by expofure to the air, funfhine, or (which is now more common, becaufe more expeditious) by the operation of a pair of bellows. After trial made by taking off a fmall portion of the etching-ground with the fcraper, or a fmall piece of pointed charcoal, fuch parts of the etching as are believed to be fufficiently corroded, muft be painted over carefully, or *ftopped-out*, with the compofition of lamp-black and turpentine varnifh which is mentioned above; and when this is dry, the aquafortis muft be re-applied, and the biting proceeded with in the fame manner, till the ftronger parts are judged to be fufficiently corroded, the aquafortis being ftrengthened from time to time according to the judgment of the operator.

To bite-in a large plate will fometimes occupy feveral days, for great judgment and nicety of obfervation are required in gradating the chiarofcuro, and confiderable care muft be exerted in the ftopping-out. It need fcarcely be mentioned, that the operator fhould be as cautious as the neceffary degree of attention to his work will allow, not to inhale the fumes which arife from the mingled copper and aquafortis, which become more and more deleterious, as the biting advances.

When the ftrongeft parts are believed to be fufficiently corroded, and the plate is thoroughly wafhed with water, it may be again placed on the chafing difh, or German ftove, till it be fufficiently warm for the border of wax to be removed, after which, and while it is yet warm, the varnifh may be diluted by the application of a fmall quantity of oil of turpentine or of olives, and wiped off with a rag; when, if the biting-in hath been fuccefsfully accomplifhed, the etching is complete, and in fome cafes the plate is finifhed; though in moft cafes it happens that the engraver's tafte and judgment direct him purpofely to leave certain parts to be finifhed with the dry point and graver.

For an account of the early progrefs of the art of etching, the reader is referred to our account of the GERMAN and ITALIAN *fchools* of engraving. Its more recent improvements have taken place in England. In etching trees, which no other mode of engraving can adequately exprefs, Vivares and Pouncy have difplayed an art of characterizing the fpecies of tree which it was their object to reprefent, and at the fame time of fuggefting in the varying ftyles of their foliage, thofe maffes or countlefs numbers of leaves which are feen in nature itfelf. Their etchings of trees are decidedly fuperior to thofe which have been produced on the continent, unlefs we might except the trees of Waterlo and Kobell, and have rarely been equalled by thofe of the engravers of our own ifland.

He who would fee the moft perfect fpecimens which have been produced of this fpecies of art, fhould look at aquafortis proofs (not the finifhed engravings) which Vivares has produced after Claude, Patel, and Gainfborough; and thofe which Pouncy has etched after Wilfon, Hearne, and Farington. In looking at the former, he will fee with furprife how much Vivares has attained of the peculiar beauty, feeling, and delicacy of Claude's pencil, although he could only have been acquainted with certain pictures:—the larger Colonna Claude for example, from which he has produced a moft exquifite etching—through the medium of chalk drawings, and thofe not very good. It is not lefs worthy of admiration, at leaft of high approbation, to obferve how truly Pouncy has characterized the painting of Wilfon, in his

his etchings of "Athens in Profperity," and "Athens in Ruin," which are alfo executed from chalk drawings copied from the originals of Wilfon in the library of the late Mr. Willett.

In rocks and cottage fubjects Browne has fcarcely been lefs fuccefsful, as may be feen in the aquafortis proofs of the beft of his large plates after Both, Salvator Rofa, and Du Sart. In the rocks of his "St. John preaching," after Salvator Rofa, he is perhaps fomewhat extravagant, and out of harmony with his own figures and foliage, though vigorous and characteriftically rugged; but in "the Cottagers," and "the Jocund Peafants," after Du Sart, he is unrivalled; the feveral textures of the old plafter walls, old planks, thatch, broken ground, rough coated animals, (though thefe are probably etched by Woollett,) and even the flufh which trickles down the hog-trough, are etched with the trueft feeling of nature and Du Sart.

In etching ruins, as well as more perfect architectural fubjects, Piranefi the Roman led the way, and Rooker the elder fuccefsfully followed. Thefe artifts more than perhaps any other, except Mr. Lowry, fhewed the affinity, or fufceptibility of picturefque union, which fubfifts in fine art, between freedom of handling and geometrical precifion; as may be feen with pleafure in the antiquities of Rome and Pæftum, which Piranefi etched from his own drawings; (the original and very mafterly drawings of the temples at Pæftum being preferved in the collection of Mr. C. Lambert of the Temple F. A. S.) in the fix large views of London, which Rooker etched after the drawings of P. Sandby and himfelf; and among numerous other works from the hand of Mr. Lowry, in the plate of the weft door of the cathedral of Carrara from the drawing of Flaxman, as well as in various other plates of architectural and mechanical fubjects, by which this work is illuftrated and adorned, and which confift almoft entirely of etching.

With the view of etching fubjects of this kind with fuperior accuracy and facility, Mr. Lowry, about twenty years fince, invented and began to conftruct feveral inftruments or machines, which it is within the knowledge of the writer of this article have been much employed on the engravings which are fpoken of above. The firft was "for etching fucceffive lines either equidiftant, or in juft graduation from being wide apart to the neareft approximation, *ad infinitum*; the compafs of the inftrument being commenfurate with the poffible demands of the art. The fecond, which is more recently conftructed, is for ftriking elliptical, parabolical, and hyperbolical curves, and, in general, all thofe lines which geometricians call mechanical curves, from the dimenfions of the point of a needle, to an extent of five feet."

Within the laft feven years he has conftructed other machinery for facilitating particular operations in etching, and enfuring precifion in defcribing arches of circles of every poffible radius; lines converging to points at all diftances; various kinds of fpiral lines, and the cogs and fmaller teeth of wheel work; of the feveral ufes and fuperior powers of which machinery, numerous examples may be feen in what has already appeared of this Cyclopædia.

Of thefe inventions it may be truly faid that they combine elegance with utility, and are of high value if only confidered as auxiliaries of the imitative part of this branch of engraving; but as the auxiliaries of chemical, agricultural, and mechanical fcience, they are of incalculable advantage. The accuracy of their operation, as far as human fenfe, aided by the magnifying powers of glaffes, enables us to fay fo, is perfect; and it is not neceffary here to infift on the advantages that muft refult to the whole cycle of fcience, from mathematical accuracy. A hope may be indulged that before the completion of thefe volumes, Mr. Lowry may be induced to favour the public with plates, and particular defcriptions of his various apparatus.

It now remains to defcribe the compofition of the feveral kinds of etching-ground, which have been ufed by different engravers from time to time.

Of etching grounds there are three principal kinds, *viz.* common etching ground, hard ground, and foft ground.

The hard ground was formerly much ufed, being better accommodated to the intention of imitating the engraving with the tool; but the former has now wholly fuperfeded the ufe of the other, as it gives a power of expreffion incompatible with the greater inflexibility of the hard varnifh, which confines the lines and hatches to fuch a famenefs and regularity as give a ftiffnefs of manner, and coldnefs of effect to the work.

There are various directions for preparing the *common* etching-varnifh, which is by far the moft in ufe and the moft worthy of being fo. Le Boffe recommends the following: take of virgin wax, very white and clean, and of grains of maftic very clear and pure, each one ounce; and of calcined afphaltum, half an ounce: grind the maftic and afphaltum feparately, very fmall, and melt the wax over the fire in an earthen pot well glazed. When the wax is thoroughly melted, and very hot, fprinkle the maftic into it gradually that it may melt, and ftir the mixture that the ingredients may incorporate. Then fprinkle the afphaltum into the mixture, ftirring the whole compofition over the fire till the afphaltum be entirely melted: take the pot from the fire, and let the mixture cool; and pour the varnifh into clean warm water, and by working it with the hand, form it into a roll of about an inch in diameter, or into fmall balls, which may be wrapt up in taffety and kept for ufe. The quantity of wax fhould be increafed in winter, in order to attemper the varnifh to the exifting ftate of the atmofphere.

The following varnifh is ufed by many of the engravers at Paris: take of virgin wax, and afphaltum, of each one ounce; half an ounce of black pitch; and a quarter of an ounce of Burgundy pitch: the afphaltum muft be pounded in a mortar, and the wax melted over a flow fire in a pot of glazed earthen-ware, and the reft of the ingredients added by little and little, ftirring the mixture till the whole be well melted and incorporated. Then throw the whole mafs into a veffel of clean warm water, and proceed as before.

Mr. Lowry's recipe for common etching ground is as follows:—To two ounces of afphaltum add one of Burgundy-pitch, and an ounce and a half of white virgin wax. The afphaltum muft firft be finely powdered, and then melted in the glazed earthen veffel over a moderate fire, before the Burgundy pitch is put in: the wax muft be added laft, when the whole compofition muft be well ftirred, and then poured into warm water, to be further incorporated by means of the hands, and made up into balls for ufe.

The *hard* varnifh, which was ufed by Callott and other engravers of the continent, and which was commonly called the Florence varnifh, was prepared in the following manner. Take four ounces of fat oil, very clear, and made of good linfeed oil, like that ufed by painters. Heat it in a new pot of glazed earthen ware, and afterward put to it four ounces of grains of maftic well powdered, and ftir the mixture brifkly till the whole be well melted together, then filter the whole through a piece of fine linen into a glafs bottle with a long neck, that can be ftopt very fecurely, and keep it for ufe.

In laying this varnifh on the plate, it may be fpread evenly with the dabber and fmoked, as before directed, but after

after it is so spread, there remains to dry or harden it over the fire, for which purpose it will be proper to prepare a charcoal fire which shall emit no sparks; it should be contained in a coal-pan or chafing-dish, somewhat larger than the plate, which should be placed over it for the space of from eight to twelve minutes, every precaution being used to prevent dust from approaching the plate. Whilst in this situation the varnish will soon begin to smoke, and when this smoking is observed to decrease, the plate must be removed from the fire, and touched at the side or on the margin with a little piece of hard wood. If the varnish be easily raised by the touch, it is yet too soft, and the plate must be again placed over the fire as before: after a short time it must again be tried with the stick, and if the stick adhere to the varnish so as to require some slight effort to draw it away, the plate must from that instant be left to cool. If on the first trial the stick adhere strongly to the varnish, water must be immediately thrown on the back of the plate, to cool it as quickly as possible, lest a longer continuance of the heat render it too hard, or burn the varnish. When the plate is cold, the artist may proceed with the tracing and etching, as before directed.

The *soft* ground or varnish is prepared simply by mixing common etching ground with animal oil, in proportion of more or less according to the existing state of the atmosphere; a much smaller portion of the oleaginous ingredient being admissible in summer than in winter. If common tallow be used for the purpose, the salt which it may contain should first be precipitated, by dropping the melted tallow into water, and afterward skimming it from the top; but Mr. Gilpin recommends veal suet, and it is probably to be preferred.

The method of using soft ground is as follows. Over a plate thinly covered with this sort of varnish, and smoked as in the case of the common etching ground, the artist cautiously spreads a sheet of very thin paper, which it is best to spread in a damp state, and to fasten with strong paste by the edges, which should be folded over for the purpose on the back of the plate: the paper will thus, when dry, be stretched tight and flat over the surface of the varnish.

All is now ready for the reception of the etching, which is performed simply by making a hatched drawing of the intended subject with a black lead pencil on this paper. Great care must be taken during the etching that nothing but the pencil touch the paper, and for this purpose such a bridge must be employed on which to rest the hand of the artist, as is before recommended. When the drawing is complete, the paper must be carefully removed from the surface of the plate, which must be surrounded with a rampart of wax, and the aquafortis applied as before directed. This is the whole of the process of etching in soft ground. As much of the varnish as it was necessary to remove, in order to admit the aquafortis to the copper, will be found to have adhered to the back of the paper on which the artist has been drawing, which, presuming the plate to be judiciously *bit-in*, will exhibit the exact archetype of the impressions which the etchings will produce.

It remains to be said of etching in soft ground, that the stippling with the graver, which it is sometimes found necessary to add in certain parts, after the plate is bit-in, does not incorporate so thoroughly with the sketchy looseness and chalky texture of the etching, but that a judicious eye will always discover the junction, and a delicate taste will dwell on it with the same kind of dissatisfaction that we regard a modern repair of a fine old picture that has been damaged; and further, that though it be a mode of art extremely well calculated to imitate a painter's sketch or drawing in black-lead or chalk, it is by no means capable of producing a complete abstract of a finished picture.

There are certain local energies peculiar to every branch of engraving. He who should endeavour in mezzotinto or the chalk manner to rival the playful freedom and characteristic taste which is displayed by Vivares in his etchings of trees, would find himself as much mistaken in his aims as he who by etching through soft ground, or on *stone* (for which see Etching *on Stone*,) should attempt to render the delicate blandishments, so as to produce a complete abstract of the full harmony, of the finished works of Correggio or Claude. On the other hand, either of these modes of etching is far more capable of producing a faithful transcript of a drawing hatched with chalk or lead-pencil, than the powers of the graver and aquafortis united on copper, and of multiplying such drawings, certainly affords the most efficient means.

It may not be superfluous to add that it is not the painter's sketches that it is most desirable to multiply, but his finished performances; we wish most to see the mercury of his active imagination amalgamated with the sterling gold of his cultivated understanding; and we justly value an art of engraving as it is capable of rendering or reproducing the pure forms into which this rich mass may be moulded.

Etching *on Stone*. A method of etching on calcareous substances, which may be termed a chemical art of multiplying hatched drawings, has also been recently discovered in England, or recently imported from Germany; and some very spirited sketchy etchings have been executed in this way by the president West, and Messrs Fuseli, Cosway, Barry, and some other members of the Royal Academy. Messrs. Corbould, Stubbs, and C. Heath are also among those who have successfully practised this new art.

The materials were supplied by a gentleman not now in England: the knowledge of the exact proportions of the ingredients of which they consisted, was not imparted to those who made use of them, neither is it believed to have been imparted to any one else; but the materials themselves being known, the proportions may presumptively be ascertained by a little experience.

The stone was of a species resembling that fine-grained stone of a yellowish colour, which is found in large quantities in the neighbourhood of Bath, and is called Bath stone. The etchings were of two kinds; those performed with a crayon, and those performed with pen and ink. The crayon was a mixture of white wax and lamp-black, with a small quantity of shell-lac. The ink consisted of shell-lac, borax, and water, and the stones which received the crayons were ground to a surface somewhat less smooth than those which were prepared for the reception of the ink.

The method of etching is merely *drawing* on the stone with these materials. The mystery, or secret—which any chemist would easily develope—resides in the manner of printing these drawings, and is simply as follows.

The ink is to be prepared as printer's ink is commonly prepared, namely, ground up with oil, and the paper which is to receive the impression must be damped in the usual manner. The etched stone is then to be wetted by immersion in water; when it is taken out, and while it is still wet, the ink being carefully applied on its surface, without violent friction, by means of a printer's ball (such as is used in letter-press printing) will be found to adhere only where the stone has been hatched by the artist, with the crayon or ink, the antipathy of oil to water effectually preventing it from sticking any where else. The paper is now to be placed as in letter-press printing, and a pressure, which need not be very violent,

violent, applied either by means of a roller paſſed over the back of the paper or otherwiſe: a blanket or finer woollen cloth, being interpoſed between the roller and paper.

ETCHING *on Glaſs*, is performed in the following manner: Lay a thin coat of white wax (as etching ground is laid) on the plate of glaſs. On this the drawing muſt be traced in the uſual way. When the ſubject is etched, a border or wall of wax of a very even height muſt be put around: take then ſome fluor ſpar powdered to about the fineneſs of oatmeal, and ſtrew it *evenly* over the etching, and on this pour a mixture of equal quantities of ſulphuric acid and water, till the whole is about the conſiſtence of thick cream: a cover of metal or wood muſt then be laid over, and fitted cloſe on the border of wax, to keep in the fumes of the acid, the eſcape of which would ſo weaken the liquor that it would not act on the glaſs, and would beſides be very hurtful to the lungs.

If the ſubject be to be etched with care, and high finiſhing be required, the acid mixture muſt be taken off occaſionally, and the plate, after being well waſhed and dried, muſt have the parts that are bit-in enough, ſtopped-out, as in common etchings, when the mixture muſt be again put on, and cloſed down as before; and this muſt be repeated till the ſeveral gradations of ſhade are believed to be ſufficiently corroded.

Etchings on glaſs are printed by means of the rolling preſs, and it need ſcarcely be added that much care is requiſite on the part of the printer, leſt the plates of glaſs ſhould ſplit in paſſing through the preſs.

ETEA, or ETIA, in *Ancient Geography*, a ſmall town of the iſle of Crete.

ETELENT, in *Geography*, a town of Aſiatic Turkey, in the Arabian Irak, ſituated on the Tigris; 66 miles N.N.W. of Baſſora.

ETENDUE, *Fr.* in *Muſic*. See COMPASS.

ETEON, in *Ancient Geography*, a town of Greece, in Bœotia.

ETEONOS, a town of Greece, in Eubœa.

ETERNAL FLOWER, in *Botany*. See XERANTHEMUM.

ETERNITY, duration which is conceived incommenſurable with time, and excluſive of beginning, progreſs, ending, &c. See GOD.

Authors are much at a loſs for a proper and juſt definition of eternity: that of Boethius, De Conſol. Philoſ. lib. v. part 6. *viz.* " Interminabilis vitæ tota ſimul et perfecta poſſeſſio, *i. e.* a perfect poſſeſſion of a whole endleſs exiſtence altogether," though retained by S. Thomas and others, is faulty in divers reſpects.

Cenſorinus, De Die Natal. defines eternity by infinite duration, that is, duration which has always been, and always will be. Others more fully deſcribe it by a duration that exiſts altogether without any flux or ſucceſſion of parts prior or poſterior to each other; where the word duration, taken abſtractedly, imports no more than the perſeverance of a thing in its exiſtence, the τὸ *durare* being here oppoſed to the *τὸ ceſſare, in exiſtendo.*

But ſoften the word duration how you will, it is ſcarcely conceivable but by conceiving a quantity thereof, nor a quantity without conceiving a ſucceſſion. Others, therefore, define eternity by a *perpetuum nunc*, a perpetual now, or a *nunc ſemper ſtans*, an everſtanding now; but neither are theſe unexceptionable, the words *perpetuum* and *ſemper ſtans* importing an obſcure ſort of duration. See DURATION.

ETERNITY, in *Mythology*, a divinity among the Romans, who had neither temples nor altars. They repreſented it under the figure of a woman, who held the ſun in one hand and the moon in the other: her ſymbols were a phœnix, globe, and elephant.

ETERNOZ, in *Geography*, a town of France, in the department of Doubs, and diſtrict of Quingey; 2½ leagues S.E. of Quingey.

ETESIÆ, or ETESIAN *Winds*, are ſuch as blow at ſtated times of the year, from what part ſoever of the compaſs they come. They are ſo called from the Greek word ἔτος, *year*, being yearly or anniverſary winds, ſuch as our ſeamen call monſoons and trade-winds, which, in ſome parts of the world, continue conſtantly blowing for certain ſtated ſeaſons of the year. Thus the north winds, which, during the dog-days, conſtantly blow upon the coaſts of Egypt, and hinder all ſhips from ſailing out of Alexandria for that ſeaſon, are called eteſiæ in Cæſar's Commentaries. In other authors, the weſt and eaſt winds are called eteſiæ, when they continue blowing for certain ſeaſons of the year. Vide Salmaſ. Exercit. in Solin. p. 421.

Cellarius endeavours to prove that thoſe winds are properly eteſian which blow from that part of the horizon which is between the north and weſt about the time of the ſolſtice. Geog. Antiq. lib. i. cap. 8. See MONSOON and WIND.

ETETA, in *Ancient Geography*, a town of Upper Myſia, according to Ptolemy; called Ægeta in the Itinerary of Antonine.

ETFU, or EDFOU, in *Geography*, a village of Upper Egypt, ſituated near the Nile, above Eſneh, built on the ruins of the great city of Apollo, or Apollinopolis Magna, and now governed by an Arab ſcheik. It poſſeſſes an ancient temple, covered with hieroglyphics, among which, ſays Savary, we diſtinguiſh men with falcons' heads. Its inhabitants were enemies of the crocodile. The extent, majeſty, and preſervation of this edifice, ſays Denon, who has given a view of it, " ſurpaſſed all that I had ſeen in Egypt, or elſewhere; it made an impreſſion on me as vaſt as its own gigantic dimenſions. This building is a long ſuite of pyramidal gates, of courts decorated with galleries, of porticoes, and of covered naves, conſtructed, not with common ſtones, but entire rocks." " The excellent preſervation of this ancient edifice forms a wonderful contraſt with the grey ruins of modern habitations built within its vaſt incloſure; a part of the population of this village is contained in huts built in the courts, and around the fragments of the temple; which, like ſwallows' neſts in our houſes, defile them without concealing or injuring their general appearance." Below Etfu, the cultivated country becomes very narrow, ſo that there is only a quarter of a league in breadth between the deſert and the river.

ETHAM, in *Ancient Geography*, a town of Egypt, ſituated in the deſert, which gave name to the lower part of the Red ſea, oppoſite to Magdalum. It was the third ſtation of the Iſraelites in their eſcape from Egypt.

ETHELBERT, in *Biography*, king of Kent, ſucceeded to the throne about the year 560. He began his reign with a reſolution to revive the reputation of his family, which had been ſinking in the ſcale of monarchy; with this view he made war upon the king of Weſſex, by whom he was twice defeated, though he was afterwards triumphant, and acquired the complete aſcendancy over Weſſex and the other ſtates, except Northumberland, and reduced them to the condition of his tributaries or dependants. In the reign of Ethelbert, Chriſtianity was introduced into England. The king had married Bertha, daughter of the king of Paris, who being a Chriſtian, had ſtipulated for the free exerciſe exercife of her religion, and had carried over in her train a French bifhop. So exemplary in every refpect were her life and conduct, that fhe infpired the king and his court with a high refpect for her perfon, and for the religion by which fhe appeared to be influenced. The pope, taking advantage of this circumftance, fent a miffion of forty monks, at the head of whom was Auguftine, to preach the gofpel in the ifland. They landed in Kent in 597, and were well and hofpitably received by Ethelbert, who affigned them habitations in the ifle of Thanet. A conference was held, and the king took time to confider of the new doctrines propounded to him; and in the mean while gave them full liberty to preach to his fubjects. Numbers were converted, and at length the king fubmitted to a public baptifm. Chriftianity proved the means of promoting knowledge and civilization in this ifland; and the king, with the confent of his ftates, enacted a body of laws, which was the firft written code promulgated by the northern conquerors. Ethelbert died in the year 616, and left his crown, after a reign of 50 years, to his fon Edbald. Hume's Hift of Eng.

Ethelbert, king of England, was fon of Ethelwolf, and fucceeded to the government of the eaftern part of the kingdom in 857, and in three years afterwards he became fole king. He died in 866, but had, in the courfe of his reign, fhewn a confiderable fhare of vigour in defending his dominions from the inroads of the Danes, who at that period were cruel enemies to this country, and continued to ravage one part as they were repulfed from another. Hume.

ETHELEUM, in *Geography*, a river of Afia, which feparated between the Troade and Myfia.

ETHELING, or Ætheling. See Atheling.

ETHELRED I., in *Biography*, king of England, fon of Ethelwolf, fucceeded his brother in the year 866. The reign of this monarch was fhort but full of troubles. The Danes had already gained an afcendancy over the kingdom, and feemed now to threaten it with entire conqueft. The enterprifing Alfred united his fkill to the power which his brother the king was able to call forth; they purfued the invaders from place to place, and drove them from the centre of Mercia. The Mercians, carelefs of their liberties, or jealous of the fuperiority which victory was likely to give to the monarch, refufed to co-operate with him, and Ethelred was under the neceffity of oppofing the Danes with his Weft Saxons alone. With thefe he was generally fuccefsful, till large reinforcements were fent to fupport the invaders, which enabled them to make a ftand againft the natives. The actions fought were frequently very bloody, and in one of them Ethelred was wounded. He died in 871, leaving his crown to the immortal Alfred; of whom we have already fpoken. Hume's Hift.

Ethelred II. king of England, was fon of Edgar, and brother to Edward the Martyr, whom he fucceeded to the crown in the year 978. He was at this period a minor, and from his want of capacity and vigour in the affairs of government he was, in his riper years, characterized by the epithet of "The Unready." No man, however, ftood more in need of exertion and enterprife, for the Danes, who had for feveral years forborne all depredations, renewed their attacks with the utmoft fury; and meeting with little oppofition, they became more bold, till, at length, in the year 993, under Sweyn king of Denmark, and Olave king of Norway, they made a formal invafion of the country. At firft nothing feemed to oppofe the rapidity of their progrefs: and they laid fiege to London, which was valiantly and fuccefsfully defended by the citizens. A miftaken policy in behalf of the Englifh induced them to purchafe the departure of the invaders, who, in 997 and 998, returned in large bodies, laid wafte the fouthern parts of the kingdom, and demanded a ftill larger bribe than they had before received. To ftrengthen himfelf by a foreign connection, Ethelred married, in 1001, Emma, fifter to Richard II. duke of Normandy. In the following year a dreadful maffacre took place, on the fame day throughout England, of all the Danes fettled in the kingdom. The Englifh in this inftance were the willing inftruments in the hands of the king to execute his bloody orders. They fpared neither age nor fex; even a fifter of the Danifh fovereign, who had married an earl, and had conformed to the Chriftian profeffion, was barbaroufly murdered, having already witneffed the death of her hufband and infant children. Such revenge, fays the hiftorian, added nothing to the ftrength of the nation, but rendered its enemies more implacable. In 1003, Sweyn again invaded the ifland, and carried defolation all along the Weftern coaft. On a fubfequent occafion the bold invader obliged the nobles to fwear allegiance to him as king of England, while Ethelred, in 1013, fled into Normandy with his family. Sweyn maintained his power only a year, when death put an end to his reign, and Ethelred was recalled by his loyal fubjects. He refumed the government, but had not learned that wifdom which his misfortunes were calculated to teach; he fubmitted to Canute the fon of Sweyn, whofe valour and activity he was unable to refift. Ethelred died in 1016, after an inglorious reign of thirty-five years. Hume.

ETHELWOLF, king of England, fucceeded his father Egbert in the year 838. Little ambitious of government, one of his firft acts was to give his eldeft fon, Athelftan, the fovereignty over Effex, Kent, and Suffex. His whole reign was molefted by the incurfions of the Danes, and about the year 851 they became fo formidable as to threaten the total fubverfion of the government. The natives were not inactive, but oppofed the enemy with the utmoft vigour; neverthelefs they took up their winter-quarters in England, and before they returned, burnt Canterbury and London. In the midft of thefe dangers the king, excited by a fpirit of devotion, made a pilgrimage to Rome, where he remained about a year, being accompanied by Alfred, who was afterwards king. During his abfence he left his eldeft fon Athelftan as regent, who foon after died, and thus afforded an opportunity to his ambitious brother of feizing the reins of government with an intention of dethroning his father. To avoid the evil confequences of civil war the king, without hefitation, ceded the weftern part of his dominions to his fon. After this, influenced, in all probability, by the intriguing monks, he fummoned the eftates of the whole kingdom, and folemnly conferred upon the clergy the tithes of all the produce of the lands. This act of piety, as it was denominated, was confidered as the moft effectual meafure for refifting the Danes. Ethelwolf died in 857. Hume.

ETHER, in *Chemiftry*, is a light, odorant, inflammable liquid, produced by the action of certain of the acids upon alcohol. The acids that have actually been employed for this purpofe are the fulphuric, the nitric, the muriatic, the acetic, and the fluoric; whence originate as many fpecies, or perhaps varieties of ether, all of which we fhall defcribe in due order.

§ 1. *Sulphuric ether.*—The method of preparing this fubftance is firft mentioned in the Difpenfatory of Valerius Cordus, publifhed about the year 1540; it was alfo known to Bafil Valentine, Paracelfus, and Boyle: it had, however, attracted the notice of chemifts only in a very imperfect degree, before it was defcribed by Froben, a German, in the Philofophical

Philofophical Tranfactions for 1730. Since that period the preparation and properties of fulphuric ether have been carefully inveftigated by many able chemifts, efpecially Scheele, Dollfufs, Macquer, Pelletier, Vauquclin and Fourcroy.

The mode of obtaining ether in the fmall way is as follows. Take a tubulated glafs retort, of the capacity of about fix quarts, lengthen its beak by an adopter, and pafs the other end of the adopter into a two-neck quilled balloon receiver; fix another adopter into the oppofite neck of the balloon, and join to this a common quilled balloon receiver, placed in fuch a pofition that the quill, inftead of pointing directly downwards, as in the firft receiver, fhall flant gently upwards; then lute all the junctures with linfeed meal or common pafte, except that of the retort to the firft adopter; fix alfo a 24 ounce vial to the quill of the firft receiver, and loofely clofe the quill of the fecond with a cork or plug of moift paper. The lute being moderately dry and hard, withdraw the retort, and pour in through the tubulure 40 ounces by weight of rectified alcohol, and 32 ounces of the ftrongeft fulphuric acid. Replace the retort with its contents, being careful to fhake it as little as poffible, and let it remain for 12 hours or more, during which the acid and alcohol will gradually act on each other, producing a confiderable degree of heat. Afterwards withdraw the retort, and mix together its contents as accurately as poffible, by communicating to them a gentle circular motion; this being finifhed, replace the retort, and carefully clofe by lute its junction with the adopter, and leave the whole in this ftate till the contents of the retort have acquired a reddifh-brown colour, which will take place in a day or two. Now proceed to diftillation, by placing a pot of lighted charcoal beneath the retort, obferving to heat it very gradually. The firft impreffion of the fire drives off a little highly dephlegmated alcohol, but as foon as the mixture begins to boil, the ether itfelf paffes over and condenfes on the fides of the receiver in large ftreaks. It is now effentially requifite to keep the receiver as cool as poffible, by the application of ice or of wet cloths wrung out in cold water and frequently renewed; and if this is properly attended to, by far the greater part of the ether will be condenfed in the firft receiver, whence it will flow into the vial beneath; a little, however, will pafs through the fecond adopter into the fecond receiver, where it muft be condenfed by the fame means as have already been recommended. The contents of the retort are to be kept moderately boiling, till fulphurous acid gas begins to pafs through the quill of the fecond receiver, which may be known at once by its ftrong fuffocating odour. As foon as this is perceived, the fire is to be withdrawn, and the vial is to be detached from the receiver, and its contents poured into a ground-ftoppered bottle; being then replaced as before, the procefs of diftillation is to be re-commenced till about fix or feven ounces of a coloured liquid are produced, after which the operation is to be ftopped. The original mixture of fulphuric acid and alcohol is thus divided into three feparate products; namely, the refidue in the retort, and the products of the fecond and firft diftillations. In the retort is a black thickifh matter, fmelling ftrongly of fulphurous and acetous acids, and intenfely four to the tafte. If diluted with an equal bulk of warm water and filtered through pounded glafs or clean white fand, it will be feparated from the carbonaceous matter with which it was loaded, and by fubfequent boiling the fulphurous and acetous acids will be driven off, leaving behind fulphuric acid in a confiderable degree of concentration, and applicable to a variety of ufeful purpofes. The product of the fecond diftillation confifts of two diftinct liquids, the heavieft of which is acidulous water, and the lighter an impure ether, called *oil of wine*, which may be feparated from the water by inverting the vial that contains them in warm water; a little of the ether is in confequence converted into elaftic vapour, which forces out of the vial the lower and heavier fluid. The product of the firft diftillation is impure ether, in quantity about $17\frac{1}{2}$ ounces. Thus from 32 ounces of fulphuric acid and 40 ounces of alcohol there are procured about $17\frac{1}{2}$ ounces of impure ether, and three ounces of oil of wine; and the fulphuric acid that may be recovered, taking into confideration its quantity and denfity, amounts to about 46 per cent. of that originally employed.

Ether, when frefh diftilled, is contaminated by fulphurous and acetous acids and a little coloured oil, in confequence of which it is neceffary to purify it by rectification. This is generally done by adding to the ether fucceffive portions of cauftic potafh or foda diffolved in water, and fhaking together the two fluids in a well clofed bottle, after each addition of alkali, till the fulphurous odour is totally deftroyed; the contents of the bottle are then to be poured into a retort, and by the application of a gentle heat, never amounting to ebullition, the ether will pafs into the receiver in a ftate of great purity, leaving behind a watery faline liquor covered by a thin film of brownifh-yellow oil. Scheele recommends that the alkali employed in rectification fhould be diffolved in alcohol inftead of water; the advantage of which is that no fpontaneous feparation of the liquors takes place, and therefore the fulphurous and acetous acids are neutralized and feparated with greater certainty. Diftillation at a gentle heat will readily feparate the ether from the other ingredients. A ftill cheaper and very effectual method of rectifying ether is the following, firft employed by Mr. Woulfe. "Fill three-fourths of a bottle with the impure ether, add a little water and a portion of flacked lime; agitate the bottle with violence, and keep it for fome time in cold water, before taking out the cork; if the fmell of the fulphurous acid be not removed, add a little more lime and agitate a fecond time. Decant off the ether into a receiver, and diftil it off." Another very cheap and ingenious procefs was invented by Pelletier. It confifts in adding to the impure ether a little finely pulverized black oxyd of manganefe. The mixture being corked up in a bottle, is to be well fhaken four or five times a day for the fpace of a week, at the end of which time the fulphurous acid will have been converted into fulphuric, and will have combined with the manganefe, from which the ether may be poured off without the neceffity of diftillation.

By any of the above methods ether is rectified fufficiently for any purpofes to which it is ufually applied; but if the greateft poffible degree of purity is required, there fhould be added to the rectified ether fucceffive portions of dry pulverized muriat of lime, till it ceafes to be diffolved; from this mixture, by diftillation with a very gentle heat, and keeping at the fame time the receiver quite cold by the application of ice, an ether may be procured, probably entirely free from alcohol and water, and of the fpecific gravity of 0.65.

Rectified ether exhibits the following properties. It is a tranfparent colourlefs liquor, of a peculiar and to moft perfons an agreeably fragrant odour, and a hot penetrating, and fomewhat fuffocating tafte. Its ufual fpecific gravity, according to Lavoifier, is $=0.758$. It is volatilizable at a lower temperature, and more rapidly than any other liquid; a confiderable proportion being loft, efpecially in hot weather, by merely pouring it from one vial into another; hence the veffels in which it is kept ought to be very exactly clofed, and for further fecurity are often kept inverted in cold water.

water.

water. It boils at 98° Fahr. under the ufual atmofpherical preffure, and at 20° in vacuo.

Owing to the extraordinary rapidity with which ether evaporates, it poffeffes a very great power of refrigeration. This is made obvious to the feeling by pouring a little into the palm of the hand; it is almoft inftantly volatilized, and the hand becomes painfully cold. So alfo if fome fine tow is wrapped about the bulb of a fmall thermometer, and the blaft from a pair of double bellows is let upon it, after it has been well foaked in ether, the mercury in the thermometer will, in the fpace of a minute or lefs, be lowered to 0° Fahr. Ether, notwithftanding its ready volatility, is capable of being congealed at a low temperature. If a fmall matrafs filled with this fluid is cooled down to —25° Fahr. by a mixture of fnow and muriat of lime, the liquor becomes gradually filled with brilliant tranfparent cryftalline laminæ, refembling benzoic acid or oxymuriat of potafh; and prefently, efpecially at a fomewhat lower temperature, the whole is congealed into a white almoft inodorous mafs. Ether is remarkably inflammable, taking fire inftantly on the near approach of an ignited body; it burns with a large white flame and a little fmoke, and is refolved into water, carbonic acid, and a minute quantity of charcoal. When paffed through a red-hot earthenware tube, it is entirely decompofed, and a large production of carburetted hydrogen takes place. Ether remarkably increafes the bulk of any of the permanent gaffes to which it was added, as was firft obferved by Dr. Prieftley. A fmall quantity of this fluid being mixed with oxygen confined over mercury, exactly doubled its bulk, nor could any additional quantity occafion a further dilatation. Nearly the fame effect took place with atmofpheric air, azot, hydrogen, nitrous gas, and carbonic acid; but by a flight agitation in water the ether was abforbed, and the gas refumed its former dimenfions without any alteration of its original properties. If oxygen gas thus diluted by ether is fet fire to, it burns rapidly, but does not explode; but if one part of this mixture is added to three parts of oxygen, the application of an ignited body, or of the electric fpark, caufes a violent explofion, the products of which are water and $2\frac{1}{2}$ parts of carbonic acid. Hence it appears that one part of ether requires 6.8 of oxygen for its faturation, and that the proportion of carbon to hydrogen in fulphuric ether is nearly as 5 to 1.

Water and ether appear to combine with each other in two different proportions. If equal parts of thefe fluids are fhaken together in a graduated tube, the ether will be found to have diminifhed in bulk about $\frac{2}{10}$, and the water to have enlarged in nearly the fame proportion; the lower fluid confifts of water faturated with ether, and the upper fluid is ether combined with a little water. The ether in this ftate is faid to be *wafhed*, and acquires in confequence fome properties which pure ether does not poffefs; in particular, it is now capable of diffolving caoutchouc with great eafe, whereas this fubftance is acted on by pure ether only in a very imperfect manner. Phofphorus is foluble in ether, but the folution is not luminous. When ether is boiled with phofphorus, it often depofits cryftals by cooling; agitation with water produces no change in this liquid, but the addition of a little alcohol caufes an immediate turbidnefs, whence the fophiftication of ether by alcohol may be detected by the addition of a few drops of phofphorized ether. The fixed alkalies feem incapable of uniting with ether, but ammoniacal gas is abforbed by it very copioufly. The fame may be obferved of nitrous gas; but neither of thefe combinations has hitherto been fubmitted to an accurate examination. Sulphuric acid acts on ether with confiderable energy, efpecially if affifted by a gentle heat; it is converted into a brownifh oily fluid, much heavier than ether, called oil of wine, and at a higher temperature is changed into olefiant gas. With regard to the action of oxymuriatic acid on ether, a curious experiment is related by Mr. Cruickfhank. "If we fill a bottle of the capacity of three or four pints with the pure oxymuriatic acid gas, taking care to expel the water as completely as poffible, and then throw into it about a drachm or half a drachm of good ether, covering its mouth immediately with a piece of light wood or paper, in a few feconds white vapour will be perceived, moving circularly in the bottle; this will foon be followed by an explofion, accompanied by flame, at the fame time a very confiderable quantity of carbon will be depofited, and the bottle will be found to contain carbonic acid gas." Nitric acid excites a confiderable effervefcence in ether, and feems to convert it into oil of wine. The effential oils are foluble in ether, and it combines with alcohol in almoft all proportions.

Concerning the theory of etherification, much has been written, and many experiments have been made by able chemifts, without, however, obtaining the fatisfaction that could be wifhed. According to Macquer, ether is a fubftance intermediate between alcohol and oil, and alcohol approaches to the ftate of oil precifely in proportion as it parts with its water of compofition. But though it is true that the production of water accompanies the converfion of alchohol into ether, and of ether into oil of wine, yet this is by no means the only phenomenon, fo that the theory of Macquer is, at beft, imperfect, fince the depofition of charcoal, and the generation of acetous acid, are not at all accounted for. According to Pelletier, Chaptal, and others, the whole procefs of etherification confifts in a transfer of oxygen from the fulphuric acid to the alcohol: the difengagement of fulphurous acid accompanies the production of ether, and therefore fhews that the fulphuric acid is deoxygenated: the oxygen, thus feparated, does not come over in the ftate of gas, and therefore muft be combined with the alcohol forming ether. But in reply, it may be obferved, that this mode of explanation accounts for only a few of the phenomena, and that the preparation of ether, if carefully managed, may be carried on without the difengagement of any fulphurous acid. The moft elaborate enquiry into this intricate fubject was undertaken by Vauquelin and Fourcroy, which we fhall now proceed to detail, though it is by no means fo complete and fatisfactory as to preclude the neceffity of further refearches. The facts and obfervations by which this theory is fupported are the following.

If one part of alcohol and two of fulphuric acid are mixed together, the temperature rifes to about 200° Fahr.; the mafs immediately acquires a deep brownifh-red colour, which deepens into black in a few days after, and at the fame time exhales a vapour manifeftly ethereous.

Equal parts of concentrated fulphuric acid and rectified alcohol acquire on mixture a temperature of 190° Fahr.; bubbles of gas are extricated, the liquor becomes turbid and opalefcent, and at the end of a few days acquires a deep red colour. The whole being then transferred to a diftillatory pneumatic apparatus, and being heated to 107° Fahr., ebullition takes place, and ether paffes over into the recipient; if the operation is carefully conducted no elaftic fluid is difengaged, and the vapour, when condenfed, is found to be only water and ether. When the liquor thus obtained amounts to about half of the alcohol employed, fulphurous acid begins to be manifeft, and, in a fhort time, the production of ether ceafes, and is fucceeded by oil of wine, accompanied by acetous acid. The contents of the retort being kept boiling, and becoming more and more concentrated as the

the diftillation proceeds, are conftantly acquiring a higher temperature; when this amounts to about 234° Fahr., olefiant gas begins to come over, and continues till the oil of wine ceafes to flow. At this period carbonic acid gas firft makes its appearance, and water and fulphurous acid ftill continue to be produced, the refidue in the retort being in the mean time reduced to little elfe than fulphuric acid thickened by charcoal.

From thefe facts the able chemifts who obferved them have concluded,

1. That the fpontaneous action of alcohol and fulphuric acid, when this latter is confiderably in excefs, is fufficient for the formation of ether without the affiftance of any extraneous heat, and that by duly proportioning the two fubftances, the alcohol might be wholly decompofed and made to yield all the ether of which it is capable when treated in the ufual manner.

2. That the formation of ether is not owing to the affinity of the oxygen of the fulphuric acid, for the hydrogen and carbon of the alcohol, becaufe in the preparation of ether no fulphurous acid gas is evolved till the production of ether has almoft ceafed. It muft therefore be the entire attraction of the acid for one or more of the elements of the alcohol that determines its decompofition: now fince water is formed during the whole procefs, and, fince the attraction of fulphuric acid for this fubftance is very powerful, it appears likely that this is the caufe that deftroys the equilibrium of the affinities by which the elementary particles of alcohol are retained in combination, and induces the oxygen and hydrogen to unite and form water. Hence it might at firft fight be fuppofed that ether differs from alcohol in containing a fmaller proportion of oxygen and hydrogen. This however will not be found to be the cafe, when we advert to the depofition of charcoal, which, equally with the production of water, accompanies the formation of ether: now the amount of charcoal depofited is greater in proportion to that which is left, than the hydrogen of the water compared to what remains in the ether; therefore this latter fluid, though compofed of the fame elements as alcohol, differs from it in containing a fmaller proportion of carbon compared with the hydrogen. During the progrefs of diftillation the heat to which the materials in the retort are expofed is conftantly increafing, and (the affinity of the acid and alcohol alfo augmenting) the acid itfelf is at length decompofed, fulphurous acid is generated, and the excefs of oxygen deprives the alcohol of part of its hydrogen whence refults the oil of wine, differing from ether in containing a larger proportion of carbon; and in confirmation of this, it may be obferved, that the charcoal depofited during the production of oil of wine is not fo abundant as during the generation of ether.

Hence as (according to the authors of the above hypothefis) no decompofition of the fulphuric acid takes place during the formation of ether, the agency of the acid is partly that of detaining the alcohol in a temperature more than fufficient for the volatilization of this fluid when uncombined, and partly that of affifting the caloric to decompofe the alcohol in confequence of its own powerful affinity for water.

A circumftance, however, firft remarked by Scheele, but which has hitherto failed to obtain the notice to which it is fo well entitled, fufficiently proves that in the formation of ether the acid employed acts a much more important part than is affigned to it in the theory of Vauquelin and Fourcroy. The admirable chemift above-mentioned ftates that if fulphuric ether be duly rectified by agitation with cauftic alkali and fubfequent diftillation, it occafions no precipitate with barytic falts; but if to the ether thus purified there be added nitric acid, a copious precipitate is then produced by any of the foluble falts of barytes, indicating the prefence of fulphuric acid. This fact ftrikingly points out that a portion of the bafe of the acid in a more or lefs deoxygenated ftate actually combines with the alcohol to compofe ether. A like fact refpecting muriatic ether is alfo mentioned by Scheele, namely, that though this ether, when rectified, occafions no decompofition of nitrated filver, yet the watery refidue, after combuftion of the ether, occafions a copious precipitate of muriated filver when mixed with the nitrat of this metal.

§ 2. *Nitrous ether.*—Although nitrous ether appears to have been known to Bafil Valentine and Kunkel, yet the mode of its preparation being kept a fecret, it foon ceafed to be attended to by chemifts, till in the year 1740 it was re-difcovered by Duhamel, and afterwards was more particularly defcribed by Navier, Sebaftiani and others. It was prepared by Navier in the following manner. Put 12 ounces of rectified alcohol into a ftrong bottle, and add to it gradually and at intervals 8 ounces of ftrong nitric acid; after each portion of acid the liquors are to be well mixed by agitation, and the bottle is to be kept clofe corked and immerfed up to its neck in ice and water; when the whole of the acid has been added, the bottle is to be well corked and further fecured by a leathern cap. A ftratum of ether rifes by degrees to the furface of the liquor, and after five or fix days the cork is to be pierced by a needle in order to let out the nitrous gas formed during the procefs: this gas having efcaped, the cork is to be drawn, and the whole contents of the bottle being poured into a feparatory funnel, the ether is thus procured unmixed with the heavier fluid on which it floats. This is, however, a very rude way of proceeding, and is attended with the utmoft rifk to the apparatus, the ether obtained alfo is in fmall quantity, and very impure. In order to prevent the violent and rapid action of the concentrated acid on the alcohol, which is the chief difficulty in the preparation of nitrous ether, Dr. Black propofed to interpofe a thin ftratum of pure water, and Fifcher on the fame principle made ufe of a little weak fpirit of nitre for the fame purpofe. M. Dolfufs, from a careful repetition of the latter procefs, obtained the following refult. Upon two ounces of very ftrong nitric acid he poured gently fix drachms of the fame very much diluted, and upon this three ounces of rectified alcohol. The bottle was loofely corked and fuffered to ftand undifturbed for three days; at this time the lower liquor appeared perfectly homogeneous with a ftratum of ether floating above it. The whole being put into a retort and fubjected to a gentle heat, there were obtained two ounces and a drachm of very pure ether unmixed with any acid, and the refidue in the retort confifted of weak acetous acid mixed with oxalic acid, nearly the whole of the nitrous acid having been decompofed.

The laft mode by which nitrous ether may be prepared, that we fhall mention, and which on the whole appears to be the beft, confifts in mixing together alcohol and fulphuric acid, and pouring the liquor upon pulverized nitre; the fulphuric acid difengages the nitre, which immediately re-acts on the alcohol, and ether is the refult. The able chemift whom we have already mentioned has fhewn the excellence of this method by the following experiment. Having put into a retort four ounces of perfectly dry and pulverized nitre, he added to it a mixture confifting of two ounces of concentrated fulphuric acid, and four ounces of alcohol. The whole being fubmitted to diftillation, there came over firft fix drachms of dulcified fpirit of nitre, and then three ounces of a liquor from which by fubfequent rectification were procured two ounces of pure ether.

Nitrous

Nitrous ether, when recently made, contains in loofe combination a confiderable quantity of nitrous gas, which in fome degree modifies its properties, and renders it peculiarly liable to burft the bottles in which it is kept, efpecially in warm weather. This lofs and trouble, however, may be avoided by rectifying the ether, which is beft done in the following way. Pour into a ftrong vial fo as to fill it two thirds, one part of ether and four parts of pump-water, and agitate it cautioufly at firft, frequently removing the thumb from the mouth of the vial in order to afford a free paffage to the difengaged nitrous gas: when no more of this gas is given out add a quantity of dry pearlafh equal in weight to the ether, and fhake the whole well together; then put the mixture into a tubulated retort and proceed to diftillation, taking care that the temperature does not exceed 120° Fahr.; the ether will pafs into the receiver quite pure, and may be kept for any length of time in ftrong well clofed bottles, with no more rifk of accidents than fulphuric ether is fubject to.

Nitrous ether refembles fulphuric ether in moft of its properties; it has, however, a dilute yellow colour, and a fomewhat different odour and flavour; this appears to be owing to the prefence of a little refinous matter, from which it can never be entirely freed; by repeated diftillations from frefh parcels of dry white fugar, as Deyeux has obferved, this impurity may, in great part, be feparated, and in proportion as this takes place the ether becomes more and more analogous to that prepared by fulphuric acid.

Nitrous ether appears capable of uniting with nitrous gas in two proportions; when the ether is in excefs it forms nitrous ether in the ftate in which it appears previous to rectification; when the nitrous gas exceeds the ether it forms a permanently elaftic fluid that has obtained the name of *etherized nitrous gas*. The preparation of this differs only in the rapidity with which the nitrous acid and alcohol are made to act on each other: when the combination takes place very flowly much ether and little etherized gas are the refult, but when the contrary is the cafe, thefe two products are formed in an inverfe proportion. If equal parts of alcohol and ftrong nitrous acid are mixed together at the common atmofpheric temperature, or at a higher heat in proportion as the acid is diluted, a very rapid and copious effervefcence takes place, a little ether is condenfed in the receiver, and a large quantity of gas paffes through the conducting tube, the firft portions of which are etherized nitrous gas, and the latter common nitrous gas. What remains in the retort is acetic acid with a little oxalic acid. The properties of etherized nitrous gas (according to Van Diemen and his affociates, to whom we are inbebted for its difcovery) are the following. It has a difagreeable ethereal odour, exactly refembling that of olefiant gas when treated with oxymuriatic acid. By the application of flame it takes fire and burns with a yellowifh lambent flame like alcohol; after the combuftion has ceafed, the veffel in which it was carried on contains a vapour of fingular pungency. Water abforbs this gas, but requires a confiderable time to effect this, except agitation is had recourfe to, refembling, in this refpect, carbonic acid. Alcohol produces the fame effect as water, and takes up the gas not only more rapidly, but alfo in larger proportion. A folution of cauftic potafh alfo diffolves it, but with confiderable difficulty, and on the addition of fulphuric or muriatic acids the etherized gas is again fet at liberty unaltered in any of its properties. Ammonia, whether liquid or in the gafeous ftate, is incapable of contracting any union with it; the fame is the cafe with oxygen gas at the common temperature, but a mixture of the two airs, when inflamed, produces a moft violent explofion; fulphuric acid immediately decompofes this gas, by abforbing the ether, the nitrous gas retaining its elaftic ftate. Sulphurous acid produces the fame effect, only it requires fome days for this purpofe. If fulphuric acid, previoufly diluted with an equal weight of water, is placed in contact with this gas over mercury, its action is greatly retarded, the diminution of volume in the inclofed air takes place much more flowly, and even after fome days a portion of ether is retained by the nitrous gas, which in confequence acquires the property of enlarging the flame of a taper that is immerfed in it, in the fame manner as nitrous oxyd does. Nitrous acid, according to the degree of its concentration, abforbs either wholly or in part, the ethereous portions of the gas, and the fame may be obferved of muriatic acid.

Etherized nitrous gas, when paffed through a red-hot tube, depofits a little oil, and by fubfequent wafhing in lime-water is freed from fome carbonic acid; the refidue is nitrous gas, mixed or combined with common carburetted hydrogen, and is not acted on by the fulphuric, nitric, or muriatic acids, by cauftic potafh or alcohol. The addition of oxygen gas produces red vapours, the nitrous gas is converted into acid, and the gafeous refidue is carburetted hydrogen.

§ 3 *Muriatic ether*.—After chemifts had fhewn the production of ether by means of the fulphuric and nitric acids, it was natural to attempt its preparation by the muriatic acid. But this latter, in its ufual ftate of dilution with water, has no action on alcohol, and therefore the various modes that were firft practifed to obtain muriatic ether entirely failed. A few chemifts were faid to have fucceeded by employing fimple muriatic acid, but in a more concentrated and dry ftate than the common liquid acid; the procefs, however, was both difficult and doubtful, and muriatic ether can hardly be faid to have been known till Rouelle difcovered that it might be prepared by diftilling together alcohol and the fmoking liquor of Libavius, which is a concentrated muriat of tin in its higheft ftate of oxydation. The marquis de Courtanvaux, having repeated the procefs of Rouelle with great care, propofes the following as the beft method of making the fubftance in queftion. Mix together in a retort three parts of the fuming muriat of tin and one of alcohol; a confiderable degree of heat is immediately excited, and a white fuffocating vapour arifes, which, however, foon difappears on agitating the mixture. As foon as an ethereous odour is perceived, let two balloon receivers be luted on, and kept as cool as poffible; then by the application of a gentle heat to the retort there comes over firft a little dephlegmated alcohol, which is fucceeded by the ether: by an increafe of temperature a few drops of coloured oil are produced, and there arifes, partly in the form of a foft butter and partly in that of a denfe brown liquid, a quantity of fmoking muriat of tin, part of the metallic oxyd remaining in the retort as a grey powder. When the ether thus procured is mixed with pearlafh, a copious effervefcence and precipitation take place, owing to the decompofition of fome muriat of tin contained in the ether; after which, by diftillation at a gentle heat, the ether arifes in a ftate of great purity, amounting to half the impure product of the firft diftillation.

Several other of the metallic muriats have been found to be equally efficacious with the liquor of Libavius; the corrofive muriats of antimony and of arfenic, the muriats of bifmuth and zinc, and the red muriat of iron, have in particular been ufed with fuccefs in the preparation of muriatic ether. Scheele.

Scheele, the difcoverer of oxymuriatic acid, was induced to try the effect of this in the preparation of muriatic ether. For this purpofe he put three ounces of alcohol into a receiver,

receiver, with which was connected a retort holding two ounces of common salt, upon which was poured an equal weight of sulphuric acid; the muriatic acid thus disengaged passed into the receiver, where it combined with the alcohol; and this, when saturated with acid, was transferred to another retort, containing three ounces of black oxyd of manganese in fine powder; the mixture instantly assumed a green colour, and presently after became so hot as to boil. When the ebullition had ceased, there was found in the receiver a liquor, from which, on mixture with water, a quantity of ether immediately separated. The same method is recommended by Van Mons, except that he employs only one fourth of the manganese used by Scheele, and performs the second distillation in a Woulfe's apparatus, the bottles of which contain a solution of caustic potash, by which the acid is prevented from re-acting on the ether.

Another mode of applying oxymuriatic acid to the preparation of ether, first practised by Scheele, is mentioned by Pelletier, and deserves to be repeated, as being perhaps the most expeditious and economical of any. He introduced into a large tubulated retort a mixture of eight ounces of manganese, and 16 ounces of decrepitated common salt, upon which he poured a mixture of 12 ounces of sulphuric acid, and eight ounces of alcohol. From this mass ten ounces were drawn off by distillation at a gentle heat, which, by subsequent rectification, yielded four ounces of ether.

It deserves to be remarked, that the ether prepared by oxymuriatic acid generally deposits, during its rectification with potash, a considerable quantity of a clear aromatic and bitter oil, which sinks in drops to the bottom of the vessel; the ether also, according to Dollfuss, at least before rectification, is compleatly miscible with water when shaken with it for some time. The preparation of ether, by means of simple muriatic acid, is not easy, and was readily supposed to be impossible by some of the leaders of the modern school of French chemists, because it contradicted one of their early theories on the process of etherification; yet Beaumé, a chemist of great experience and unquestioned veracity, had affirmed, that he had obtained a small quantity of ether, by mixing together alcohol and muriatic acid, both of them in the state of vapour. The practicability of this method appears also to be established beyond doubt by the following formula of M. Basse. Keep a quantity of common salt in fusion for about an hour, in order to drive off all the water of crystallization, then pulverize it, and put 40 parts into a tubulated retort, connected with a Woulfe's apparatus, in the first bottle of which are to be poured 20 parts of most highly rectified alcohol; then add to the salt in the retort 20 parts of the strongest sulphuric acid, and proceed to distillation by a gentle heat, keeping the bottle holding the alcohol as cool as possible. When the alcohol is saturated with acid, transfer it to a retort, and distil over about one half of it; agitate this portion with an alkaline ley, and the ether will presently separate and float on the surface, whence it may be obtained by decantation or distillation. The quantity of ether from the above materials amounts to about five parts.

Muriatic ether has a striking resemblance to that prepared by sulphuric acid; its specific gravity, however, is greater, amounting, according to Hermbstadt, to 0.84; its taste also has a peculiar astringency like alum, and when burning it exhales a strong acrid odour, somewhat resembling that of sulphurous acid.

§ 4. *Fluoric ether.*—All that we know of this substance is derived from the discoveries of Scheele. He first impregnated rectified alcohol with fluoric acid gas, by distilling pulverized fluor spar with sulphuric acid, and placing alcohol in the receiver; the smoking spirit thus obtained was distilled with a gentle heat, but no sign of ether made its appearance. Another portion of the acidulated spirit was then mixed with black oxyd of manganese, and by subsequent distillation an ethereous fluid came over, from which, by subsequent rectification, a little ether was obtained of a very agreeable odour, resembling nitrous ether.

§ 5. *Acetic ether.*—Acetic ether was first discovered by the Count de Lauraguais; the method of its preparation was by distilling together equal parts of alcohol and acetic acid. Scheele, Porner, Bergman, and other chemists, repeated this process ineffectually, and hence were induced to suspect some error. In consequence of these doubts, Pelletier entered into a careful examination of the subject, and has both shewn the reason of the failure of Scheele, and has given the proper method by which to succeed. He distilled together equal parts of alcohol and acetic acid, and drew off a little more than half; this liquor was acidulous, and had an ethereal odour, but no true ether could be made to separate. He then mixed together 12 ounces of strong radical vinegar, and the same quantity of alcohol, and distilled over one half of it at a boiling temperature; this product he poured back into the retort and recommenced the distillation; the produce of this and of a third distillation were in like manner recohobated, and having distilled the whole again for the fourth time, he finally obtained 12 ounces of an ethereous fluid; with this he mixed a quantity of carbonated potash, sufficient to saturate the acid which it contained, and then submitted it to gentle distillation. The first six ounces that came over were pure acetous ether, the next four ounces also contained ether, but not so pure as the former. It is remarkable that during the cohobations a considerable absorption of air took place.

Scheele obtained acetous ether in a much more compendious manner, by mixing together acetat of potash, or of lead, or of copper, with alcohol, and then adding as much sulphuric acid as was requisite to decompose the acetous salt, and distilling the mixture at a low heat. The produce being shaken with water, the ether rises to the surface and may be poured off. From 16 parts acetat of lead, six parts strong sulphuric acid, and nine parts of water, Bucholz obtained six parts rectified ether.

Acetic ether always retains the odour of the acid by which it is formed; it is not so volatile as the ethers procured by the mineral acids; it burns with a lambent blue flame, like alcohol; it is soluble in a little more than twice its bulk of water, and is decomposable into acetous acid by repeated distillations at a very gentle heat.

Various other acids have been distilled with alcohol for the purpose of procuring ether, but with little or no success. Oxalic acid, with an equal weight of alcohol, yielded Bergman a watery somewhat etherized alcohol. Benzoic acid and alcohol, according to Scheele, afford no ether, but when a little common muriatic acid is added to the mixture, an ethereous liquor comes over, of which part floats on water and part sinks in the same fluid. The ether, or the lighter portion, has the odour of benzoic acid, burns with a clear flame and smoke, and is about equal in volatility to acetic ether. The phosphoric, boracic, tartarous, citric and succinic acids, were found by the same able chemist to be incapable of producing ether, either by their own action on alcohol, or when mixed with oxyd of manganese or muriatic acid.

Ether, in *Ancient Geography*, a town of Palestine, in the tribe of Juda, which afterwards was assigned to the tribe of Simeon.

ETHEREAL Oil. See Oil, *volatile* or *essential.*

ETHEREGE, George, in *Biography*, chiefly known as a writer of comedy, was born in the vicinity of London about the year 1636. Little is known of his early years, but it is supposed he was educated at Cambridge; spent some time in foreign travel, and afterwards entered himself at one of the inns of court. His talents were but ill adapted to the laborious profession of the law; he was fond of gay and polite company, and became a writer for the stage. In 1664, his first comedy, entitled "The Comical Revenge, or Love in a Tub," was presented to the town, and well received. The author was immediately enrolled among the wits of the age. His next piece is thought to have been entitled to more praise for wit than for morality. It is entitled "She would if she could;" its licentious tendency was justly reprobated by the "Spectator," who says he knew of but one author who had professedly written a play upon the desire of multiplying our species, and that is the polite sir George Etherege in the play of "She would if she could:" "Other poets," he adds, "have here and there given an intimation, that there is this design under all the disguises and affectations which a lady may put on, but no author except this has made sure work of it, and put the imaginations of his audience upon this one purpose, from the beginning to the end of the comedy." His next piece was not produced till the year 1676; it was entitled "The man of the mode, or sir Fopling Flutter," and dedicated to the second duchess of York, Mary of Modena. It was very popular, and regarded as a true model of polite comedy; one of its principal characters was said to be a representative of the earl of Rochester, the finished fine gentleman and man of pleasure. Etherege lived a dissipated life, and in a few years injured his fortune and constitution. With a view of maintaining his rank in society, he paid his addresses to a lady of considerable fortune, who refused to marry him, unless he could procure the honour of knighthood. This he readily obtained, and upon the accession of James II. he was sent out envoy to Ratisbon, where he resided some time, and from whence he wrote letters which are favourable specimens of his talent for easy pleasantry. He died soon after the revolution, but the account of the time and manner of his death has been differently related. By some he is supposed to have died in his native country soon after his return from France, whither he had been on public business, and by others it is said, that it happened at Ratisbon by a fall down stairs. Besides the comedies already mentioned, Etherege was author of many smaller poems. His letters to the duke of Buckingham are in the Biographia Britannica, to which the reader is referred.

ETHERINGTON'S Bay, in *Geography*, a bay on the north-west coast of the island of St. Vincent; a little to the north of Chateau Belair bay.

ETHESIUS Lapis, a name given by some authors to the chrysolite.

ETHICAL GOOD, Ethical *possible.* See the respective articles.

ETHICS, Ἐθικη, the doctrine of manners, or the science of moral philosophy. See Philosophy and Morality.

The word is formed of ηθος, *mores*, *manners*, because the scope or object thereof is to form the manners.

Gale makes ethics only the first part or branch of moral philosophy, *viz.* that which regards private persons, or in a private capacity.

By manners or morals is here meant a way, or manner, of living confirmed by custom or habit, or certain habitudes of doing, or actions which are often repeated, which, if they be according to right reason, the morals or manners are said to be good, otherwise, evil and vicious.

Hence the object of ethics is the exercise of right reason in all our affairs, actions, and relations; or it is a man himself considered as dirigible, and to be conducted according to reason: and the end of ethics is to make him good and happy: so that if a man conducted himself according to right reason in all the circumstances of his actions, affairs, and relations, he would arrive at the highest pitch of moral perfection and beatitude.

Whence ethics may be defined a right manner of thinking in order to attain to human felicity, or a science whereby man is directed to conduct his will, and the actions thereof, so as to live well and happily. See Will.

The principal, nay, the only topics thereof, are happiness and manners, whence arise two parts or branches of ethics; the first on moral happiness, considered as the end; and the second on moral virtues or good manners, as the means to arrive at that end.

ETHICOPROSCOPTÆ, formed of ηθος, *manners*, and προσκοπτω, *offendo*, *I offend*, in *Antiquity*, the name of a sect. Damascenus, in his Treatise of Heresies, tells us, that the denomination of Ethicoproscoptæ was given to such as erred in matters of morality and things relating to practice that were to be done or to be avoided, &c. who blamed things laudable and good in themselves, or recommended or practised things evil. On this footing the Ethicoproscoptæ, though a numerous body, were no particular sect.

ETHIOPIA, in *Ancient Geography*, was a name given to several countries, both of Asia and Africa, whose inhabitants were either perfectly black or of a swarthy complexion; but Ethiopia, in a more restricted application of the term, or Ethiopia propria, was limited on the north by Egypt, extending to the lesser cataract and the island Elephantina; on the west by Libya interior; on the east by the Red sea; and on the south by a part of Africa unknown to the ancients, but probably comprehending that space which includes the modern kingdoms of Girgiro, Alaba, Machida, and part of Adel or Zeila. Proper Ethiopia, however, seems to have varied in extent at different periods; but for several ages it seems to have been the tract which at this day comprehends the kingdoms of Dongola, Sennaar, and Abassia, with part of Adel or Zeila; and consequently to have taken up 17 degrees of longitude, and to have reached from the tropic of Cancer to within six degrees of the line. Some geographers have restricted it to the tract of country that lies between Egypt and Abyssinia, about 600 miles in length, and 500 in breadth, which was called by the Arabian geographers Nubia.

The proper Ethiopia was anciently distinguished by a variety of appellations. Sometimes it was called India; sometimes Cephenia; and most usually Abasene, in sound and signification approaching very near to the modern Habash, Habesh, or Abassia. We also find Chaldæa, Assyria, and even Persia denominated Ethiopia by some authors of reputation; and it must be allowed, that the ancients called all those countries, extending themselves beyond each side of the Red sea, indiscriminately India or Ethiopia.

According to the Jews, the LXX, the Vulgate, and other versions, Cush, when applied in scripture to a country, is always to be understood of the proper Ethiopia. This opinion is supported by Philo, Josephus, Eupolemus in Eusebius, Eustathius, the author of the Alexandrian Chronicon, and the concurrent testimony of the Greek and Latin fathers. See Cush.

Ethiopia did not abound in cities and towns of any considerable fiderable note. Auxume, Auxumis, or Axome, reckoned the metropolis of Ethiopia, was undoubtedly the fame city as the modern Axuma, or Axum. This country was extremely mountainous, and therefore the climate in different parts of it was very various. (See ABYSSINIA.) The days and nights, as Ethiopia lay betwixt the tropic of Cancer and the line, were for the moft part nearly equal. The winds that blew on the mountains were, generally fpeaking, falubrious and pleafant; but the atmofphere over the plains ftagnated and became unwholefome. The foil in thofe parts that admitted of cultivation was extremely fertile, and produced vaft quantities of grain, pulfe, and fruit. It abounded with metals, particularly gold, minerals, vegetables, and a great variety of animals. (See ABYSSINIA.) The moft famous river that waters this country is the Nile. (See NILE.) The chief ports and emporia of ancient Ethiopia were thofe of Adulis, Mondus, Opore, Mofylon, and the principal city of the Aualitæ, feated upon the Red fea. The Arabs imported from their country into thefe ports fruit, corn, wine, and cloaths; and exported from thence to Ocelis and Mufa, oppofite harbours in Arabia, fpices, caffia, perfumes, ivory, myrrh, and feveral other commodities. The moft noted iflands pertaining to Ethiopia were Meroe, the Sporades of Agathareides, Aftratæ, Ara Palladis, Gythitis, Myronis, Daphnine, Magi, Acanthine, Ifis, Mondus, and Menuthias.

According to Pliny, Ethiopia was anciently divided into 45 kingdoms, of which the moft powerful and flourifhing was Meroe; but he does not inform us, whether they were independent of each other, or under one fupreme head. There is reafon to believe, however, that the kings of Ethiopia always ruled with an uncontroulable fway. If we admit the Ethiopian tradition, that a long fucceffion of princes, defcended from Solomon, reigned in this country, it can fcarcely be denied, that their authority was unlimited, as that of the Hebrew monarch knew no bounds. It appears from Strabo and Pliny, that fome Ethiopic nations were governed always by queens, whofe common name was Candace, as that of the Egyptian kings was Pharaoh, and Ptolemy. From Diodorus Siculus we learn, that a great part of Ethiopia was compofed of feveral elective monarchies, the heads of which were chofen out of their priefts; and that all thefe princes made the laws of their refpective kingdoms the bafis of their government. According to Diodorus Siculus the laws of Ethiopia agreed in fubftance with thofe of Egypt; which the Ethiopians accounted for by the affertion, that Egypt was firft peopled by colonies that migrated out of their country. Herodotus, however, reprefents the Ethiopians as having been civilized by the Egyptians, and as having learned the cuftoms and manners of that people at fo late a period as the reign of Pfammitichus I. Jupiter Ammon, according to the Greek and Latin authors, appears to have been the principal object of religious worfhip in Ethiopia; though the natives paid likewife divine honours to Ifis, Pan, Hercules, Æfculapius, and others, whom they confidered as the greateft benefactors to mankind; and if thefe authors may be credited, their religion differed not much from that of the Egyptians. Diodorus Siculus tells us, that the Ethiopians valued themfelves upon their being the firft nation that had a religious eftablifhment; and for this reafon they believed, that their facrifices were more acceptable to the gods than thofe offered by any other people. He affures us, however, that fome of them were atheifts, who looked upon the fun, on account of his fcorching rays, as their implacable enemy. If a tradition of the modern Abaffines could be relied on, the Ethiopians, or at leaft a confiderable part of them, adhered zealoufly to the law of Mofes from the time of Solomon till their converfion to Chriftianity. According to this tradition, the queen of Sheba, whom our Saviour calls the queen of the fouth, and who ruled over a powerful nation of Ethiopia, had a fon by Solomon named Menileck, who was educated at that prince's court, and inftructed, under the care of his father, in the law of God. Being afterwards anointed king of Ethiopia, and fent home to take poffeffion of his kingdom, at the defire of feveral eminent Ifraelites and doctors of the law that attended him, he introduced his father's religion, which continued among his fubjects and their pofterity till the time of St. Athanafius. See ABYSSINIA.

Ethiopia, in ancient times, was a country of vaft extent, inhabited by different nations; and, therefore, it is natural to fuppofe, that a confiderable variety of languages, or at leaft of dialects, muft have prevailed in it. The moft ancient of thefe was that called the Ethiopic, into which the fcripture was formerly tranflated, and in which all the books of the Abaffines, both facred and profane, are written. According to fome authors, this language nearly refembles the Chaldee; but, according to Ludolfus, who fpent 60 years in the ftudy of it, it bears as great an affinity to the Hebrew and Syriac, and approaches nearer ftill to the Arabic, from which it appears to be immediately derived. Ludolfus afferts, that a competent knowledge of the Hebrew, or any other of the oriental tongues, will enable a ftudent foon to make a very rapid progrefs in the Ethiopic. The pureft dialect of this tongue was that ufed in the kingdom of Tigré, where Axuma and the old Ethiopian kings refided. Upon the failure of the Zagæan line, a Sewan prince afcended the throne, upon which the Amharic dialect was introduced at court, and gradually diffufed over the whole empire. (See ABYSSINIA.) From comparing the ancient Ethiopic alphabet, as given by the learned Job Ludolfus, in his "Hiftory of Ethiopia," with the old oriental alphabets, it feems not improbable, that fome of them were derived from the old Affyrian, Phœnician, Samaritan, and Syriac characters. The number of letters likewife in this alphabet, and the names of feveral of them, tend to eftablifh the fame fuppofition; though Ludolfus believes thefe characters to have been invented by the Axumites or Ethiopians themfelves, and to be much older than even the Cufic character of the Arabs. The Ethiopians both write and read from the left hand to the right, contrary to the cuftom of the orientals: a circumftance which indicates that their alphabet was not entirely of the fame extraction with that of the Arabs.

The Ethiopians agreed in feveral points with the Egyptians, though they had many cuftoms peculiar to themfelves, fome of which were very fingular and uncommon. From this mutual agreement in moft of their laws, their fplendid funerals, the deification of their princes, the feveral colleges of priefts, circumcifion, and moft of their facred and civil inftitutions, it is highly probable that the fame arts, fciences, and learning, as well as religion, prevailed in both nations.

The Ethiopians were naturally bold and intrepid, but violent in their temper. They likewife furpaffed the people of moft other nations in beauty and fize, to which a proportionable degree of ftrength was generally annexed. According to various authors, the proper ancient Ethiopians were, in general, perfectly black, as we find their pofterity at this day, though thofe of fome particular cantons were white, called by Pliny white Ethiopians. Their women were ftrong and lufty, and brought forth their children with little pain. From the teftimony of Herodotus, compared with the relations of fome modern authors, it is not

 unlikely,

unlikely, that they died of old age, a few only excepted, who fell by the fword, or were devoured by wild beafts, as Salluft has obferved of the ancient Africans. Anc. Un. Hift. vol. xvi. See ABYSSINIA and CUSH.

ETHIOPIA, in *Modern Geography*, is a denomination including the countries of Nubia, Abyffinia, Abefh or Abex, and Anian, which are bounded by Egypt and the defart of Barca on the north; by the Red fea and the eaftern ocean on the eaft; by Zanguebar and Caffraria on the fouth; and by Guinea, Nigritia, and Zaara, on the weft. Neverthelefs, all the countries ftill, according to the ancient divifion, that lie almoft in a ftraight line from Egypt to the Cape of Good Hope, may be comprehended under the general name of Ethiopia. Ethiopia is divided into Upper and Lower, the former including Nubia and Abyffinia; and the latter comprehending all the kingdoms fouth of the equinoctial line, as Congo, Lower Guinea, Caffraria, Monomotapa, &c. which fee refpectively.

ETHIOPIC VERSION. See BIBLE, *Ethiopic*.

ETHIOPIC *Year*. See YEAR.

ETHLEC, in *Ancient Geography*, a town of Upper Mœfia, according to Antonine's Itinerary.

ETHMOID, or ETHMOIDAL, in *Anatomy*, a name given to one of the bones of the head. See CRANIUM.

ETHNARCHA, ETHNARCH, formed of ἐθνος, *nation*, and αρχη, *command*, a governor and ruler of a nation.

There are fome medals of Herod I. furnamed the *Great*, on one fide whereof is found Ηρωδου, and on the other Εθναρχου, q. d. *Herod* the *Ethnarch*. After the battle of Philippi, we read that Antony, paffing over into Syria, conftituted Herod and Phafael his brother tetrarchs, and in that quality committed to them the adminiftration of the affairs of Judea. (Jof. Ant. lib. xiv. cap. 23.) Herod therefore had the government of the province before ever the Parthians entered Syria, or before Antigonus's invafion, which did not happen till fix or feven years after Herod was commander in Galilee. (Jof. lib. xiv. cap. 24, 25.) Confequently Herod was then truly ethnarch, for he can be no otherwife denominated; fo that it muft have been in that fpace of time that the medals were ftruck, which only gave him this title: which medals are a confirmation of what we read in hiftory of the government which that prince was intrufted with before he was raifed to the royalty.

Jofephus gives Herod the appellation of tetrarch in lieu of that of ethnarch; but the two terms come fo near to each other, that it is eafy to confound them together.

Though Herod the Great left by will to Archelaus all Judea, Samaria, and Idumea, yet Jofephus tells us he was then only called ethnarch.

ETHNOPHRONES, in *Antiquity*, a fect of heretics in the feventh century, who made a profeffion of Chriftianity, but joined thereto all the ceremonies and follies of paganifm, as judicial aftrology, fortileges, auguries, and other divinations.

They derive their denomination from ἐθνος, *nation*, and φρην, *thought*, *fentiment*. q. d. *paganizers*, or perfons whofe thoughts or fentiments were ftill heathen or gentile.

They practifed all the expiations of the gentiles, celebrated all their feafts, and obferved all their days, months, times, and feafons. See Damafcenus, Hæref. N° 94.

ETHOLOGUS, among the *Ancients*, a mimic, or actor, who could reprefent all the various habits and difpofitions of the mind.

ETHOPŒIA, or ETHOPEA, in *Rhetoric*, called alfo *Ethology*, a draught or defcription, expreffing the manners, paffions, genius, tempers, aims, &c. of another perfon.

The word is of Greek original, being formed of ἠθος, *mos*, *confuetudo*, and ποιεω, *facio*, *fingo*, *defcribo*. Quintilian, lib. ix. cap. 2. calls this figure *imitatio morum alienorum*; and in Greek, μιμησις, *imitation*. In Englifh we denominate it a *picture* or *character*.

Such is that beautiful paffage in Salluft, in his "Bellum Catilinarium," wherein he gives us a picture of Cataline: "He had an uncommon ftrength both of body and mind, but an ill-turned and wicked difpofition. When very young, his great pleafure was in inteftine broils, rapine, flaughter, and civil difcord. His body was formed to undergo fafting, cold, and watching, beyond all belief. His mind was daring, deceitful, and various, and could imitate or accommodate itfelf to every body; he was extremely covetous of other people's goods, and profufe of his own. His lufts and defires were very high; his ftock of eloquence confiderable, but he had little or no difcretion."

The ethopœia is divided into *profopographia* and *ethopœia*, properly fo called; the former of which is a picture of the body, countenance, make, drefs, gait, &c. and the latter of the mind.

ETHULIA, in *Botany*, a name concerning whofe origin or meaning we have met with no conjecture. Linnæus its author rarely explained names of his own contrivance, nor is any thing upon this occafion mentioned in his fon's Decas Prima Plantarum, where *Ethulia* firft appeared. Could he poffibly allude to the remote country whence it came, as *e*, *extra*, (beyond) *Thule*, fuppofed by the ancients the uttermoft part of the earth? If the plant had been of American origin, fuch an appellation would, not inelegantly, have alluded to the famous prophecy in Seneca's Medea, fo expreffive of the difcovery of the weftern world, and ending

—— "nec fit terris
Ultima Thule."——

It was however fuppofed to come from Ceylon, and is actually a native of the banks of the Nile. If the above conjecture be inadmiffible, the name muft depend on its harmony for protection. Linnæus might well be glad to get rid of the harfh *Sparganophorus* of Vaillant, to which he would object as compofed of *Sparganium*, a generic name already eftablifhed. But it is probable he did not at firft obferve that Vaillant's genus was his *Ethulia*, though he foon recognized it. Linn. Gen. 413. Schreb. 545. Willd. Sp. Pl. v. 3. 1740. Mart. Mill. Dict. v. 2. Ait. Hort. Kew. v. 3. 158. Juff. 184. Gærtn. t. 164. (Sparganophorus; Vaill. Act. Paris. Ann. 1719. Gærtn. t. 165.) Clafs and order, *Syngenefia Polygamia-æqualis*. Nat. Ord. *Compofitæ difcoideæ*, Linn. *Corymbiferæ*, Juff.

Gen. Ch. *Common Calyx* rounded, fimple, of many linear, equal, fpreading-pointed fcales. *Cor.* compound, difcoid. Florets all fertile, numerous, uniform, tubular, funnel-fhaped, with fome fpace between them; their limbs five-cleft, erect. *Stam.* Filaments five, very fhort, capillary; anthers united into a cylindrical tube. *Pift.* Germen angular; ftyle thread-fhaped, the length of the ftamens; ftigmas two, recurved. *Peric.* none, except the permanent calyx. *Seeds* folitary, truncated, top-fhaped, five-fided, five-furrowed; crown none, except a prominent margin. *Recept.* naked, convex, dotted with minute excavations.

Eff. Ch. Receptacle naked. Seed-down none. Florets tubular, five-cleft, numerous. Scales of the calyx pointed.

This is but a vague and confufed genus, depending properly on the three following fpecies only.

1. E. *conyzoides*. Linn. Sp. Pl. 1171. L. fil. Dec. Pl. Rar. 1. t. 1. "Flowers panicled."—Seeds of this were fent

fent by Profeffor David Van Royen to Linnæus, who raifed them in his ftove at Upfal, and the plant proving new, was defcribed and figured by his fon, in a work of which only two fafciculi ever appeared. Linnæus fuppofed it a native of Ceylon, which may poffibly be correct. No new information appeared concerning it, till it was mentioned in the Hortus Kewenfis as fent by Thouin, and foon afterwards Vahl difcovered it to be the *Kahiria* of Forfkall, fo that we hence learn it to be certainly a native of the muddy banks of the Nile, where it flowers early in November. The *root* is annual, fibrous. *Stem* four feet high, alternately branched, hollow, downy, leafy. *Leaves* alternate, on fhort ftalks, lanceolate, pointed, equally ferrated, fragrant, downy beneath, three inches long; without ftipulas. *Flowers* pale blue, in compound corymbofe panicles about the tops of the branches, remarkable for the flender and diftant tubes of their florets. The *feeds* form an almoft globofe head; each of them is crowned with a pale undivided angular border.

2. E. *Sparganophora*. Linn. Sp. Pl. 1171. (Sparganophorus Vaillantii; Gærtn. v. 2. 395. t. 165.) "Flowers in feffile axillary clufters. Calyx-fcales recurved."—This we know only from the work of Vaillant, (from whom Linnæus adopted it,) and that of Gærtner; nor is its native country afcertained. The *leaves* are faid to be like thofe of Golden Rod. *Seeds* exactly like the laft in general ftructure, nor does there feem any doubt of their belonging to one and the fame genus.

3. E. *Struchium*. Swartz. Prod. 111. (Struchium; Browne Jam. 312. t. 34. f. 2.) Flowers axillary, feffile, moftly folitary. Calyx with ftraight fpinous points.—Gathered by Browne in Jamaica. *Stem* herbaceous, two or three feet high, leafy, fmoothifh. *Leaves* elliptic-lanceolate, four or five inches long, pointed, ftrongly ferrated, thin, very flightly pubefcent, on ftalks an inch in length. *Flowers* fmall, axillary, feffile, either folitary or in pairs, or if more together, they have fmaller leaves between them. We prefume the ftraight fpinous points of the calyx-fcales will afford a certain fpecific difference between this and the laft, whether their foliage be different or not.

In his firft Mantiffa, p. 110, Linnæus added three fpecies to his genus *Ethulia*. Of thefe *E. tomentofa* muft be entirely ftruck out of the fyftem, being no other than his own *Artemifia chinenfis*, and not having either the habit or characters of an *Ethulia*. The fecond is *E. divaricata*, Burm. Ind. 176. t. 58. f. 1. (Chryfanthemum bengalenfe anguftifolium pufillum, fummo caule ramofum; Pluk. Phyt. t. 21. f. 4.) Leaves linear, toothed, decurrent. Flowers folitary, ftalked, terminal. Stem divaricated.—Native of rice-fields in Malabar. *Koenig*. *Root* annual. *Stem* three or four inches high, erect, much branched in a corymbofe manner; branches leafy, quadrangular, winged, fomewhat cottony. *Leaves* alternate, linear-lanceolate, toothed, running down into the wings of the branches. *Flowers* on fhort, fimple, folitary, terminal ftalks; *Calyx* of numerous, imbricated, fharp and fomewhat fpinous, fpreading, purplifh fcales. *Seeds* without any crown.—We have, as Willdenow has already done, prefumed to correct the defcription of Linnæus, and his quotation of Burmann. Linnæus moreover quotes his own *Artemifia minima*, Sp. Pl. ed. 1. n. 19, with the original fpecimen before him, for this *Ethulia*, but very erroneoufly, and his citation of Burmann is fo placed as to imply that he had committed the fame fault, which is not true. We cannot but obferve here that Burmann in his Flora Indica has copied *E. conyzoides* and *E. Sparganophora* from Linnæus, without any real knowledge of them, fo that his authority is of no avail refpecting thofe fpecies. Gærtner, v. 2. 389. t. 164, retains this *E. divaricata* as the only real *Ethulia*, adding a good fynonym from Plukenet (who figures the plant twice), Chryfanthemum parvum ramofiffimum, membranaceo caule maderafpatenfe; Pluk. Phyt. t. 160. f. 5. Gærtner therefore preferves the name and genus of Vaillant's *Sparganophorus*, which he contends is a very diftinct genus from this plant. In the laft particular he appears to be right, but the above three fpecies unqueftionably conftitute what Linnæus meant by *Ethulia*, and they only agree with his generic defcription, fo that the *divaricata* ought perhaps to be referred, notwithftanding its want of a feed-crown, to the *Grangea* of Adanfon and Juffieu, as the latter fufpects, or rather to make a genus by itfelf. (See GRANGEA.) Juffieu indeed preferves Browne's *Struchium* as a genus, but, as we prefume, improperly.

One more fuppofed *Ethulia* remains to be noticed, named *bidentis*, Mant. 110, from its refemblance to *Bidens tripartita*. This has nothing to do with the genus under confideration, being the very identical *Flaveria capitata* of Juffieu, of which we fhall fpeak under that name hereafter. It is a native of Chili.

With the *Ethulia uniflora* of Walter and Willdenow we are not at all acquainted. S.

ETIENNE, in *Biography*, the name of a family who have been celebrated as learned printers, and are more commonly known by the epithet of Stephanus, or in Englifh by that of the learned Stephens. The founder of the family was Henry, a printer at Paris. He is chiefly diftinguifhed as the editor of a Pfalter, in which the compofitions were divided into verfes, and diftinguifhed by figures, being the firft book of Scripture in which this practice was obferved. He died at Lyons, leaving behind him three fons, all eminent printers, of whom the fecond was,

ETIENNE, ROBERT. This young man worked at firft under Simon de Colines, who had married his mother, and then fet up in bufinefs for himfelf at Paris. He had received a very liberal education, and was well acquainted with the ancient languages, and was deeply fkilled in principles of found criticifm. He carried the art of typography to a very high pitch of excellence, as a number of his books well known at prefent will teftify. His office is faid to have refembled a learned feminary, in which the Latin language was the only one allowed to be fpoken by all the perfons employed by him. He eftablifhed an early reputation by the editions of the bible in different languages. He was the firft perfon who introduced the divifion of the whole into verfes; of which, we are informed, he made the neceffary preparations, as he was on a journey on horfeback from Paris to Lyons. Thefe divifions have been ufeful as marks for reference, but in other refpects they have been injurious to the work, on account of the faultinefs of the divifions which not unfrequently give a wrong fenfe to important paffages of the facred writings. In the year 1532 he publifhed his excellent "Thefaurus Linguæ Latinæ" in two volumes folio. This work obtained a very high reputation, and has paffed through many editions: the beft are faid to be that printed in London in 1734, and the one printed at Bafil in 1740. Both editions confift of four volumes folio. In the year 1539 the reputation of Robert attracted the attention of Francis I. who reimburfed him fome of his expences in procuring manufcripts and founding new types, and gave him the honour of king's printer for Greek and Latin books. At the reformation this worthy printer, in common with many biblical critics, fell under the fufpicion of herefy, and endured a long perfecution excited by the doctors of the Sorbonne, who, in the year 1548 unanimoufly decreed that

that his bible with a verfion by Leo Judæ, and notes, ought to be fuppreffed, and placed in the lift of prohibited books. By many liberal and refpectable perfons Etienne was fupported againft the fanaticifm of bigots and priefts, but, at length, he thought it advifeable to withdraw to Geneva, where he more openly avowed himfelf a friend to the reformed religion. He felt himfelf called on to vindicate his conduct, and publifhed an apology, in which he retaliated upon his perfecutors, and the church, by whom he had been driven into a kind of exile. At Geneva he continued to follow his profeffion, and publifhed many books in favour of the Proteftant caufe. He was elected burgher of Geneva, and lived in habits of friendfhip with Beza and Calvin. He died in the year 1559, at the age of fifty-fix. He has been, fince his death, to the prefent day, the theme of admiration with the learned, and by the illuftrious De Thou he was confidered as better entitled to the gratitude of his country, by the perfection which he gave to the art of printing, than thofe warriors who had extended the boundaries of the French empire. Moreri.

Etienne, Charles, a phyfician of the faculty of Paris, who is confidered by his biographers as an honour to the age in which he lived, in confequence of the extent and variety of his attainments. He was born about the year 1503. His father, Henry Etienne, and his brothers, Francis and Robert, were all celebrated for the ingenuity with which they cultivated the art of printing. But this family was not lefs unfortunate than ingenious; for, being attached to the caufe of the Proteftant reformation, fome of them were banifhed from France, and others died in prifon. Charles, however, during thefe troubles, lived and flourifhed at Paris, where he had for many years practifed his profeffion, when his brother Robert became the object of perfecution, and fled to Geneva. He immediately undertook the fuperintendence of his printing-office, which he continued to manage for feveral years, in the hope of effecting the reftoration of his brother, practifing medicine at the fame time with his former diftinction and fuccefs. Robert died at Geneva, however, in 1559; and Charles terminated his life unfortunately, a few years afterwards, having died in a dungeon in 1564, at the age of about fixty.

Dr. Etienne, the fubject of this article, made feveral difcoveries of minor importance in anatomy, which had efcaped his predeceffors, efpecially Galen, of whom he was a great admirer; he publifhed fome anatomical figures, the execution of which, however, was claimed by a furgeon of the name of Riviere, and generally allowed to be his; but the explanations were admitted to be Etienne's. He publifhed a great number of works, fome of which have no connection with his profeffion, efpecially the hiftories of Lorraine, of Flanders, and of the dukes of Milan. The works relative to medicine, befides the anatomical book juft mentioned, were principally on botanical fubjects. He alfo wrote a volume, confifting of three books, "De Nutrimentis," Paris, 1550. Eloy.

Etienne, Henry, the fon of Robert, was born at Paris in 1528, and became diftinguifhed as one of the moft learned men of his time. His father fpared neither pains nor expence in his education, and the youth had a great facility in acquiring the Greek language. At the age of eighteen he affifted his father in collating the MSS. of Dionyfius Halicarnenfis. After he had performed this bufinefs he fet out on his travels; ftaid fome time in Italy, where he became well acquainted with the learned men of that country, and obtained much valuable information from the Italian libraries. From Italy he came to England, and from thence he paffed through the Low Countries in his way to Paris, whither he returned at the moment his father was driven from that city. Here he followed the united profeffions of printer and editor. In 1554 he publifhed the Odes of Anacreon from the MSS. which he found in Italy. He accompanied his edition with fragments of Sappho and other lyric poets, and with an elegant metrical verfion. To him the learned are likewife indebted for various other Greek authors, publifhed from MSS. which he had collected in his travels, all of which he corrected and enriched with valuable annotations. In 1572 he publifhed his "Thefaurus Linguæ Græcæ," in four volumes folio, a capital companion to the Latin Thefaurus by his father. Scapula made an abridgement of this vaft work, which greatly hindered the fale of the original, and thus defrauded the learned author of the recompence to which he had the moft folid claim. This valuable man was protected by Henry IV. of France, who was fo far attached to him, that he employed him in a work entitled "Sur la precellence de la Langue Francoife." He was, however, too deeply imbued with the liberal principles which real literature almoft always infufes in the minds of her votaries, to efcape the malice of the monks. They brought a profecution againft him for his "Preparation á l'Apologie pour Herodote." Apprifed of his great danger, and well knowing the rancour of his enemies, he fled from the city and took refuge in the mountains of Auvergne. Scarcely had he left the city, when finding that he had efcaped their cruel fangs, they burnt the excellent man in effigy, regretting, no doubt, that they had not his perfon on which to wreak their vengeance. After this Etienne refided chiefly at Geneva, though he made occafional vifits to his literary friends in Germany and France. He was fubject to many difficulties, and doomed to other and fevere perfecutions, which at length fo far broke his fpirits as to caufe derangement, and in this ftate, as well as in poverty, he died at an alms-houfe at Lyons in 1598. Befides editing the Poetæ Græci Principes; Maximus Tyrius; Diodorus Siculus; Medicæ artis Principes poft Hippoc. and Galen; and the Nov. Teft. Græc., to which he prefixed an admirable preface; he was author of fome excellent pieces, befides what have been already mentioned; *viz.* Dialogues "De bene inftituendis linguæ Græcæ ftudiis;" "De criticis veteribus Græcis et Latinis," and other pieces in the French language, as well in verfe as in profe. He was a man of many fingularities, but truly refpectable, and highly refpected. He left feveral children, of whom his fon Paul fucceeded him in his Genevan printing-office, and inherited a fhare of his reputation. Moreri.

Etienne, *Saint*, in Latin *Fanum Sancti Stephani*, or *Furania*, in *Geography*, a confiderable town of France, in the department of the Loire, chief place of a diftrict of the fame name, with a population of 16,259 individuals. It is fituated on the river Furan, 36 miles S.W. of Lyons, and 348 miles S. by E. of Paris. N. lat. 45° 22'. The town is divided into two cantons, Eaft and Weft, the former with three communes and 12,735 inhabitants, the latter with three communes and 14,669 inhabitants; the whole canton has a territorial extent of 92½ kiliometres. There are at Saint Etienne and in the neighbourhood feveral manufactures of fwords and fire arms, cutlery, and hardware of all forts, ribbands, filks, and good bleaching grounds. The diftrict abounds with coal-mines, and the proximity of two large rivers, the Rhône and Loire, affords great facility for the tranfport of the produce of the manufactures.

As chief place of a diftrict, Saint Etienne has a fub-prefect, two courts of juftice, and a regifter office. The diftrict contains 9 cantons, 76 communes, and 99,261 inhabitants,

ants, on a territorial extent of $1142\frac{1}{2}$ kiliometres.—Alſo, a ſmall town of France, in the department of the Maritime Alps, chief place of a canton in the diſtrict of Puget-Theniers, with a population of 1689 individuals; its canton has a territorial extent of $212\frac{1}{2}$ kiliometres, and three communes, with 3089 inhabitants.

Etienne *de Baigorry*, *Saint*, a town of France, in the department of the Lower Pyrenées, chief place of a canton in the diſtrict of Mauléon, with a population of 6187 individuals. The canton contains 10 communes and 10,939 inhabitants, on a territorial extent of 210 kiliometres.

Etienne *de Cuines*, *Saint*, a ſmall town of France, in the department of Montblanc, chief place of a canton in the diſtrict of St. Jean de Maurienne, with a population of 830 individuals. The canton has a territorial extent of $117\frac{1}{2}$ kiliometres and 6 communes, with 6496 inhabitants.

Etienne *de Lugdarès*, *Saint*, a ſmall town of France, in the department of the Ardèche, chief place of a canton in the diſtrict of l'Argentiere, with a population of 1509 individuals. The canton has ſeven communes and 3439 inhabitants, on a territorial extent of 185 kiliometres.

Etienne *de Montluc*, *Saint*, a town of France, in the department of the Lower Loire, chief place of a canton in the diſtrict of Savenay, with a population of 4118 individuals. The number of the inhabitants of the canton amounts to 12,453; they are diſperſed in five communes, on a territorial extent of $272\frac{1}{2}$ kiliometres.

Etienne *de Saint Geoire*, *Saint*, a ſmall town of France, in the department of the Iſère, chief place of a canton in the diſtrict of St. Marcellin. It has 1546 inhabitants, and its canton compriſes, on a territorial extent of $162\frac{1}{2}$ kiliometres, 13 communes, with a population of 9381 individuals.

Etienne *en Dévoluy*, *Saint*, a ſmall town of France, in the department of the Upper Alps, chief place of a canton in the diſtrict of Cap, with only 766 inhabitants: but the canton has four communes, and a population of 2184 individuals, on a territorial extent of $262\frac{1}{2}$ kiliometres.

Etienne *les Orgues*, *Saint*, a ſmall town of France, in the department of the Lower Alps, chief place of a canton in the diſtrict of Forcalquier, with a population of 984 individuals. The canton has a territorial extent of $272\frac{1}{2}$ kiliometres, 12 communes, and 4260 inhabitants.

ETIOLATION *of Plants*, in *Gardening*, the rendering them white, criſp, and tender, by excluding the action of light from them. See Blanching.

ETIQUETTE, a French term, primarily denoting a ticket or title affixed to a bag or bundle of papers, expreſſing its contents. It is alſo uſed when applied to the Spaniſh and ſome other courts, to ſignify a particular account of what is to be done daily in the king's houſhold, and in the chief ceremonies relating to it. It likewiſe denotes thoſe forms that regulate the decorum of conduct towards perſons of various ranks and ſtations.

ETIVAZ in *Geography*, a ſmall town of Switzerland, in that part of the canton of Berne which is called the Ober Land, or Upper Country, being at the foot of the higheſt Alps, and extending to the glaciers, or ice mountains. It is ſituated in the diſtrict of Geſſenay, and is remarkable for its mineral ſprings, the water of which has a ſulphureous taſte.

ETLINGEN, or Ettlingen, a ſmall town of Germany, in the grand duchy of Baden, ſituated on the river Alb, between Pfortzheim and Raſtadt, at the diſtance of 12 miles from each. N. lat. 48° 55′.

ETMARSHAUSEN, or Etmershausen, a ſmall town of Germany, in the duchy of Saxe Coburg, in the diſtrict of Saltzungen, remarkable only for the following inſcription, which is engraved on an old garden gate of ſtone, in Latin characters: "wer weiſz obs wahr iſt," (who knows whether it be true.) It is become a proverbial ſaying in that part of Saxony, and frequently uſed as a polite inſinuation that a perſon is ſuſpected of having rather deviated from or embelliſhed the truth; people then obſerve that what has been related is engraven at the garden gate at Etmarſhauſen. The origin, occaſion, or motive of the inſcription itſelf, has never yet been explained, and has puzzled ſeveral antiquaries of the neighbourhood.

ETMASER, a town of Arabia, in the province of Yemen; 36 miles N. of Chamir.

ETMULLER, Michael, in *Biography*, an eminent phyſician, was born at Leipſic on the 26th of May, 1644. Poſſeſſing a taſte for the ſciences which his native city afforded him the moſt ample means of cultivating, he diligently ſtudied under the celebrated profeſſors of that period. He afterwards ſpent a conſiderable time in travelling through France, England, Holland, Italy, and Germany, with a view to the farther acquiſition of knowledge; and on his return took the degree of doctor of medicine at Leipſic in Auguſt 1668. In the year 1676, he was appointed profeſſor of botany in that univerſity, and extraordinary profeſſor of ſurgery and anatomy. He fulfilled thoſe offices with great applauſe; and his death, which happened on the 9th of March, 1683, when he was but 39 years of age, was generally regretted by the faculty of Leipſic. The diſorder, which occaſioned it, was contracted while he was employed in ſome chemical experiments. He was a very voluminous writer, and his works were deemed ſufficiently intereſting at the time of their publication to be tranſlated into moſt of the European languages. His medical practice and opinions were built upon the theory of Sylvius de la Boë, and the chemical ſect.

Etmuller, Michael Ernest, ſon of the preceding, was born at Leipſic on the 26th of Auguſt, 1673; and, after having ſtudied at Zittau, Altemberg, and other ſchools of Germany, he took the degree of doctor of medicine at his native place, in 1697. He afterwards travelled to the moſt eminent univerſities of Europe, and became ſucceſſively profeſſor of anatomy, of philoſophy, and of pathology at Leipſic. He had likewiſe been two years director of the Academia Naturæ Curioſorum, when his death occurred, on the 25th of September, 1732. He has left ſome diſſertations of his own, but is chiefly known as the editor of the works of his father.

ETNA. See Ætna.

ETOBESA, or Etobema, in *Ancient Geography*, a town of Spain, in Edetania, mentioned by Livy under the name of Etoviſſa, and ſituated at ſome diſtance W. of Valencia.

ETOCETUM, a place in the iſle of Albion, according to the Itinerary of Antonine, which Gale fixes at Wall, near Litchfield.

ETOILE, in *Geography*, a town of France, in the department of Drôme, and diſtrict of Valence; 3 leagues N.W. of Creſt.

ETOLIA. See Ætolia.

ETON, in *Geography*, a large village in the hundred of Stoke, and county of Buckingham, England, is noted for its great public ſeminary, or college, in which many eminent ſtateſmen, authors, military heroes, &c. have received their ſcholaſtic education. This college was originally founded by king Henry the Sixth, in the year 1440, for a provoſt, ten prieſts, four clerks, ſix choriſters, twenty-five poor grammar-ſcholars, and twenty-five poor men. The firſt provoſt was Henry Sever, who was ſucceeded by William Waynfleet, founder of Magdalen college, Oxford. This foundation was particularly excepted in the act for the diffolution of colleges and chantries, in the time of Edward VI. Its eftablifhment, however, has been in fome degree altered, and now confifts of a provoft, feven fellows, two fchoolmafters, two conducts, feven clerks, feventy fcholars, and ten chorifters, befides inferior officers and fervants. The annual election of fcholars to King's college, Cambridge, founded alfo by Henry VI. takes place about the end of July, or the beginning of Auguft, when twelve of the fenior boys are put on the roll to fucceed in this college as vacancies occur. The average number of vacancies are about nine in two years: at nineteen years of age the fcholars are fuperannuated. Eton college alfo fends two fcholars to Merton college, Oxford, where they are denominated poftmafters. It has a few exhibitions, of twenty-one guineas each, fo its fuperannuated fcholars, towards whofe affiftance Mr. Chamberlayne, a late fellow, has bequeathed an eftate of 80*l. per annum*, after the death of his widow. The fcholars elected to King's college fucceed to fellowfhips at three years' ftanding. The independent fcholars at Eton, commonly called Oppidans, are very numerous; the average number having been for feveral years paft from 300 to 350: when Dr. Bernard was mafter, under whom the fchool particularly flourifhed, the number at one time exceeded 520. Among the many diftinguifhed perfons who received their education here we find the names of bifhop Fleetwood, bifhop Pearfon, John Hales, Dr. Stanhope, fir Robert Walpole, Horace Walpole, Oughtred the mathematician, Boyle the philofopher, Waller, Gray, Weft, the late earls Camden and Chatham, and the late learned Jacob Bryant; with many other eminent literary and public characters of the prefent day.

An ancient cuftom, appertaining to this college, called the "Montem," or "Ad montem," muft not be paffed unnoticed. This is a proceffion of all the fcholars, &c., made every third year on Whit-Tuefday, to a tumulus, which has acquired the name of *Salt-hill*, by which alfo the neighbouring inns have been long known. The chief object of this ceremony is to collect money for *falt*, as the phrafe is, from all perfons prefent, even from paffengers travelling the road. The collecting fcholars are called falt-bearers, and are dreffed in rich filk habits. This ceremony has been frequently honoured with the prefence of the king and royal family, whofe liberal contributions, added to thofe of the nobility and gentry educated at Eton, who purpofely attend this meeting, have fo far augmented the collection, that it has been known to exceed 800*l.* The fum fo collected is given to the fenior fcholar who is going to Cambridge for his fupport at the univerfity. It would perhaps be a vain endeavour to trace the origin of all the circumftances of this fingular cuftom, particularly that of collecting money for *falt*, which has been in ufe for time immemorial. The proceffion itfelf feems to have been coeval with the foundation of the college, and it has been conjectured, with much probability, that it was that of the bairn or boy bifhop. It is fo afferted in a note among the MS. collections bequeathed to the Britifh Mufeum by Mr. Cole, who was of Eton and King's college: but whence he procured this information, which, if correct, might be decifive, does not appear. The cuftom of hunting a ram by the Eton fcholars on Saturday in the election week, fuppofed to have been an ancient tenure, was abolifhed by the late provoft Dr. Cooke.

Eton college confifts of two quadrangles: in the firft are the fchool, the chapel, and lodgings for the mafters and fcholars. The other is occupied by the library, the provoft's lodgings, and the apartments of the fellows. The chapel, as far as relates to its external appearance, is a very handfome ftructure; the infide has none of that ornamental architecture fo much admired in King's college chapel at Cambridge, to which this has fometimes been compared, but is quite plain, and has been much disfigured by fome injudicious alterations, made in the beginning of the laft century, when feveral of the monuments were removed, and others concealed behind the wainfcot then placed at the eaft end. The whole length of the chapel is 175 feet, including the ante-chapel, which is 62 feet long. Among the eminent perfons who are buried in this chapel, are Richard, lord Grey of Wilton, henchman to king Henry VIII.; John Longland, bifhop of Lincoln, confeffor to that monarch; fir Henry Saville, the learned warden of Merton, and provoft of this college, who founded the Savilian profefforfhips of aftronomy and geometry at Oxford; fir Henry Wotton, an eminent ambaffador and ftatefman, who was alfo provoft of Eton; Francis Rowfe, a diftinguifhed writer among the puritans, and one of the lords of Cromwell's upper-houfe, who died while provoft of Eton in 1658; Dr. Alleftree, alfo provoft, an eminent royalift, who built the new or upper fchool, with the cloifters beneath, at the expence of 1500*l.*, and died in 1680; and Nathaniel Ingelo, who died in 1683. The monuments of fome of the above-mentioned perfons are not now to feen. Sir Henry Wotton's tomb has the following fingular infcription:

> "Hic jacet hujus fententiæ primus auctor—
> Difputandi pruritus fit ecclefiarum fcabies"
> "Nomen alias quære."

In the ante-chapel is a ftatue of the founder, by Bacon, erected in 1786; the fum of 600*l.* having been bequeathed for that purpofe by the Rev. Edward Betham, fellow of the coll ge, who died in 1783: and a monument of the young earl of Waldegrave, who was drowned when at Eton fchool, in 1794.

The college library contains a very large and valuable collection of books, having been from time to time enriched by munificent bequefts.

In 1452 the college had a charter for a market on Wednefdays, with confiderable privileges; but it has been long difufed. Two fairs were granted by the charter of 1444: one for the three days following Afh-Wednefday, the other for fix days next after the 13th of Auguft. There is now only one fair, held on Afh-Wednefday. The parifh church of Eton, called in ancient records Eton-Gildables, having been fuffered to fall to decay, the inhabitants are permitted to attend divine fervice in the college chapel. The provoft is always rector, and has archideaconal jurifdiction within the parifh. There is a chapel of eafe in the village ferved by one of the conducts of the college; it was built for the ufe of the inhabitants by William Hetherington, who had been one of the fellows, and was a very liberal benefactor to the blind and to the poor of other defcriptions.

Eton is fituated on the northern banks of the Thames, oppofite to Windfor, with which it is connected by a bridge. It is 22 miles diftant from London; confifts chiefly of one ftreet; and contains 290 houfes, and 2026 inhabitants. Lyfons's Magna Britannia, vol. i. Beauties of England and Wales, vol. i.

ETORPU, one of the Kurifkoy or Kurile iflands, lying 30 verfts from Urup; and about 300 verfts in extent. The whole ifland is covered with lofty mountains; one of which, at the northern extremity, emits a continual fmoke, and occafionally flames. The fummits of the mountains are bald, with fteep cliffs and heaps of rubbifh. Here are forefts, confifting of the fame trees with thofe of the ifland Urup.

Urup. In the fouthern half, near about the centre of the ifland, grew larch-trees, in the proximity of the fea, but flender, though further inland, in the plains of the vallies, good timber trees, fit for the purpofes of building. Here are likewife black bears, and in the forefts fables and foxes are met with. Of rats there is no fcarcity; fifh-otters haunt the ftreams; and the brooks abound in fifh. During the ftorms that happen here, whales and large dolphins are thrown afhore by the fea. The fea-otter is not feen here, but fea-lions, though not of any great dimenfions. The inhabitants are hairy Kurils, who dwell together in villages. They are numbered in the capitation-tax at 92 perfons.

ETRETPAGNY, or Estrepagni, a fmall town of France, in the department of the Eure, chief place of a canton in the diftrict of Les Andélys, with a population of 1201 individuals. It is fituated 9 miles from les Andélys, and 9 miles W. of Gifors; its canton contains 10,442 inhabitants, difperfed in 26 communes, on a territorial extent of 140 kiliometres.

ETRIGNY, a town of France, in the department of the Saone and Loire, and diftrict of Chalons fur-Saone; $3\frac{1}{2}$ leagues S. of Chalons.

ETRIS, a town of Egypt; 18 miles N.W. of Cairo.

ETROEUNG, a town of France, in the department of the North, and diftrict of Avefnes; $1\frac{1}{4}$ league S. of Avefnes.

ETRURIA, in *Ancient Geography*, a country of Italy, feparated on the weft from Liguria by the river Macra; from Latium and Umbria on the eaft by the Tiber; on the north-eaft by a part of the Apennines from the country of the people called Boii and Senones; and on the fouth-weft wafhed by a portion of the Mediterranean fea, called Mare Tufcum, or Tyrrhenum, the Tyrrhenian fea. This country was once more extenfive than the prefent Tufcany, as it reached as far as the Tiber. The inhabitants of Etruria, who for a long time poffeffed a great part of Italy, were denominated Tufci or Etrufci. (See Etrusci.) The principal rivers of this country were the Arnus, the Umbro, the Clanis, and the Tiber. The chief lakes were the Lacus Trafimanus, and Vulfinienfis. Among the moft confiderable cities we may reckon Luna, Pifæ, Luca, Pittoria, Florentia, Fefulæ, Portus Herculis, Labronis, Voluterræ, Sena Julia, Arretium, Cortona, Perufia, Clufium, Vetularii, &c. &c.

Etruria, in *Geography*, a country fituated between the Mediterranean, the Tiber, and the Apennines; bounded on the eaft by the dominions of the pope, on the north and north-eaft by the kingdom of Italy, on the weft by the republic of Lucca, and on the fouth-weft by the Mediterranean; about 115 miles in length, and 80 in breadth. The face of this country is beautifully varied with hills and vallies, and the foil which is rich and fertile produces abundance of corn, and excellent fruit, oranges, lemons, olives and grapes. The air is in feveral parts rendered infalubrious by fens and moraffes; the falt-pits are rich. Manna is gathered in the marfh-lands near the fea; and the mountainous parts are rich in mines and minerals. Several medicinal fprings have been difcovered befides thofe of Pifa. Arno is the principal river; and Florence is the capital. After feveral revolutions, Etruria became a republic, and deriving its name from its capital, was called Florence. And in this republic the Medici family obtained by commerce the wealth and rank of princes. It was alfo denominated *Tufcany*, which fee; and in 1569, Cofmo I. was declared duke of Tufcany by pope Pius V., which title was ratified by the emperor Maximilian II. in the year 1575, on condition of his enjoying and holding it as a fief of the empire. By the fifth article of the quadruple alliance, made in 1718, it was ftipulated that, with the confent of the Germanic body, the emperor fhould confer it as a fief on the king of Spain's eldeft fon by the fecond marriage, and that it fhould devolve to his male defcendants, and on their failure to the younger brother and his heirs. In 1737 the duchy of Tufcany became annexed to the houfe of Auftria. By the fifth article of the treaty of Luneville in 1801, the duchy of Tufcany was ceded to the duke of Parma, and erected into a kingdom, under the name of Etruria. It has fince been annexed to the kingdom of Italy.

ETRUSCA Terra, in the *Materia Medica*, a kind of bole of which there are two fpecies, the white and the red; thefe are called by many authors the *terra figillata alba & rubra magni ducis*, as they are brought to us fealed with different impreffions.

The *white Tufcan earth* is a denfe and compact fubftance of a dull deadifh white, which in drying acquires fome degree of yellownefs; it is of a fmooth furface, and does not ftain the fingers in handling. It is not eafily broken, and but flightly adheres to the tongue, and freely melts into a fubftance like butter in the mouth. It makes a flight effervefcence with acid menftruums.

The *red Tufcan earth* is a pure bole, very heavy, and of a compact texture, and of a dull brownifh red colour. It is naturally of a fmooth furface, breaks eafily between the fingers, and does not ftain the hands; it adheres ftrongly to the tongue, and melts freely in the mouth, and has a ftrong aftringent tafte, and leaves no fandy harfhnefs between the teeth. It makes an effervefcence with acid menftrua. This is made up of fmall flat cakes, and impreffed with a fhield bearing a ducal coronet, &c. Thefe are the characters by which both thefe earths may be known from others of the fame colour: they are both dug in feveral parts of Italy, particularly in the neighbourhood of Florence: they are kept in the fhops there, and prefcribed with fuccefs in fevers of many kinds, and in diarrhœas, dyfenteries, and the like cafes.

ETRUSCI, Etruscans, in *Ancient Geography*, a people of Italy, who inhabited that part which is now called Tufcany; though it was formerly much more extenfive under the name of *Etruria*. The Etrufcans, in very ancient times, are fuppofed to have been mafters of almoft all Italy; for the whole region called Italia by the Latins was denominated by the more ancient Greeks Tyrrhenia, according to Dionyfius Halicarnaffenfis (Antiq. Rom. lib. i.); whence it is inferred, that it was formerly fubject to the Tyrrhenians, or Etrufcans, and from them received that denomination. Livy and Plutarch intimate, that the feas, which partly furround Italy, *viz.* the Tyrrhenian, Ionian, and Adriatic, were anciently denominated the Etrufcan fea; and that the Etrufcans poffeffed the whole large tract extending from the Alps to the ftraits feparating Italy from Sicily. They built twelve cities beyond the Tiber, which were afterwards the boundary of Etruria Proper on one fide; and they were the founders of Nola and Capua, and poffeffed twelve capital cities in the tract terminated by th Po and the Alps. Virgil and Silius Italicus rank Cæfena and Mantua among the cities of Etrufcan extraction; and we learn from Livy, that this ancient nation in very early times occupied the whole tract between the Alps and the Apennines. According to Pliny, Bononia, or Bologne, was anciently regarded as the principal city of Etruria; and we may obferve, that many Etrufcan relics and fragments of antiquity have been dug up in various provinces of the kingdom

dom of Naples, Verona, Padua, &c. as well as the duchy of Tufcany, or the Proper Etruria. The kingdom of Latium was probably a colony of the Etrufcans; and the firft traces of the city of Rome may poffibly have been owing to that nation. However, in procefs of time, the Gauls made feveral irruptions into Etruria, and feized upon that part of it which lay between the Alps and the Apennines. The firft of thefe irruptions happened about 600 years B.C. and the laft a little before the taking of Rome by Brennus. Several colonies of Greeks made fettlements in the fuperior part of Etruria; and from them it was denominated Magna Græcia. The Etrufcans were likewife difpoffeffed of a large extent of territory by the Samnites and Ligurians, long before they fubmitted to the Romans; fo that at laft they found themfelves confined within the limits of Etruria Propria, where for feveral ages they made a very confiderable figure. Etruria was called by the moft ancient Greeks Tyrfenia; but Polybius, and thofe who lived after him, denominated this country Tyrrhenia. Tyrfenia is faid to be the true name, as it correfponds with that of the Lydian prince, Tyrfenus, under whofe conduct, according to Herodotus, the Tyrfeni, or Tyrrheni, firft made a fettlement in Italy. Etruria was divided into twelve ftates or dynafties, each of which had its peculiar city. Each ftate or tribe was governed by its own prince, called in the Etrufcan language "Lucumo," and received its denomination from the capital city. See ETRURIA.

The Tyrfeni, or Etrufcans, were a branch of the Pelafgi, that migrated into Europe, according to Dionyfius Halicarnaffenfis, not many ages after the difperfion. Thofe who marched by land as far as Lydia detached a colony under the conduct of Tyrfenus to Italy. This colony feems to have been joined by a body of Pelafgi, previoufly fettled in fome of the iflands of the Archipelago. Hence fome have concluded that the Lydian Pelafgi, or Etrufcans, conducted by Tyrfenus into Italy, and the firft Pelafgi that inhabited Greece, were the fame people; but Dionyfius Halicarnaffenfis makes the Tyrfenians and Pelafgi two different nations. The Etrufcans denominated themfelves Rafeni, from their leader Rafan, or Rafen; and Tyrfenus, or Tyrfen, is faid to be only the name Refen, with the fervile letter T fuperadded. This circumftance ferves to evince, not only that the Etrufcan name of the people under confideration agreed with that of the Greeks, but likewife that they were both of oriental extraction. See PELASGI.

The Etrufcans feem to have derived their appellation from Etruri, or Etuni, as they were anciently denominated; and that this appellation was deduced from Athuria, or Aturia, that of their parental country, may be proved from Dionyfius Halicarnaffenfis, Strabo, and Dio. Moreover, Aturia and Affyria differ merely in dialect; the former being equivalent to the Chaldæan word אתוריא, and the latter to the Hebrew אשור, as may be evinced from Bochart (Phaleg. L ii. c. 3.) and others. Since, therefore, nothing is more frequent than the permutation of A and E in oriental words, efpecially when written in Greek letters, Atura and Etura muft be regarded as the fame word, and as the ancient name of Etruria. More efpecially if we confider that Refen was a city of Aturia or Affyria, whence, probably, the leaders of the Etrurian or Etrufcan colony were denominated Rafeni, or Refeni; and that, from the facred hiftorian, we may conclude Afhur to have been the brother of Lud, or great anceftor of the Lydians. The term Tufci, or Thufci, is of a later date, and feems to have been given to the Etrufcans by the Greeks. The facrifices, or ufe of frankincenfe, that prevailed among the Tufcans in after ages, probably fuggefted this appellation to that people.

As each of the twelve tribes, or cantons, called in the Tufcan language "Lucumonin," was governed by its own prince, a king prefided over the whole; and whilft the lucumo affumed the adminiftration of affairs in his own province, the king was confulted on all extraordinary occafions, and convened the general diet of the twelve nations on all preffing emergencies. This diet was held at the temple of Voltumna, which was a celebrated city of Etruria, feated on the fpot which is occupied, according to Cluverius, by the prefent city of Viterbo; and in this temple meafures were concerted for making war upon, or concluding peace with their neighbours. Although the power of each lucumo was limited, the Etrufcan kings feem to have been vefted with a fort of abfolute authority, confonant to the firft oriental form of government.

Some of the principal Tufcan laws were fuch as follow: 1. By the original conftitution of Etruria, no fingle ftate, or lucumony, could enter upon a war, or conclude a peace, with any neighbouring power, without the participation of the whole Etrufcan body. 2. The Etrufcans, by a particular law (Athen. Deipnof. l. i. p. 23.) admitted their women to all nocturnal entertainments; in which they were afterwards followed by the Romans. 3. They obliged themfelves to treat all foreigners with the utmoft humanity. 4. They gave all poffible encouragement, as it fhould feem, by virtue of their conftitution, to all polite arts and artificers. 5. In order to deter people from contracting larger debts than they were able to pay, the Tufcan boys, by way of ridicule, followed all infolvent debtors with an empty purfe. 6. They muft have had many good moral inftitutions, fince from them the Romans received a fupplement to their Twelve Tables. 7. The jura fecialia were firft obferved by the Etrufcans. 8. The Etrufcan polity, in general, feems to have been founded upon maxims of the moft confummate wifdom, as may be collected from Ariftotle, and Heraclides Ponticus in Athenæus's Deipnos.; to which the curious reader may be referred for further information.

The religion of the Etrufcans was a grofs and multifarious idolatry. In common with the ancient Greeks, and Phœnicians, they worfhipped the Cabiri, or Dii magni majorum gentium. They were alfo initiated in the Samothracian or Cabirian myfteries.

Befides the Greek and Roman deities, they had feveral peculiar to themfelves; fome of which were confined to particular towns or diftricts. The divine fervice and facred myfteries of the old Etrufcans agreed, in feveral points, with thofe of the Greeks, but in others differed from them, and thefe they communicated to the Romans long before that nation had any intercourfe with the Greeks. The feftivals, holy days, and ftated times of public worfhip of the Romans and Etrufcans, muft alfo have agreed in feveral particulars, as the Romans, before they became acquainted with the Greeks, received every thing relating to religion, and even their calendar itfelf, from the Etrufcans. The latter borrowed of the Egyptians, or rather the Phœnician fhepherds expelled Egypt, their public fupplications, pomps, and folemn proceffions, which occurred in fome of their principal feftivals. The rites and ceremonies ufed by the harufpices, augurs, and pontifices at Rome, were derived from the Etrufcans, who feem to have been the moft celebrated nation in the Pagan world for fkill in augury, and divination, as well as knowledge of the nature of facrifices, to which all rites and ceremonies neceffarily relate. This, however, was their character among the Romans, as Cicero and Livy have teftified. Hence this branch of fcience was emphatically ftyled at Rome "Ars Etrufca," and "Difciplina Etrufca;" fo that Etruria was denominated by Ar-

nobius

nobius the mother of ſuperſtition. It is obſervable, that neither the Etruſcans nor the Romans had any magnificent temples in the earlier ages. The Etruſcans had ſome peculiarities in their religion, which diſtinguiſhed it from that of every other nation; but the ancient Egyptian and Phœnician modes of worſhip were the ſame with thoſe, for many of the earlieſt ages, uſed in Etruria; nor can any material difference be found between the oldeſt oriental and Etruſcan divinities. With regard to the theological notions of the Etruſcans, they believed one ſupreme Being, whom they called Jave, or Jove; they conſidered him as the great governor of the univerſe, as the principle of life and motion. They were firmly perſuaded of the immortality of the ſoul, and therefore believed a future ſtate of rewards and puniſhments; though in later times they ſeem to have followed the ſyſtem of Pythagoras, and conſequently to have adopted the metempſychoſis of that philoſopher. However, the generality of the Tuſcans adhered to the Sabian ſuperſtition, in common with moſt of the inhabitants of the Eaſt.

The Etruſcan language muſt have been the ſame, or nearly ſo, with the Hebrew and Phœnician. The firſt Pelaſgic ſettlements in Etruria could not have taken place many centuries after the deluge, and very few after the diſperſion; and at that time the languages, or rather dialects of the Egyptians, Aſſyrians, Babylonians, Celtes, Syrians, and Arabs, muſt have approached extremely near to the Hebrew and Phœnician, which the learned allow to have been almoſt the ſame. In ſhort both ſacred and profane hiſtory concur in ſhewing the Hebrew, Phœnician, and Etruſcan tongues to have been, in the earlier ages, nearly the ſame. This alſo appears from the letters and manner of writing anciently uſed in Etruria. The letters are almoſt the ſame with thoſe of the earlieſt Greeks, brought by Cadmus out of Phœnicia. The manner of writing is purely oriental, the letters being drawn from the right hand to the left, agreeably to the practice of the eaſtern nations. The former point is rendered indiſputable by the Eugubian tables, in conjunction with the Sigæan inſcription; and the latter by merely peruſing the Etruſcan inſcriptions. The very remote antiquity of the firſt colonies that ſettled in Etruria, as well as of the Etruſcan language and alphabet, may be eaſily inferred from theſe inſcriptions; for as the Pelaſgic alphabet, that prevailed in Greece before the age of Deucalion, conſiſted of ſixteen letters, the Etruſcan or Pelaſgic alphabet, firſt brought into Italy, compoſed only of thirteen letters, muſt have preceded the reign of that prince. The high, and indeed the almoſt incredible antiquity of the Etruſcan language and alphabet, has been clearly evinced in two diſſertations, printed at Oxford in the year 1746. For other particulars relating to this ſubject, we refer to Dempſter's "Etruria regalis," Gori in his "Muſeum Etruſcum," publiſhed at Florence in 1737; M. Bourguet's Diſſertation publiſhed in 1733, and Buonarota's of Florence in 1726; and Swinton's Etruſcan alphabet, publiſhed at Oxford; and for an abſtract, Anc. Un. Hiſt. vol. xviii.

The Etruſcans were extremely well verſed in all the arts of war and peace, and from them the Romans derived thoſe arts and ſciences that paved the way to the empire of the world. In the beſt ages of Rome, the Romans imitated the Etruſcans; nevertheleſs, in after-ages the Etruſcans became thoroughly debauched both in principle and practice. Augury, and every kind of divination; all the principal religious inſtitutions, temples, ſtatues of gods and heroes, the manner of forming or building cities, fortifications, conſecrations, and nuptial rites were tranſmitted to the Romans by the Etruſcans. Every thing alſo that bore any relation to civil government at Rome, ſuch as enſigns of royalty, the diſtinction of nobles from plebeians, the ſecures and faſces, the lictors, &c. was derived from the ſame ſource. Arms, inſtruments of military muſic, military accoutrements and decorations, trophies, triumphs, chariots, crowns, &c. and in ſhort every thing belonging to the art of war, or military exerciſes, that prevailed at Rome, were brought from Etruria. This was alſo the caſe with reſpect to money, locks and keys, lamps, candleſticks, glaſſes, cups, drinking veſſels, together with the laws and cuſtoms relating to banquets and entertainments. Agriculture, planting of vines, all inſtruments requiſite in huſbandry, mills, architecture, muſic, and a variety of muſical inſtruments, many ſorts of diverſions, eſpecially tragedies, various kinds of garments, and even the rudiments of phyſic, ſeem to have been introduced into Italy by the Etruſcans. Scenical amuſements, maſks, pantomimes, wreſtlers, the cuſtom of anointing their bodies, the uſe of wool, plaſtic ſtatuary, the fabulæ oſcæ or Atellanæ, nuptial verſes, or verſus Feſcenini, and the art of making earthenware, were alſo derived from the Etruſcans. The art of conſtructing ſhips and of navigating them, the method of equipping fleets, and all kinds of naval armaments, were known to the Etruſcans before the time of Romulus; and hence we may conclude, that this nation muſt have been a maritime power, and that it muſt have poſſeſſed an extenſive commerce in the earlier ages of the world. The Etruſcans, who were followers of Pythagoras, and who cultivated the principles of the Italian philoſophy, muſt have cultivated the art of muſic and poetry, and muſt have been well verſed in natural philoſophy and aſtronomy. Tragedy is ſaid to have owed its birth to this nation; or at leaſt they firſt communicated it to the Romans. The firſt actors who appeared upon the ſtage of Rome were ſent for from Etruria. Beſides, the ancient Etruſcans, valuing themſelves upon being the diſciples of Pythagoras, could not be ſtrangers to geometry, nor indeed to any of the mathematical ſciences. For military learning they were famous, and eſpecially for the art of drawing up an army, and making diſpoſitions for an engagement. Athenæus informs us, that the formation of the phalanx, and manner of fighting conſequent upon it, was invented by the Etruſcans, or at leaſt borrowed from them by the Romans. To all the other branches of literature and ſcience for which the Etruſcans were diſtinguiſhed, we may add that they excelled in the knowledge and compoſition of hiſtory.

The firſt perſon who fixed monarchical government in Etruria was Janus, ſuppoſed by ſome to be the Javan of ſcripture, or one of his poſterity, and in ſubſequent ages deified by his ſubjects as a ſingular benefactor. The hiſtory of their ſucceeding kings is intermixed with much fable, and, of courſe, very obſcure and uncertain. It appears, however, that they were a maritime power in the time of the Argonauts; and that they commanded reſpect as ſuch at leaſt a generation before the Trojan war, and made a figure at ſea before the Greeks. That the Etruſcans were a powerful and poliſhed nation, when Romulus founded or rather reſtored Rome, appears from ſome approved authors. That prince could not carry the deſign he had formed into execution, without the aſſiſtance of the Etruſcans. From them he derived all his civil and religious inſtitutions. Anc. Un. Hiſt. vol. xviii.

ETSED, in *Geography*, a town of Hungary, 40 miles N.W. of Zatmar. N. lat. 48° 2'. E. long. 21° 51'.

ETTENHIEM, a town of Germany, in the biſhopric of Straſburg; 12 miles S.S.E. of Straſburg.

ETTENSTATT, a town of Germany, in the principality of Anſpach; 5 miles N.E. of Weiſſemburg.

ETTERSHAUSEN, a town of Germany, in the principality of Wurzburg; 3 miles N. of Volckach.

ETTLSTORFF, a town of the archduchy of Auſtria; 9 miles W. of Sonneberg.

ETTRICK, a river of Scotland, which originates in the S.W. angle of the ſhire of Selkirk, and runs N.E. augmented by many ſmall ſtreams in its progreſs through a pleaſant valley to the Tweed, into which it falls near Sunderland-hall, 1½ mile below Selkirk. The banks of this river were formerly ſhaded with woods, whence the county obtained the name of Ettrick foreſt.

ETUEND, a mountain of Perſia, in the province of Irak; 60 miles S.E. of Hamadan.

ETYMOLOGICON, is uſed for a book, containing the etymologies of many languages. See ETYMOLOGY.

ETYMOLOGY, (from the Greek ετυμος, *true*, and λογος, *a word*,) means a true or real account of words: and as this true account is obtained by tracing them to their origin, etymology hence ſignifies that part of grammar which teaches the derivation of words.

Etymology is an eſſential and uſeful branch of philology; but from partial views, and an inattention to the principles which it implies, it is regarded by many as the fruitleſs ſtudy of words, in which neither knowledge nor certainty is attained. In order to limit, as much as poſſible, the province of etymology, and to remove the objections which have been made againſt it, we ſhall here briefly ſtate the laws which direct, and the conſiderations which give it the preciſion and the fixedneſs of a ſcience.

1. Etymology implies a due attention to the ſtructure of the vocal organs, or to the affinities of elementary ſounds. All men have the ſame organs of ſpeech, and the ſame letters are ſounded by a ſimilar modification of thoſe organs. Letters pronounced by the ſame organs, or the ſame parts of the mouth, approximate in ſound to each other, and from this conſideration become more eaſily corrupted and changed one for another. Thus all the vowels, whatever peculiarity in character and ſound they preſent to a perſon familiar with them, have yet a cloſer affinity to each other than to other letters; and hence are even interchanged. The more modern art of printing, indeed, has contributed to fix the fluctuating ſounds of the vowels, by uniformly preſenting them to the eye under diſtinct characters; but ſtill in an etymological view they are utterly to be diſregarded, or to be regarded only as one capricious, ever fluctuating impulſe of the voice.

The juſtneſs of theſe obſervations will immediately appear to any one who conſiders thoſe words in Latin, which are evidently derived from the Greek; or thoſe in French and in Italian, which are derived from the Latin; or thoſe in modern Engliſh, which are borrowed from the Gothic and Saxon tongues, and are ſtill farther diverſified in the Scotch, Iriſh, and Welſh dialects.

While the vowels form, as it were, the ever corrupting fleſh, or the ever varying complexion of language, the conſonants are the ſinews and bones which impart to it ſtrength and firmneſs, and which alone render it a ſubject of philoſophical inveſtigation. But the conſonants have a cloſer alliance to ſome than to other letters; and their affinity depends on the manner in which they are enunciated. Thus, *p*, *b*, *f*, *v*, *w*, *m*, or φ in Greek, are kindred letters, being produced principally by the *lips*, and are therefore often changed one for another, as caprice or cuſtom ſhall dictate. The ſame obſervation holds in regard to the letters *ſ*, *t*, *d*, *r*, *l*, which being produced by the tongue, impreſſed in various degrees on the extremity of the upper teeth, are called *dentals*; to thoſe which are produced by the tongue and the roof of the mouth and the palate, ſuch as *g*, *j*, *z*, *ch*, and finally to the gutturals, which, though they exiſt not in our tongue, form an important claſs of letters in moſt other languages. To this diſtribution of the conſonants into *labials*, *dentals*, *palatines*, and *gutturals*, the ſcientific etymologiſt will pay a ſtrict attention, and obſervation will ſoon teach him that, however perfect any alphabet may be in regard to etymology, each claſs is but a variation of the ſame letter.

2. Etymology ſuppoſes a ſtrict attention to be paid to *analogy*, that is, to thoſe general principles by which any language is formed in regard to its internal ſtructure, to the diſtinguiſhing terminations of its nouns and verbs, to its general mode of combining words, and to thoſe changes which words uſually undergo after they have been imported and naturalized, as it were, from any foreign tongue. In order to diſcover the nativity and parentage of any term, we muſt, as it were, ſtrip it of the dreſs with which the cuſtom of the country has clothed it, and we can trace it to its true origin, only when we view it ſeparated from the termination by which it is diſguiſed: thus μηνη, when imported into Engliſh, appears under the form of *moon*, having dropped η, its peculiar termination; and when expreſſing that period of time which comprehends one revolution of the moon, it aſſumes the termination *th*, which the analogy of the language hath warranted *month*; while in Latin it exiſts in the ſhape of *men-ſis*. And here it is to be obſerved, that the general principles of analogy, as in natural philoſophy, ſo in etymology, are to be collected by *induction* from inſtances that are ſimple, unequivocal, and definite, and then applied to words that are not ſo. The propriety and juſtice of theſe remarks it will be neceſſary to illuſtrate by a few examples.

Suppoſe we were aſked the derivation of οινος, *wine*, ὁν, or ἑ, *ſelf*, ανασσω, *to rule*, in Greek; we ſhould be able to aſcertain this only by unfolding a general principle in the ſtructure of that language. The oriental tongues, to which the Greek owes its origin, abound with gutturals, which by degrees ſoftened down into an aſpirate in many of thoſe words derived from them; while in others they melted into ſimple vowels, or were replaced by a labial, ſuch as φ, *f*, *b*, *v*, or *w*. Thus חי, *khee*, *life*, *ſelf*, became ὁν, חאן, *khaan*, *a king*, ανασσω, *to rule*, and יין, *yeen*, οινος. In theſe derivations our conviction would be complete, becauſe it is juſtified by a general principle that holds in a thouſand other inſtances.

Suppoſe, farther, we were aſked what were the origin of the Latin *vicus*, *a village*; *video*, *to ſee*; *vinum*, *wine*; *ovis*, *a ſheep*; or of *wheel*, *year*, *well*, *weal*, in our own tongue; we anſwer that the ſubſtitution of a labial for an aſpirate or a guttural, or a diphthong, forms a general principle which pervades the Latin tongue in its formation from the Greek. Hence *vicus* is from οικος; *vinum* from οινος; *ovis*, from οις; *video* from ειδω. With reſpect to our own language a ſimilar analogy obtains, which has converted a guttural into a labial; thus *laugh* is pronounced *laff*; *enough*, *enuff*; and moſt of thoſe words which begin or end with *y* and *w*, whether derived from Hebrew, Greek, or Gothic, began or ended with a guttural. On this general principle *year* may ſafely be ſaid to be derived directly or indirecty from γυρος, *a circle*, and means a period or revolution of time; *wheel*, from κυλιω, *to roll*; *well*, from גיל, *geel*, *a fountain*; and *weal* from חיל, *kheel*, *ſtrength*, which alſo has given birth to the words *heal*, and *health*.

Moreover, if we were aſked the origin of *ſperno*, *to deſpiſe*, we ſhould ſay that it comes from πτερνη, *the heel*, for the prefixing of the letter *s* to Greek words is a principle that pervades the Latin tongue; thus the primary ſenſe of *ſperno*, is is to put the heel upon; on the ſame principle is *ſalio*, *inſilio*, *inſult*, taken from ἁλλομαι. The French generally drop the gutturals either in the middle or at the end of words; hence we ſhould be juſtified by an invariable analogy in ſaying, that *eau*, *water*, is from *aqua*, and *ſeul* from *ſingulus*. The Italians generally drop the liquid *l*; agreeably to this cuſtom of the language, *fiume* is derived from *flumen*, *a ſtream*, and *piano* from *planus*, *a plain*. In German moſt of thoſe words which have *t* in Engliſh are uſed with an *s*; as *waſer*, *water*; *beſſer*, *better*; *es*, *it*: and the corruption of *m* into *f*, or *v*, is a principle that runs through the Welſh tongue; thus, *ve*, *voer*, and *vayr*, are but the Latin words *me*, *mare*, and *major*.

3. Etymology, in order to claim its proper rank as a branch of ſcience, requires a ſtrict attention to the *aſſociation of ideas*, the great law which regulates the human mind. The opinions and cuſtoms of men, it is well known, greatly influence their language; and this influence is produced by the ſecret and unerring impulſe of aſſociation; and the reaſon why this branch of philology has been ſo much abuſed or called in queſtion, is, that little or no regard has been hitherto paid to its connection with that grand invariable principle which governs the human underſtanding. He who attempts at etymology in any language muſt know the philoſophical, the religious, and the political notions of the people who uſe it; he muſt be acquainted even with the phyſical peculiarities of their country, and from an acquaintance with the laws of the human mind he ſhould be able to trace the ſecret proceſs by which thoſe circumſtances influence their ſpeech. We will give a few examples in illuſtration of theſe remarks.

In the early ages of the world, the principal idea under which the character of *God* preſented itſelf was that of *ſuperior power*; and, accordingly, the feelings which it awakened in the beholder were chiefly thoſe of *fear*. And even the Jews, who had far more rational notions of the Deity than the Gentiles, apprehended that no one could ſee God and live. Accordingly moſt of thoſe names, which ſignify a god, are in Greek either immediately derived from a word which ſignifies *fear*, or both from a common origin; thus, from באב, *baab*, *the firſt principle of things*, are taken φοιβος, ποποι, *Gods*; and φοβος, *fear*; ταρβος, *terror*, owes its origin to the Chaldæan תרף, *Terph*, *a houſehold god*. Παν, the god *Pan*, is only the Hebrew פון, *pon*, *conſternation*: δειμων is the *god of terror*, and hence δαιμων, *an inviſible ſpirit*, which was an object of *fear*, and δεισιδαιμων, *the fear of the dæmons*, *religion*. It was the common notion that thoſe dæmons produced violent paſſions and diſorders in the mind and body: hence came the verb δαιμονιαω, *to be mad*. It was thought, too, that they were the agents of God in preſiding over men; hence ευδαιμων, *one who had a good dæmon for his guardian angel*, and κακοδαιμων, *one who had an evil one*.

The introduction of evil into the creation could not be accounted for by the heathen philoſophers, only by ſuppoſing the exiſtence of two principles equal in power, and oppoſite in character and operation. The good principle they naturally aſſimilated to the *ſun*, the moſt ſplendid body in nature, whilſt the evil they called *darkneſs*; hence the ſaying *God is light*: זי, is pronounced by the Perſians *tzee*, but by the Arabians *tdee*, or *tdeio*, *light*; hence ζευς from the former mode of pronunciation, and θεος from the latter. On this principle the Chaldean אזא, *aza*, *to make hot*, the action of the ſun, gave birth to αζω, *to worſhip*, or *reverence*. The general opinion among the philoſophers was that water is the firſt principle of things. Hence the Arabic *mao* came, in Perſian, with little variation, to ſignify *fruit*, *wine*, and in Greek, μαια, *the goddeſs of birth*, and in Engliſh the producing month, *May*. The ſame word in Hebrew, by aſſuming *t* after the analogy of feminine nouns, is מות, *mot*, *death*, which means *reſolution into water*; hence the Egyptian *mot*, (whence Moſes is ſuppoſed to have been taken,) and *mud*, what is waſhed together by water, juſt as *lutum*, *clay*, is the ſupine of *lavo*, or *luo*, *to waſh*.

In eaſtern countries, where the heat of the ſun is violent and long continued, rain is deemed the greateſt bleſſing, and all the terms expreſſive, in moſt of the Aſiatic tongues, of plenty, ſucceſs, and joy, are generally borrowed from the names of water; hence the Hebrew ברך, *berek*, *to bleſs*; in Greek is βρεχω, *to rain*; in Latin *precor*, *to aſk for bleſſing*, *parco*, *to give bleſſing*; *ſpare*, and *ſpargo*, *to ſhed as the dew*, *or ſcatter as ſeed*. The ſame root exiſts in Engliſh in the form of *brook*, the effect of rain.

4. Etymology, in order to become a rational ſtudy, implies an extenſive and an accurate acquaintance with languages. It is not ſufficient to be acquainted with Latin to know Greek; nor to know Italian to be acquainted with Latin, nor to know Engliſh to be acquainted with the Saxon or Gothic; but to be a good etymologiſt in either of theſe, a man muſt comprehend them all. So manifold is the intercommunity between all languages, that no language exiſts derived from one and the ſame ſource. Words exiſt in Engliſh which exiſt alſo in moſt other tongues, under differences of character and termination; and they are derived not from each other, but from a common origin; and a ſcientific etymologiſt, inſtead of deriving them from each other, will trace them all till they meet in a few primitive terms. It would probably be wrong, or at leaſt it would be very doubtful to ſay, that *hand* comes from the Latin obſolete *hendo*, *to catch with the hand*, or from χανδω, the parent of *hendo*, but it would be right to ſay that theſe are *connate*, or *kindred* terms, ſprung, if not from each other, from ſome common root. In Hebrew, Perſian, and Arabic כף, *caph*, *is the hand*. The action of this is two-fold, as it *imparts*, or as it *receives*. In the former ſenſe it gave birth to the Saxon or Gothic *giff*, and hence *if*; in the latter to *capio*. *To take in hand is to begin a thing*; hence the ſame word exiſts in the form of *Cæpio*; and paſſing into Greece it produced κωπη, *a handle*.

And here it is obvious to remark, that as the root, paſſing into different countries, produces as it were new branches; thoſe branches will not continue long till they in their turn become the ſtems of more numerous and diverſified ſhoots; and as they thus multiply by accident, the progreſs of knowledge, the multiplication and diſtinction of ideas attendant thereon, ſeize, as it were, theſe wild and promiſcuous offspring, and give them the ſanction of cuſtom, the ſupreme arbiter of ſpeech, thus conſidering as genuine, words which at firſt were mere *corruptions*. Thus in our own tongue *guſt* is wind; hence *ghoſt*, what conſiſts of *wind*, *ſpectre*, *a-ghaſt*, *ghoſtly*, like a ſpectre, and *gas*, an aeriform fluid, ſo denominated from ghoſt, firſt by Van Helmont. Thus alſo in Latin, from πηγω, *to join together*, is *pango*, *to faſten*, *paco*, *to unite in concord*, *pacify*. To paint is to faſten adventitious colours on a thing; hence *pingo*, and to give to falſehood the adventitious colours of truth is *fingo*, *to feign*. Again, from μενος is *men's mind*, *force*, *eſſence*, *memini*, *to call to mind*, *moneo*, *to put in mind*; *manus*, *force*, or that organ in which the ſtrength of the human body chiefly conſiſts, *manes*, *the ſouls or departed ſpirits*, ſpirit being the eſſence of man; and *maneo*, *to exiſt*, the ſoul being that which exiſts after the deſtruction of the body.

Etymology, then, to be raiſed above the caprice of fruitleſs ſtudy, and to be claſſed among the uſeful and ſolid

I branches

branches of fcience, muft be founded on a juft regard to the affinities of letters, and to the ftructure of the organs of fpeech. It fuppofes an acquaintance with the philofophy of the human mind; with the analogies which form and diftinguifh each language; with the hiftory of mankind, philofophical, religious, and political. From thefe, its qualifications, refults its utility as a department of human knowledge. Etymology, it is evident, furnifhes the readieft and moft effectual means to acquire the knowledge of language; and as language is but the drefs of our ideas, it holds up a mirror to delineate and reflect the operations of the human mind. It helps to afcertain the pofitions of ancient places, to clear obfcurities in the antiquities of nations and families. What is more, when confined within its proper limits, and purfued to its full extent, it will throw much light and additional evidence on the truth of the Mofaic hiftory, refpecting the origin and propagation of mankind.

EU, or Eo, in *Geography*. See Eo.

Eu, a fea-port town of France, and chief place of a canton, in the department of the Lower Seine, and diftrict of Dieppe, feated on the Breffe, near the coaft of the Englifh channel; 15 miles N. of Dieppe. The place contains 3400 and the canton 12,810 inhabitants, on a territorial extent of 182½ kiliometres; and in 27 communes.

EVA, in *Ancient Geography*, a town of the Peloponnefus, in Arcadia.—Alfo, a hill of the Peloponnefus, in Laconia, near Sellafia. Polybius.

EVACUANTS, in *Medicine*, are thofe remedies which operate by diminifhing the quantity of fluids in the body. This effect may be produced either directly, by an artificial opening into the veffels or cavities containing the fluid to be evacuated; as by blood-letting, by means of the lancet, or by cupping; by tapping; &c. Or the evacuation may be accomplifhed indirectly, by exciting the action of the veffels, which are naturally deftined to throw off redundant fluids, on the one hand; or by producing inflammation, and a confequent difcharge of fluids, from parts not naturally fecreting them. Evacuants acting upon the natural emunctories, as the organs of excretion have been called, are of various quality and denomination, according to the parts upon which their action is exerted: thus, fome ftimulate the veffels which open into the cavity of the inteftines, and carry off the fluids by ftool, and are called *purgatives*, *laxatives*, or Cathartics; others excite the veffels of the kidnies to increafed action, and are denominated Diuretics; others augment the perfpiration, and are termed Diaphoretics and *fudorifics*; others again ftimulate the falivary glands, and produce a great difcharge of faliva, whence they are called Sialogogues; and others excite an increafed difcharge of the mucus of the noftrils, and are termed Errhines. All thefe kinds of evacuant medicines are occafionally employed, with a view to relieve the conftitution at large, or fome part of the body, from an inflammatory or febrile condition; or to remove local congeftions in particular organs, &c. See Bleeding, Cupping, and the words in capitals; under which heads the principles of the evacuation, thus varioufly effected, are explained.

EVACUATION, fee the preceding article.

Evacuation, in a *Military Senfe*, relates to the withdrawing of troops from any fortrefs or poft, not befieged, but intended to be relinquifhed, or eventually to be difmantled. This term is fometimes erroneoufly ufed in capitulations, where it is expreffed that the garrifon fhall evacuate within a certain number of hours. Now, as it is in almoft every cafe, a ftipulation on the part of the victors, that they fhall be put in poffeffion of certain gates, or defences, previous to the garrifon marching out; thereby fecuring every advantage that may have been obtained; it ftands to reafon, that the term evacuation is incorrectly applied. We have, indeed, but rarely inftances wherein it is properly introduced; one very recent cafe is however very prominent; namely, the evacuation of certain fortreffes in Pruffia by the French troops; for, if we are correctly informed, the Pruffian forces did not, in fome inftances, attempt to enter until their *friends* had completely withdrawn.

It is fometimes made a condition, that particular approaches, lines, or pofts, fhall be evacuated; there we fee the term appropriately ufed; becaufe fuch approaches, and lines efpecially, are not confidered as permanent works; therefore are intended to be difmantled fo foon as thofe who erected them fhould retire.

Where a place is to be evacuated under the exprefs condition of all damages being paid for, it becomes the duty of the future poffeffors to be very correct in caufing an enquiry to be made into all depredations and grievances, before the forces about to retire quit the place. Commiffioners on both fides are neceffary; in order that every matter may be adjufted at the moment, fo as to obviate future difagreements. This appears to have been attended to when the Portuguefe territory was evacuated by Junot; though we have ftrong reafon to apprehend that great evafion, and many highly nefarious acts, were practifed by the French on that occafion.

EUÆMIA, of ευ, *well*, and αιμα, *blood*, is ufed by Tremelius and fome other writers, to denote a good and healthy ftate of the mafs of blood.

EUÆMON, in *Ancient Geography*, a town of Greece, placed by Steph. Byz. in the territory of the Orchomenians.

EVAGRIUS, in *Biography*, patriarch or bifhop of Conftantinople, who fucceeded Eudoxus in 370, and whofe election was much refented by the emperor Valens. From this event commenced a cruel perfecution againft the Catholics, which did not terminate till the acceffion of Gratian to the throne. Evagrius probably died in exile during this period.

Evagrius, bifhop of Antioch, fucceeded Paulinus in the year 389; in confequence of whofe election, in oppofition to Flavianus, the fchifm in the church of Antioch, that has been much lamented by the orthodox, was continued. However, by the influence of Siricius bifhop of Rome, in the council of Capua, held in 390, Evagrius's election was approved. Two years afterwards Evagrius died, and the fchifm terminated. Evagrius was the friend and companion of St. Jerome, who reprefents him as a perfon of an active and ardent fpirit, and as the author of various writings, which he had perufed. None of thefe that deferve particular mention are now extant. Cave. Dupin.

Evagrius, furnamed *Ponticus*, and by St. Jerome *Hyperborita*, on account of the fituation of the place of his nativity near the Euxine fea, flourifhed near the clofe of the fourth century. Having been ordained deacon of Conftantinople by St. Gregory Nazianzen, he was inftructed by this bifhop in biblical learning, and advanced to the office of his archdeacon. His perfon and manners recommended him to the favour of the ladies; and being fufpected of an improper intimacy with the wife of a man of confequence, he was obliged to retire from Conftantinople in the year 385, and to remove to fome diftant place. At Jerufalem he embraced the monaftic life, and paffed 15 years at a monaftery amidft the deferts of Nitria in Egypt.

Whilft

Whilst he was in this situation he refused the episcopal dignity which was offered him by Theophilus bishop of Alexandria. He afterwards defended the opinions of Origen, and laid the foundation of the tenets which, in the course of a few years, were propagated by Pelagius and his followers. He lived to an advanced age, but the time of his death has not been ascertained. Sozomen speaks of him as a man, distinguished by his learning, judgment, and eloquence; and represents him as devout, humble, abstemious, and irreproachable in his manners. Some of his writings are found entire in the "Bibliotheca Patrum," and in "Cotelerius's Monum. Eccl. Græc.;" but fragments only of the greater number are dispersed in the works of Socrates and other authors. Socrates' Hist. Eccl. Cave. Dupin. Another monk of this name flourished among the ecclesiastical writers of the fifth century. Cave. Dupin.

Evagrius, an ancient ecclesiastical historian, was born at Epiphania, a city of Syria in 536 or 537. From the study of rhetoric and the profession of an advocate, in which he acquired considerable reputation, he derived the surname of *Scholasticus*. At Antioch he lived in habits of intimacy with Gregory, patriarch of that city, and when Gregory was charged with the crime of incest, and made an appeal to the emperor and a synod, Evagrius attended him to Constantinople, where his abilities and character were held in high estimation; nor was he less respected at Antioch, the place of his customary residence. The intervals of leisure which he could gain from the public duties of the several offices which he sustained, were devoted to the composition of his "Ecclesiastical History, in 6 books," comprehending the period from the year 430 to 594, and including the events that occurred from the close of the histories of Theodoret and Socrates till the twelfth year of the emperor Mauricius. His books of "Epistles, &c." and "Panegyrical Oration on Mauricius," &c. are lost. His history is, upon the whole, a work of industrious research, general information, and considerable merit; though it manifests, on the part of the author, a great degree of credulity. The writers of the Romish church extol him as the only Greek ecclesiastical historian who has maintained the doctrine of the true faith; and Photius represents his style as sometimes elegant and beautiful, often too redundant and luxuriant.

The original Greek of this history was published at Paris in 1544, in folio, by Robert Stephens; in 1612 at Geneva, in folio, accompanied with a Latin version; in 1679 by Valesius, with a new version and notes; and in 1720 this last edition was republished at Cambridge in folio, with many additional notes. Cave. Valesii Præf. Dupin.

EVANDRIA, in *Ancient Geography*, a small town of Spain, in Lusitania, according to Ptolemy; supposed to be "Talavera la Veja."

EVANDRIUS Mons, one of the seven mountains, forming the site of the city of Rome, called also mount Palatine.

EVANGELICAL *Harmony* and *Economy*. See the substantives

EVANGELISTS, the inspired authors of the Gospels. See Matthew, Mark, Luke and John. The symbols of these in the order now recited, according to Jerom, are a man, a lion, a calf or ox, and an eagle. According to St. Augustine, in his interpretation of Ezekiel, ch. i. 5.—10. and Rev. iv. 7, they are a lion, a man, an ox, and an eagle.

The word is derived from the Greek, ευαγγελιον, formed of ευ, *bene*, *well*, and αγγελος, *angel*, *messenger*.

The denomination evangelists was likewise given in the ancient church to such as preached the Gospel up and down, without being attached to any particular church, being either commissioned by the apostles to instruct the nations, or of their own accord, abandoning every worldly attachment, consecrated themselves to the sacred office of preaching the Gospel.

In which sense some interpreters think it is that St. Philip, who was one of the seven deacons, is called the evangelist, in the twenty-first chapter of the Acts of the Apostles, ver. 8. Again, St. Paul writing to Timothy, Ep. ii. chap. iv. ver. 5. bids him do the work of an evangelist. The same apostle, Eph. iv. 11. ranks the evangelists after the apostles and prophets.

Evangelists, in *Geography*, four small islands at the western extremity of the Straits of Magellan, near the coast of South America; three are low, and one, at some distance, appears like a hay-stack. S. lat. 52° 45'. W. long. 67° 16'.

EVANIA, in *Entomology*. See Sphex.

EVANID, a name which some authors give to those colours which are transient, or not of long duration; as those in the rainbow, in clouds, before and after sun-set, &c.

Evanid colours are the same with those otherwise called fantastical and emphatical colours. Some authors also use the same term to express those flowers of plants whose petals fall off as soon as they are opened.

EVANS, John, in *Biography*, was born at Wrexham, Denbighshire, in the year 1680. His father was one of the ejected ministers in 1662, who, on account of his nonconformity, being driven from the established church, became minister to an independent congregation at Wrexham. The son was educated with great care, and inducted to the different branches of literature necessary to qualify him for the office of the ministry, which he afterwards exercised in London, first as an assistant, and afterwards as successor to Dr. Daniel Williams. He died in the year 1730, in the fifty-first year of his age, highly esteemed by all who knew him. He had ever been eminent for piety, integrity, and public spirit; in his principles he was orthodox, but disposed to think well of, and to honour, those who differed from him, without any regard to the sentiments which they might hold. He received a diploma of doctor in divinity from the universities of Edinburgh and Aberdeen. His principal work as an author consisted of two volumes of sermons, entitled "Practical Discourses concerning the Christian Temper," which are still in considerable estimation. The celebrated Dr. Watts characterized them as "the most complete summary of those duties which make up the Christian life." Gen. Biog.

Evans's *island*, in *Geography*, a small American island, near the coast of Main. N. lat. 44° 31'. W. long. 67° 3'.

EVANSHAM, a town of America, the capital of Wythe county, in Virginia, situated on the E. side of Reedy creek, which falls into the Great Kanhaway, Woods or New River. It contains a court-house, gaol, and about 25 houses; 40 miles W. by S. from Christiansburg.

EVANTES, in *Antiquity*, the priestesses of Bacchus, thus called, because in celebrating the orgia they ran about as if distracted, crying *evan, evan, ohe evan!*

The word is formed from Ευαν, a title or appellation of Bacchus.

EUANTHI Colores, in *Painting*, a term used by the Greeks to express what the Romans call the *floridi colores*; these were such colours as had a remarkable brightness in their works. The other duller and coarser colours the Romans called *austeri colores*, and the Greeks *bathyci*.

Of

Of the firſt ſort were cinnabar, lapis armenus, chryſocolla, minium, indigo, and purpuriſſa, according to the Romans; but the Greeks, as we find by Dioſcorides, made cinnabar one of the auſtere colours.

EUA'PHION, (from ευ, *eaſe*, and αφη, *the touch*,) in *Surgery*, a medicine for the hemorrhoids, named from its gentleneſs. Galen.

EVAPORATION, in *Natural Philoſophy*, is that proceſs by which water and other liquids are converted into vapour or ſteam, an elaſtic fluid, and diſſipated in the atmoſphere. Certain ſolid bodies, too, are ſubject to a ſimilar diſſipation in air; this is uſually denominated *exhalation*: but as the cauſe is no doubt the ſame in both caſes, it may be properly conſidered under this head.

The ſpontaneous evaporation of water, or that which is conſtantly going on in a greater or leſs degree from all parts of the ſurface of the globe, has always been an intereſting phenomenon to the ſpeculative philoſopher. Various hypotheſes have been advanced to account for the aſcent of water into the atmoſphere in an inviſible form, and for its ſubſequent deſcent in the form of rain; but the opinions of early writers on this ſubject are of little importance, as they were not acquainted with the principal facts and experiments which ought to guide us in the inveſtigation. Ariſtotle ſeems to have aſcribed the formation of vapour to the action of fire; and ſo far his notion was correct. Halley ſuppoſes ſmall hollow ſpheres of water to be filled with a ſubtile elaſtic fluid, ſo as to make them ſpecifically lighter than air; he alſo hints at a chemical affinity between air and water, ſimilar to that between water and ſalts. Deſaguliers, after having ſhewn the inſufficiency of former hypotheſes, propoſes a new one; he aſſerts that water is capable of being converted by heat into an elaſtic fluid much lighter than air, and refers to the ſteam engine as a proof; he ſhews, too, that a glaſs veſſel filled with water, and inverted in another veſſel of water, and then expoſed to the heat of ebullition, has its water expelled, and ſteam, an elaſtic inviſible fluid, takes its place. This ſteam, he ſhews, is again condenſed into water as the veſſel cools. He argues that ſteam is 16½ times lighter than air, and that when formed at a low temperature it muſt aſcend in the atmoſphere till it meets with air of the ſame denſity, and there it will ſtop; but when accumulated, the cold condenſes a portion of it into drops of water: hence clouds and rain. This notion, which goes to identify vapour in the air, with the ſteam or vapour of water formed by heat in a vacuum, is ingenious and apparently original, but how the vapour ſhould aſcend till it arrives at air of the ſame denſity, is not very eaſily conceivable: for the vapour, in aſcending, muſt expand as the preſſure is diminiſhed, according to the eſtabliſhed laws of elaſtic fluids, and therefore never can obtain the ſame denſity as the air. The vapours might indeed aſcend to the top of the atmoſphere, and form a diſtinct ſtratum, as ſome have imagined with reſpect to hydrogen gas. The author has extravagantly under-rated the ſpecific gravity of ſteam, or aqueous vapour, which is certainly at leaſt one-half that of atmoſpheric air. Upon the whole, this hypotheſis was more plauſible than that adopted by Halley.

As the ſcience of chemiſtry gradually expanded, the phenomena of evaporation began to be conſidered as moſt nearly allied to thoſe of chemical ſolution. From the year 1743 to 1766 the eſſays of Nollet, Franklin, Roi, Hamilton and others, tended to eſtabliſh the opinion that water is taken up into the air by chemical ſolution, in a ſimilar way to that in which water and other liquids diſſolve ſalts. In the 55th vol. of the Philoſophical Tranſactions, there is an eſſay of Profeſſor Hamilton on evaporation, in which he inſiſts at large on the hypotheſis of ſolution. Hot water, he obſerves, diſſolves ſalts ſooner and in greater quantities than cold water, and depoſits a part of the ſame on cooling: ſo warm air takes up more water than cold air; but the water is depoſited again when the air cools, or by the contact of a cold body, as a glaſs of cold water. Evaporation always produces cold; this is obſerved when any part of the human body is moiſtened with water, and the ſame ſuffered to evaporate, but ſtill more remarkably when moiſtened with ether or other fluids more evaporable than water; in like manner, certain ſalts diſſolved in water conſtantly produce cold. In ſhort, the points of reſemblance between evaporation and chemical ſolution are ſo numerous and ſtriking, that the generality of philoſophers ſeem to have adopted the idea that air poſſeſſes a chemical affinity for water, and attaches a portion of it to itſelf, which becomes incorporated with the elaſtic maſs of the atmoſphere, under the denomination of vapour, till cold, or ſome other cauſe, reduces it again to the ſtate of water.

In the year 1783, Sauſſure of Geneva publiſhed his celebrated eſſays on hygrometry, in which the ſubject of evaporation is diſcuſſed much more largely than had been previouſly done. This author does not claim the merit of any new theory; for, he ſays, "the converſion of water into elaſtic vapour has been known time immemorial; the diſſolution of water in air was diſcovered by Roi, and the veſicules, which compoſe fogs and clouds, were conceived by Halley, and ocularly demonſtrated by Kratzenſtein. But no philoſopher has, I believe, clearly diſtinguiſhed the different modifications of vapours: all the ſyſtematic authors have endeavoured to reduce all vapours to one and the ſame ſpecies, whilſt in reality they exiſt under forms abſolutely different. It had not been perceived that water, on being diſſolved in the air, is converted into an elaſtic fluid; but I have ſhewn this to be the fact by the moſt exact experiments; and further, the preciſe effect which the ſolution of a given quantity of water in air has upon the ſpecific gravity of the air. Finally, the laws according to which the humidity of the air varies in proportion to its condenſation and rarefaction, form an entirely new ſubject, on which our ideas hitherto have been vague and erroneous. Theſe, I believe, will be found to have received a ſatisfactory elucidation." Preface, page 10. Before we examine the concluſions of Sauſſure, it may be proper to advert to the facts which are alluded to above. Having procured a large glaſs balloon, containing 4¼ cubic feet of air, Sauſſure adapted to it a manometer or inſtrument to meaſure the force of elaſtic fluids; the balloon being filled with air of the natural humidity, the manometer, or thermometer, and a veſſel containing cauſtic alkali of a given weight, were all encloſed in the balloon, and confined from the action of the external air. The cauſtic alkali abſorbed the vapour in the balloon; and the manometer ſhewed the diminution of elaſticity conſequent thereon; after the experiment was carried as far as was deſired, the balloon was opened, and the increaſe of weight of the alkaline veſſel was aſcertained. Hence were derived data for calculating the influence of vapour on the elaſticity of the air, and likewiſe the whole quantity of water in a ſtate of vapour in a given bulk of air. This might be called the analytic experiment; but the ſynthetic one was alſo made. By encloſing a piece of wet linen of a given weight in the balloon containing air as dry as poſſible, along with the other inſtruments, the moiſture of the linen evaporating increaſed the elaſticity of the confined air a quantity which could be obſerved; and at the cloſe of the experiment the loſs of weight of the linen indicated the quantity of water which had been evaporated, and had increafed the elafticity. The two methods were thus found to corroborate each other remarkably well. The refults were, that at the temperature of 64°, a quantity of extremely dry air acquires an increafe of $\frac{1}{74}$th in elafticity in attaining extreme humidity; and *vice verfâ*: that a cubic foot of air takes up 10 grains of water in paffing from extreme drynefs to extreme humidity; and that confequently it diminifhes the fpecific gravity of the air, as if a volume of elaftic fluid, equal in weight to 10 grains, and of $\frac{3}{4}$ths the fpecific gravity of air were added to it. Of the general accuracy of thefe refults there is no room for doubt. They form a valuable acquifition to this branch of fcience. One important fact was ftill wanting; as air was fuppofed to diffolve water by virtue of an affinity, it was reafonable to expect that every fpecies of air would have its peculiar affinity, or take up a certain portion of water peculiar to itfelf, agreeably to what is obferved in other cafes of chemical faturation. Sauffure afcertained this point clearly in regard to inflammable and fixed air, that is, hydrogen and carbonic acid. Both thefe gafes were found in their pure ftate, and when mixed with any proportion of common air, to affect the hygrometer in the fame way as common air, and to promote evaporation in the fame degree. In fhort, there was not any appearance to indicate that they contained either lefs or more vapour than common air in like circumftances. Sauffure found that evaporation was accelerated in proportion to the rarefaction of the air; this circumftance he accounted for by obferving that the preffure of the atmofphere retards evaporation; however, upon the principle of folution, it might have been expected that the greater quantity and denfity of the folvent would have compenfated for the greater preffure. The condenfation of air, on the contrary, uniformly tends to make it depofit moifture, and retards evaporation. This he explains by obferving, that the folvent power of air does not increafe quite fo rapidly as its denfity; continued condenfation therefore muft firft faturate the air with moifture, and then make it depofit a portion. Sauffure found that warm and denfe air required more vapour to faturate it than cold and rare air; he was led too haftily to afcribe the folvent power of the air partly to its temperature and partly to its denfity; but it has fince been proved that temperature alone is concerned, and the denfity has no effect whatever. On the head of rarefaction and condenfation, Sauffure adverts to a curious fact, known by every philofopher, but not fatisfactorily explained by any one; namely, the abundant and inftantaneous formation of a cloud or mift upon exhaufting a receiver by the air-pump. As the rarefaction of air is found to promote evaporation, it appears aftonifhing at firft fight that the air fhould exhibit figns of fuperfaturation at the fame inftant. When the pump plate is covered with wet leathers the above appearance never fails; but the abbé Nollet found it to take place when water was totally excluded. Sauffure, however, denies this to be the fact; he thinks that water muft not have been excluded with fufficient care in Nollet's experiments; and affirms that from his own experience no appearance of mift was found upon exhauftion, when the pump was carefully dried. The hygrometer at the time was 70°, extreme moifture being 100°. As the two authors here appear to be at iffue as to the fact, the writer of this article, from his own experience, can venture to affirm that both of them may ftill be correct. When care is taken to exclude water from the pump and receiver, the mift is by no means fo copious as otherwife; it is alfo more diminutive as the air is dry or far from extreme humidity; with both thefe circumftances and a large receiver, no mift will appear by a moderate rate of exhauftion; but it may always be produced by ufing a fmall receiver, and rapid exhauftion. Sauffure's explanation of the fact is very inadequate, and unworthy of repetition; he further notices the dew obferved on the receiver of an air-pump after letting in the air, and very juftly afcribes it to the condenfation of the vapour raifed up into the receiver after exhauftion; the air taking in with it nearly as much vapour as it is capable of holding. Upon liberating condenfed air a great mift is obferved in the receiver; Sauffure explains this in the fame unfatisfactory manner as before, and that in one cafe only, namely, when the receiver contains water; but his explanation does not apply when the receiver is perfectly dry; yet the phenomenon of mift is equally apparent in that cafe. The true explanation is, that a great but momentary cold, of 50° or more, occafions the precipitation of vapour, both upon rarefying air and liberating condenfed air. The fact has fince been demonftrated by Mr. Dalton; but it was hinted at by Lambert, as quoted by Sauffure, page 331.

Though Sauffure does not affect to introduce any new theory on the fubject of evaporation, he certainly advances fome notions on the fubject that were not previoufly held by others, efpecially by thofe who adopted the chemical folution of water in air. He fays, "evaporation, properly fpeaking, is the refult or rather the effect of the intimate union of elementary fire with water; by this union the water and fire combined form an elaftic fluid fpecifically lighter than air, and which is peculiarly diftinguifhed by the name of *vapour*. This vapour being formed in a vacuum, or otherwife when the heat is fufficient to give it force fuperior to atmofpheric preffure, fo as to expel the air from any veffel in which it is formed, is called *pure elaftic vapour*." Page 361. This reprefentation is, in all probability, correct, and will be generally adopted without hefitation. He proceeds: "but when the vapour cannot entirely furmount the preffure of the air, it penetrates it, mixes with it, undergoes a true folution, and may then be properly called *diffolved elaftic vapour*." Page 362. Certainly the advocates for the folution of water in air cannot adopt this language. Pure elaftic vapour is firft formed; then by means of fuch force as it happens to have, which is generally fmall, it penetrates and mixes with the air; afterwards it is diffolved by the air; that is, the particles of air finding thofe compound particles of water and fire amongft them, attract them, and form triple compounds of air, water, and fire. Here the bufinefs for which folution is called in is performed before hand; for we muft fuppofe it to be the affinity of air for water which enables the latter to rife at all againft fo fuperior a preffure. If the vapour can, by virtue of its elafticity, penetrate the air, why may it not continue there by virtue of the fame elafticity? Sauffure proceeds; "when afterwards the air faturated lets fall the water which it contains, this water fometimes takes the form of veficules or bubbles; thefe veficules, filled and furrounded with a fubtile elaftic fluid, are fupported in the air, and even fometimes rife in it, by their lefs fpecific gravity. Thefe veficules are effentially diftinct from the air, as well as from the vapour above defined; but according to cuftom I have arranged them in the clafs of vapours, and diftinguifhed them by the name of *veficular vapour*. Finally, when the elaftic vapour, or the veficules themfelves, condenfe into folid drops, which only differ from drops of rain by their extreme fmallnefs, they are ftill very different from vapours properly fpeaking. Notwithftanding, as thefe fmall particles float in the air, and can even be fupported in it for fome time, by its agitation and vifcofity, I have claffed them alfo amongft vapours, and given them the name of *concrete vapours*."

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Page 363. It may be proper to obferve here, that the vefi-cular vapour of Dr. Halley was fuppofed to be tranfparent, and therefore to correfpond to the *diffolved elaftic vapour* of Sauffure. It was moreover hypothetical; but Kratzenftein and Sauffure affirm that the fmall vifible particles floating over fteaming water, as well as thofe of certain fogs, are difcernible by a microfcope to be hollow or veficular. Thefe vifible particles are the *veficular vapour* of Sauffure. Though it is by no means improbable that the vapour iffuing from warm water is enveloped in a film of water, juft as we fee it in ebullition, and that the fame bubble of fteam on cooling may fhrink into a veficule, containing an atom of air, the original nucleus of the fteam; yet it is not equally probable that in the condenfation of pure vapour a veficule fhould be formed: ftill lefs likely is it that fometimes veficules, and at other times folid drops, fhould be formed. Microfcopic obfervations on atoms dancing about in the air are fcarcely to be relied on. But whatever may be the fact as to the conftitution of condenfed vapour, that is, whether the particles are hollow or folid, there is not any fufficient reafon for fuppofing them conftituted of any other principles than water and atmofpheric air. The only one that has been advanced in fupport of the hypothefis is, that without fome fubtile elaftic fluid, internal or external, the watery particles conftituting clouds muft conftantly defcend; whereas clouds are feen to remain ftationary and fometimes even to afcend, which, it is alleged, could not take place. were not the particles of lefs fpecific gravity than the air. Now the afcent of clouds is in all probability an optical deception. It is occafioned by the diffolution or evaporation of the under furface of the cloud, and the fuperior new formation of a cloud. We have no fufficient reafon for believing that the individual particles of clouds afcend; yet they frequently defcend with a velocity almoft imperceptible; this arifes from the refiftance the air makes to the motion of fmall bodies, which, it is well known, increafes in proportion as their diameters decreafe. The epithet *vapour*, which denotes an elaftic fluid, cannot, with philofophical propriety, be applied to the vifible particles of water conftituting clouds.

Mr. Pictet of Geneva publifhed an ingenious effay on fire, which was tranflated into Englifh and publifhed in 1791. This gentleman, impreffed with fuch ideas of the powers of fire in every thing which relates to evaporation, is tempted to look upon it as the fole agent in this clafs of phenomena, and to renounce the idea that air acts in the manner of chemical *diffolvents*. He obferves, " the very fpecious arguments of my learned colleague (Sauffure,) in his hygrometry in favour of that opinion, had long feduced me; but the charming fimplicity which the theory of evaporation would acquire if we could diveft it of the agency of air; the poffibility I perceive of reducing the whole to the action of fire; the probability which increafes with the fimplicity of every natural hypothefis, attract me, I confefs, ftill more forcibly." Page 222.

In the Philof. Tranfac. for 1792, there is an effay of De Luc on evaporation. This acute philofopher diftinctly maintains that vapour in the air is precifely the fame as vapour in vacuo, and in both cafes is formed by the intimate union of fire with water; he denominates it *fteam*, and fhews that fteam in air of any denfity, and fteam in vacuo, affect the hygrometer alike, provided the fteam has the fame temperature and elafticity, at leaft within the ordinary range of atmofpheric temperature. He ftrengthens his opinion of fteam in air, and in vacuo being the fame from the fact that cold is produced, or heat abforbed, by evaporation in both cafes. From the facts as afcertained refpecting fteam, by Mr. Watt and others he juftly infers, that there is a certain minimum diftance of the particles of fteam for each temperature, at which they retain their elafticity; if they are condenfed by any mechanical force within the limit of this diftance, they lofe their elafticity and become water; if not, they retain it, and act as any other permanently elaftic fluid. In fpeaking of fteam in air, he obferves, " that no mechanical caufe can produce the decompofition (condenfation) of that fluid, but by forcing its particles to become nearer each other than the actual temperature can admit, which cannot happen in the atmofphere, except by the accumulation of fteam itfelf in fome part of it." " He concludes that the product of evaporation is always of the fame nature, namely, an expanfible fluid, which either alone, or mixed with air, affects the manometer by preffure, and the hygrometer by moifture, without any difference arifing from the prefence or abfence of air, at leaft without any perceived hitherto."

In 1793, Mr. Dalton publifhed a volume of meteorological effays, in which he gives a theory of vapour, very nearly allied to that of De Luc above-mentioned, and to the opinion of Pictet, though he feems to have been unacquainted with thefe circumftances. From the refults of certain experiments and obfervations he concludes, " that the vapour of water (and probably of moft other liquids) exifts at all times in the atmofphere, and is capable of bearing any known degree of cold without a total condenfation, and that the vapour fo exifting is one and the fame thing as *fteam* or vapour of 212° or upwards. The idea, therefore, that vapour cannot exift in the open atmofphere under the temperature of 212°, unlefs chemically combined therewith, I confider as erroneous; it has taken its rife from a fuppofition that *air* preffing upon vapour condenfes the vapour equally with *vapour* preffing upon vapour, a fuppofition we have no right to affume, and which, I apprehend, will plainly appear to be contradictory to reafon and unwarranted by facts; for, when a particle of vapour exifts between two particles of air, let their equal and oppofite preffures upon it be what they may, they cannot bring it nearer to another particle of vapour, without which no condenfation can take place, all other circumftances being the fame; and it has never been proved that the vapour in a receiver from which the air has been exhaufted, is precipitated upon the admiffion of perfectly dry air. Hence then we ought to conclude, till the contrary can be proved, that the condenfation of vapour expofed to the common air does not in any manner depend upon the preffure of the air." Effays, p. 201.

In 1802, Mr. Dalton publifhed, in the fifth vol. of the Manchefter Memoirs, a feries of interefting effays relative to evaporation; he found, 1ft. The expanfive force of pure fteam over water in vacuo at all temperatures from 32° to 212°; 2d. The expanfive force of dry air for the fame range of temperature; and, 3d. The expanfive force of dry air in contact with water for the like range. From a comparifon of thefe experiments it appeared that the obfervation of De Luc was univerfally true; namely, that fteam in vacuo and fteam in air are precifely of the fame force at the fame temperature. The law was found to apply equally to the fteam from ether and other liquids, and to other elaftic fluids, as well as common air. Mr. Dalton confiders thefe facts to be decifive as to the nature of the connection between fteam and air, and infers that fteam forms a mechanical mixture with air, and not a chemical compound, as fome have fuppofed. This conclufion was confirmed by experiments upon the quantity of water evaporated at different temperatures; which was always in proportion to the elaftic force of vapour at the temperature. For inftance, water at 212°, or kept juft boiling, evaporates twice as faft as water of 180°, and this twice as faſt as water of 150°; and the forces of pure ſteam at thoſe temperatures are 30, 15, and $7\frac{1}{2}$ inches of mercury reſpectively. The rule, however, does not apply without a correction for low temperatures; becauſe the ſteam already in the air prevents in degree the aſcenſion of freſh ſteam; whereas in high temperatures, the ſmall portion of ſteam commonly in the air is too trifling to have any obſervable effect. Mr. Dalton has given a table founded upon experience, and adapted to the above-mentioned law, by which not only the actual quantity of water evaporated in atmoſpheric temperatures may be aſcertained, but alſo the quantity of vapour exiſting in the air may be found, provided the rate of evaporation is given. The following is an abſtract of it.

The firſt column of the table expreſſes the temperature; the ſecond, the correſponding force of vapour in vacuo, derived from experiment; the third column expreſſes the number of grains of water evaporated per minute, from a ſurface of $28\frac{1}{4}$ ſquare inches, in a moderate current of air or nearly calm; the fourth is the like evaporation in a medium current; and the fifth is the evaporation when a ſtrong breeze exiſts, or a rapid current of air ſweeps over the evaporating ſurface. The air is ſuppoſed to be perfectly dry or free from vapour; otherwiſe every particular ſtate of atmoſpheric vapour would require a table. The table is intended to be uſed when we want to find the quantity of water evaporated from a given ſurface by the ſlow and gradual operation of the atmoſpheric temperature, or what has been called *ſpontaneous* evaporation. But as it is adapted to air perfectly free from vapour, it cannot be of any practical utility without further data. The force of vapour actually exiſting in the atmoſphere at the time muſt be firſt aſcertained, by determining the temperature at which dew begins to be formed on a glaſs, &c. containing cold water or a cold mixture. Then the force due to that temperature muſt always be ſubtracted from the whole force due to the given temperature of the evaporating water.

Table.

Temperature	Force of vapour in Inch. of Mer.	Grains of Water evaporated.		
		Loweſt	Mean	Higheſt
212°	30.00	120	154	189
20°	.129	.52	.67	.82
25	.156	.62	.79	.97
30	.186	.74	.95	1.17
35	.221	.80	1.14	1.39
40	.263	1.05	1.35	1.65
45	.316	1.26	1.62	1.99
50	.375	1.50	1.92	2.36
55	.443	1.77	2.28	2.78
60	.524	2.10	2.70	3.30
65	.616	2.46	3.16	3.87
70	.721	2.88	3.70	4.53
75	.851	3.40	4.37	5.34
80	1.000	4.00	5.14	6.29
85	1.17	4.68	6.07	7.46

Problem 1.—Having given the quantity of force of atmoſpheric vapour, to find the rate of evaporation,—

Suppoſe that atmoſpheric vapour begins to be condenſed at 50°, and the temperature of the air is 60°; query the rate of evaporation, with a medium breeze?

Whole evaporating force, per table, for 60°	=	2.70 grains.
Exiſting force of atmoſpheric vapour for 50°	=	1.92 grains.
Remainder - -		.78 grains.

Hence a ſurface of $28\frac{1}{4}$ inches would loſe $\frac{78}{100}$dths of a grain in each minute.

Again; ſuppoſe the atmoſpheric vapour to be at 20°, with a ſtrong breeze, in one caſe, the air being 32°; and the atmoſpheric vapour to be at 50°, in another caſe, with calm air at 58°; query the rates of evaporation in thoſe two caſes?

1ſt Caſe. Whole evaporating force per table, for 32° - - -	=	1.26 grains.
Exiſting force of atmoſ. vap. for 20°	=	.82 grains.
Remainder, or rate of evaporation	=	.44 grains.

2d Caſe. Whole evaporating force, per table, for 58° - - -	=	1.96 grains.
Exiſting force of atmoſ. vap. for 50°	=	1.50 grains.
Remainder, or rate of evaporation	=	.46 grains.

Hence it appears that under the circumſtances above-mentioned the evaporation would be nearly the ſame in both caſes.

Problem 2.—Having given the rate of evaporation, to find the quantity or force of amoſpheric vapour.

Suppoſe the evaporation from a ſurface of $28\frac{1}{4}$ inches is found to be one grain in a minute, with a medium breeze, the temperature being 70°; query the quantity and force of atmoſpheric vapour?

Whole evaporating force, per table, at 70°	=	3.70 grains.
Obſerved evaporating force - -	=	1.00 grains
Remainder = exiſting atmoſpheric force		2.70 grains,

which correſponds to 60°, for the temperature at which the atmoſpheric vapour would be found to be condenſed at the time.

Mr. Dalton contends that all the different gaſes conſtituting the atmoſphere, namely, azotic, oxygenous, carbonic acid, and ſteam, are independent of each other; ſo that they preſs the ſurface of the earth and other bodies with their own weight only, when in a ſtate of equilibrium. Whence he conſiders the *quantity* and *force* of ſteam in the atmoſphere as ſynonymous terms. Thus in the above example, the force of ſteam of 60° being repreſented by .524 parts of an inch of mercury, the weight of the incumbent atmoſphere of ſteam muſt be the ſame, or equal to 7 inches of water nearly. This notion, concerning the whole quantity of ſteam in the atmoſphere incumbent upon any place, is entirely new; and, if correct, muſt be of the firſt importance in meteorology.

Though the reaſons aſſigned by De Luc and Dalton for the non-condenſation of ſteam, already exiſting in air, appear to be incontrovertible, yet from what has been ſaid above, no ſufficient reaſon has been given by either of them for the *entrance* of ſteam of low temperatures into the atmoſphere. How does ſteam of $\frac{1}{60}$th part of the force of the atmoſphere at firſt penetrate it? Even Sauſſure ſpeaks of the fact, and as if there were no difficulty attending it. De Luc does not attempt any explanation. Dalton ſeems to have been fully aware that the hypotheſis of pure ſteam exiſting in air was not tenable without obviating this difficulty. Accordingly he conceived that the particles of ſteam are not repulſive to thoſe of air, but only to other particles of ſteam; hence the new formed ſteam has a kind of vacuum, to enter in the pores or interſtices of the air. But this, it is thought by many, is going into the other extreme, and making the facility much too great; befides, there is no notion fo general and fo probable, as the one that heat is the caufe of repulfion; and if this notion be true, the particles of fteam cannot be admitted to be repulfive of each other, and indifferent to thofe of air. Mr. Dalton, it feems, now confiders the inequality in the fize of the ultimate particles of different elaftic fluids to be the caufe why they are conftantly diffufing themfelves through each other, and never obtain a proper equilibrium till their particles take the arrangement, which they would do in a vacuum; and the elevation of fteam from the furface of water, he fuppofes, takes place, becaufe certain particles of the furface are in a great meafure exempt from the preffure of the atmofphere. See New Syftem of Chemical Philofophy, p. 190.

From the experiments of Mr. Watt on fteam, it appears that evaporation at high and low temperatures is much the fame as to the expenditure of heat for a given weight of water.

The evaporation from ice of 32° does not differ materially from that of water, at the fame temperature. Electricity is faid to promote evaporation in fome degree.

Evaporation in Meteorology.—With refpect to the natural evaporation of water from the furface of the earth, the experiments of Mr. Hoyle and Mr. Dalton, of Manchefter, are nearly the only ones that are fufficiently numerous from which to draw any conclufions. They took a cylindrical veffel of tinned iron, 10 inches in diameter, and three feet deep; there were two pipes foldered into it, one at the bottom, the other at the top, for the water to run off into bottles. The veffel was filled with gravel, fand, and foil, and fubfequently the foil was covered with grafs and other living vegetables. It was nearly buried in the ground in an open fituation, and provifion made for placing bottles to the two pipes. In this manner it was expofed to receive the rain, and to fuffer evaporation from the furface, the fame as the furrounding green ground. A regular regifter was kept of the water which percolated through the foil and gravel into the bottles; and a rain gage of the fame furface was kept clofe by, for the fake of comparifon. The refults are contained in the table below, together with the mean evaporation from a like furface of water, for the three fucceeding years.

Water through the two Pipes.	1796	1697	1798	Mean.	Mean Rain.	Mean Evap. from Ground	Mean Evap. from Water.
	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
January	1.90	.68	1.77	1.45	2.46	1.01	1.50
February	1.78	.92	1.12	1.27	1.80	.53	2.00
March	.43	.07	.34	.28	.90	.62	3.50
April	.22	.30	.18	.23	1.72	1.49	4.50
May	2.03	2.44	.01	1.49	4.18	2.69	4.96
June	.17	.73	—	.30	2.48	2.18	6.49
July	.15	03	—	.06	4.15	4.09	5.63
Auguft	—	—	.50	.17	3.55	3.38	6.06
September	—	.98	—	.33	3.28	2.95	3.99
October	—	.68	—	.23	2.90	2.67	2.35
November	—	1.04	1.59	.88	2.93	2.05	2.04
December	.20	3.08	1.88	1.72	3.20	1.48	1.50
	6.88	10.95	7.39	8.41	33.55	25.14	44.43
Rain	30.63	38.79	31.26				
Evap.	23.75	27.84	23.87				

From this table it appears that the evaporation from a furface of water, is nearly twice as much as from green ground; alfo, that about eight or nine inches of rain are left for the fupply of fprings and rivers. This furplus of water muft be evaporated from the fea, and return to it again by the rivers.

Evaporation in Chemiftry.—When artificial heat is applied, the quantity evaporated will be nearly in geometrical progreffion to the excefs of temperature, above that of the air. It is always nearly in proportion to the furface expofed. When the liquid is much below the margin of the veffel, the evaporation is greatly retarded.

Evaporation in the Arts. In certain arts, fuch as dyeing, printing, &c. quick evaporation is expedient. This is effected by expofing the wet pieces in a ftove, which has commonly a fire and long flues from which the heat is diffipated into the room. The cold air fhould be admitted into the room as near the fire and flues as poffible; and feveral fmall openings at the top of the ftove fhould be made to fuffer the vapoury air to efcape.

See the articles Clouds, Dew, Distillation, Hygrometer, Rain, Steam, &c.

Evaporation, in *Pharmacy, Chemiftry*, &c. denotes an operation by which the more aqueous and volatile parts of fluids are fpent, or driven away in fteam, fo as to leave the remaining part ftronger, or of a higher confiftence than before.

Evaporation is effected by fetting a liquor over a gentle heat, to carry off the moft fluid and volatile parts, without leffening the quantity of the other matters with which the liquor is impregnated.

The veffels ufed for this purpofe are bafons, tefts, or crucibles, which are made of glafs, metal, or earth, according to the nature of the bodies on which the operation is to be performed. They are flat, fhallow, and wide, fo that the body from which the evaporation is to be made may prefent a large furface to the air. In all evaporations the degree of heat ought to be proportioned to the volatility of the fubftance to be evaporated, and to the degree of fixity of the fubftance intended to be left, and of its adhefion to the volatile parts. In fome cafes, as in obtaining oil from rectified fpirit of wine and ether, the liquors ought to be evaporated upon the furface of water in open air, without any other heat than that of the atmofphere; in others, when the part to be evaporated is not very volatile, and when the remaining fubftance is very fixed, and does not adhere much to the volatile part, as in the purification of gold by antimony, a ftrong heat may be applied, and a current of air directed upon the furface of the body. Macquer.

EVARCHUS, in *Ancient Geography*, a river of Afia, forming the boundary between Paphlagonia and Cappadocia. Valerius Flaccus affigns it to Scythia, and fays it abounded with fwans.

EVARISTUS, in *Biography*, bifhop of Rome, was elected to that office about the year 100, in which he continued eight or nine years. Much has been faid of him with regard to his decretals; his diftribution of Rome into parifhes, his prefenting Adrian with a book concerning the excellence of the Chriftian religion, and his martyrdom under the reign of that emperor; but thefe and other facts collected by modern writers do not ftand on fufficient authority to obtain credit. Moreri.

EVASION, Evasio, in *Law*, is ufed for any fubtile endeavour to fet afide truth, or to efcape the punifhment of the law, which will not be endured. Thus, if a perfon fays to another that he will not ftrike him, but will give

him

him a pot of ale to ſtrike him firſt; and accordingly he ſtrikes, the returning of it is puniſhable; and if the perſon firſt ſtriking be killed, it is murder; for no man ſhall evade the juſtice of the law by ſuch a pretence to cover his malice. 1 Hawk. P. C. 81.

EUASPLA, in *Geography*, a river of India, in the northern part of the mountain Paropamiſus, which ran S.E. into the Indus.

EVATES, a branch or diviſion of the ancient Celtic philoſophers, the Druids.

Strabo diſtributes the philoſophers among the Britons and Gauls into three ſects; Βαρδοι, *Bards*, Ουατεις, *Evates*, and Δρυιδαι, *Druids*. He adds, that the Bards were poets and muſicians; the Evates, prieſts and naturaliſts; and the Druids, moraliſts as well as naturaliſts. But Marcellinus, Voſſius, and Hornius, reduce them all to two ſects, *viz.* Bards and Druids. Laſtly, Cæſar, lib. vi. comprehends them all under the name of *Druids;* which ſee.

The Evates or Vates of Strabo might probably be what other authors, and particularly Ammian. Marcellin. calls *Eubages;* but Mr. Bouche, in his Hiſt. de Provence, lib. ii. chap. 2. diſtinguiſhes between them. The Vates, he ſays, were ſuch as took care of the ſacrifices and other ceremonies of religion; and the Eubages, thoſe who ſpent their time in the ſearch and contemplation of the great myſteries of nature.

EVAUX, in *Geography*, a town of France, in the department of Creuſe, and chief place of a canton, in the diſtrict of Aubuſſon; 26 miles E. of Gueret. The number of inhabitants in the place is 2,081, and in the canton 8,036, and the territorial extent of 232½ kiliometres includes 12 communes. Near it are a mineral ſpring and baths. N. lat. 46° 10′. E. long. 3° 33′.

EVAX, in *Botany*, Gærtn. v. 2. 393, ſee FILAGO.

EVAZA, in *Ancient Geography*, an epiſcopal ſee of Aſia propria, under the metropolis of Epheſus; mentioned in the acts of the council of Epheſus.

EUBAGES, an order of prieſts or philoſophers among the ancient Celtæ or Gauls. Chorier takes the Eubages to be the ſame with the Druids and Saronidæ of Diodorus. Others will have the Eubages to be thoſe whom Strabo, lib. iv. p. 197. calls Ουατεις, *Evates*, or *Vates*, on which principle there is room to conjecture, that the word ſhould be written Ουαγεις, it being eaſy to miſtake a Γ for a T. See DRUID.

EUBELSTADT, in *Geography*, a town of Germany, in the biſhopric of Wurzburg, on the Maine; three miles S. of Wurzburg.

EUBŒA, in *Ancient Geography*, one of the moſt conſiderable of the Greek iſlands, formerly joined to Bœotia, as Pliny informs us, by an iſthmus, ſo narrow is the Euripus in ſome places, which ſeparates it from the continent; and extending from north-eaſt to ſouth-weſt 150 miles, but where broadeſt being only 40 miles, and 20 where it is narroweſt. In compaſs it is eſtimated at 365 miles. This iſland was anciently denominated Chalcis, Ellopia, Aonia, Abantis or Abantia, Macris, Oche, Bomo, &c. Its appellation Eubœa is ſaid to be derived from a famous cave on the eaſtern coaſt of the iſland, called by the Greeks αυλη βοος, or the ox-ſtall, and this name was probably deduced from its excellent paſtures. Eubœa had ſeveral remarkable promontories, which ſtretched far into the ſea; of theſe Pliny and Mela mention three, *viz.* Geraſtus and Caphareus to the ſouth, and Cenæum to the north; and Strabo mentions a fourth, which he calls Petalia, over-againſt Sunium. Cenæum, now Capo Liter, and Geraſtus, now Capo Roſſo, are, according to Strabo, 1200 furlongs diſtant from each other, which meaſure exactly the length of the iſland, as it is ſet down by Pliny. The mountains of Eubœa are high, and covered during a great part of the year with ſnow. The famous city of Chalcis was ſituated under one of them of the ſame name, and on another, called Dryphis, was a temple dedicated to Diana. The following rivers are mentioned by Strabo, *viz.* Callas, Budarus, Cireceus, and Neleus or Melas. The champaign country was exceedingly fertile, and yielded great plenty of corn, wine, oil, and all ſorts of delicious fruits; but it was chiefly famous for its rich paſtures. This iſland had in former times many cities of great note, which are mentioned by Strabo, Pliny, Ptolemy, and Mela. On the eaſtern coaſt ſtood the cities of Geraſtus, which was a famous haven, Petalia, and Caryſtus, near which were the celebrated quarries of Caryſtian marble, ſo much valued by the Romans, and alſo of Amianthus or Aſbeſtos. About five miles from Caryſtus was the village of Amarynthus, famous for a temple of Diana. On the ſame coaſt ſtood Eretria and Chalcis, which ſee reſpectively. Between Chalcis and the promontory Cenæum, ſtood the cities of Edepſum and Oreos; the former being famous for its hot-baths, and the latter one of the moſt powerful cities of Eubœa during the Trojan war, and occupying the fourth part of the iſland, in the time of Philip, the father of Alexander. The name Oreos was changed by the Athenians, when they became maſters of the iſland by means of Pericles, into that of Iſtiæa, or Heſtiæa, which was the name of their tribe. On the north ſide of the iſland, oppoſite Theſſaly, and extending from Cenæum to Artemiſium, ſtood Dia, or Athenæ Diades; and on the coaſt, waſhed by the Ægean ſea, ſtood the maritime city of Cerinthus. The inland cities mentioned by Strabo, Pliny, Ptolemy, &c. were Ellopia, Nyſa, Eubœa, Orabiæ, Rhamnus, Porthmus, Algæ, and Tamyna.

Eubœa was probably one of the iſlands in which the firſt Orientals, who paſſed from the continent of Aſia towards the coaſts of Greece, made a ſettlement. It muſt have formed a very powerful ſtate at an early period, ſince its king Elephenor conducted 40 ſhips to the war of Troy. Solinus aſcribes the commencement of this monarchy to the Titans. Others ſuppoſe Abas to have been the firſt ſovereign of Eubœa. The ſucceſſion of its ſovereigns is little known. In the time of Darius Hyſtaſpis, the cities of Chalcis, Eretria, Caryſtus, and Oreos, formed diſtinct republics, governed by the nobles, whom they called hippobates, or horſemen; none being received into the government who were not able to maintain a certain number of horſes. This oligarchy was not of long duration; but it was ſucceeded by a democracy, compoſed of domeſtic tyrants, who ſeized all power to themſelves, and ruled in their ſeveral cities without controul. At length the Eubœans ſubmitted firſt to Philip of Macedon, and then to his ſon Alexander, on whoſe death they endeavoured to ſhake off the Macedonian yoke; but they were again brought under ſubjection by Antigonus. When the Romans firſt paſſed into Greece, the kings of Macedon held this iſland in ſubjection; but it was ſoon after declared free by the ſenate, in order to weaken the power of Philip in theſe parts. But not being ſupplied with forces, they were unable to maintain their liberty; and fell under the power of Antiochus the Great, and Mithridates king of Pontus. The Romans, however, prevailing in the Eaſt, reſtored the Eubœans to their former ſtate of liberty. It was not long before Marc Antony ſubjected them to Athens; but Auguſtus, incenſed againſt the Athenians for aſſiſting his rival, firſt gave freedom to the city of Eretria, and ſoon after to the whole iſland, which remained in a flouriſhing condition, under its own laws, till the

the reign of Veſpaſian, when it underwent the ſame fate as the other ſtates of Greece.

Eubœa, the name of ſeveral towns in the iſland of Eubœa, Corcyra, and Lemnos.

EUBULIDES, in *Biography*, a native of Miletus, was a ſucceſſor of Euclid in the Megaric ſchool. He was a ſtrong opponent of Ariſtotle, and ſeized every occaſion of cenſuring his writings and calumniating his character. He introduced new ſubtleties into the art of diſputation, ſeveral of which, though often mentioned as proofs of great ingenuity, deſerve only to be remembered as examples of egregious trifling. They belong to that ſophiſtical mode of reaſoning, called by Ariſtotle eriſtic ſyllogiſms. A ſingle ſpecimen will be ſufficient. It ſhall be of the ſophiſm, called from the example, "the Lying :" if, when you ſpeak the truth, you ſay you lie, you lie ; but you ſay you lie, when you ſpeak the truth ; therefore in ſpeaking the truth, you lie. Theſe ſilly inventions for perplexing plain truth were formerly in ſuch high repute, that Chryſippus wrote ſix books upon the above mentioned ſophiſm ; and Philetas, a Choan, died of a conſumption which he contracted by the cloſe ſtudy he beſtowed upon it. The inſcription upon his tomb was Ὁ ψευδόμενος, "The Deceived." Brucker's Hiſt. Phil. by Enfield, vol. i. p. 192.

EUCALYPTUS, in *Botany*, from ευ, *well*, and καλυπτος, *covered*, alluding to the peculiar lid which covers the calyx and encloſes the organs of impregnation. L'Herit. Sert. Angl. 18. Ait. Hort. Kew. v. 2. 157. Willd. Sp. Pl. v. 2. 976. Mart. Mill. Dict. v. 2. Sm. Bot. of N. Holl. 39. Juſſ. 451. Claſs and order, *Icoſandria Monogynia*. Nat. Ord. *Heſperideæ*, Linn. *Myrti*, Juſſ.

Gen. Ch. *Cal.* Perianth ſuperior, of one leaf, abrupt, entire, permanent, cloſed before impregnation with a convex or conical, entire, deciduous lid, which is ſometimes, if not always, of two or three layers. *Cor.* none. *Stam.* Filaments numerous, thread-ſhaped, equal, inſerted into the margin of the calyx within the lid, and not expanding till after it falls, anthers roundiſh, two-lobed, ſmall. *Piſt.* Germen inferior, urceolate, firmly united with the baſe of the calyx, ſometimes angular ; ſtyle ſimple, columnar, about as long as the full-grown ſtamens ; ſtigma ſimple, bluntiſh. *Peric.* Capſule roundiſh, crowned with the rim of the calyx, of three or four cells, opening at the top. *Seeds* numerous, angular, ſmall.

Eſſ. Ch. Calyx ſuperior, permanent, truncated, covered before flowering with an entire lid, which ſoon falls off. Capſule of three or four cells, opening at the top. Seeds numerous.

This genus was founded by the late M. L'Heritier in his Sertum Anglicum, upon a ſingle ſpecies, from Van Diemen's land, named by him *obliqua*, and figured in the 20th plate of that work. Its deſcription never appeared. The generic characters were by him communicated to the Hortus Kewenſis, and adopted, with ſome neceſſary corrections, in Dr. Smith's Botany of New Holland, where a ſecond ſpecies is figured, *E. robuſta*, t. 13. This is called New Holland Mahogany, or Brown Gum Tree, and is one of the loftieſt trees about Port Jackſon, being often 100 feet high, and proportionably thick. The wood hard, heavy, ſtrong, red and very reſinous. *Leaves* alternate, ſtalked, ovate, entire, a little oblique and unequal. *Flowers* in denſe ſimple umbels, of a tawny yellow, on ſimple or divided angular ſtalks, growing in a corymboſe manner about the ends of the branches. The *lid* in this ſpecies is conical, as long as the calyx and germen, with a ſtricture in the middle ; that of the former is ſhort and hemiſpherical, with a minute point. Four more ſpecies from New South Wales are deſcribed in the work laſt mentioned, and ſix additional ones by the ſame author in the Tranſ. of the Linn. Soc. v. 3. p. 283—288. All theſe 12 are adopted by Willdenow in his Sp. Pl. A new one, *E. marginata*, was added to this liſt by Dr. Smith in Tr. of Linn. Soc. v. 6. 302, who has ſince figured and fully deſcribed one of the moſt important of the former, *E. reſinifera*, the Red Gum Tree, in his Exotic Botany, v. 2. 49. t. 84. This bloſſomed in Lady De Clifford's greenhouſe at Paddington. The *flowers* are green with white ſtamens. *Lid* conical, twice as long as the calyx and germen, conſiſting of three coats, of which the outermoſt is formed of three ribs originating from the angles of the germen.—The tree produces an aſtringent reſin of a fine deep red, whoſe probable uſes in medicine or the arts merit enquiry. Many more ſpecies of this genus are ſaid to abound in New Holland, all lofty trees, deſtitute of hairineſs, with ſimple, lanceolate, or ſomewhat ovate, pointed, entire leaves, generally oblique, and often unequal, at the baſe ; without ſtipulas. They are commodiouſly divided into two ſections, by their hemiſpherical or conical lids.

EUCARPIA, in *Ancient Geography*, a town of Aſia, in Greater Phrygia, according to Ptolemy and Strabo.

EUCERA, in *Entomology*, a genus of Hymenoptera, propoſed by Scopoli, and adopted by various late writers. Under this denomination are comprehended thoſe of the Linnæan genus Apis (bee), which have the mandibles horny, incurvated, acute, and toothleſs ; jaw elongated, and membranaceous at the tip ; lip horny, five-cleft ; tongue inflected and ſeven-cleft ; antennæ cylindrical, thoſe of the male very long, and often exceeding the length of the body ; the abdomen ſhort and downy ; tail of the female armed with a ſting. The inſects of this genus form cylindrical cavities in the earth, in which they depoſit their eggs, each included in a ſeparate cell, and furniſhed with a ſuitable proviſion of honey for the ſubſiſtence of the young when hatched. In the winged ſtate the Euceræ fly with great rapidity, and like the bee, collect the farina and nectar of flowers with great induſtry and activity. The females commonly differ much in appearance from the males of the ſame ſpecies, independently of the length of the antennæ.

Species.

Longicornis. Black ; ſummit of the head, thorax, and two firſt rings of the abdomen above grey-downy ; reſt of the abdomen nearly glabrous. Latreille. *Eucera longicornis*, Fabr. Kirby. Ap. Angl.

Native of Europe. The female of this ſpecies is not diſtinctly aſcertained. Mr. Kirby ſeems to entertain no doubt of its being the inſect figured by Panzer under the name of Andrena ſtrigoſa. Since his obſervations appeared, however, Latreille has written on the ſame ſubject, and though he does not refer to the remark of Mr. Kirby, he evidently alludes to it in the following paſſage, " Je doute que l'andrene, que Panzer nomme *ſtrigoſa*, ſoit la femelle de cette eſpèce. Son abdomen eſt très-different par ſes taches de celui de *l'eucere longicorne* et cet inſecte ne paroît qu'au milieu du l'ete, tandis que le dernier ne ſe voit, qu'au printemps." The difference of the abdomen may perhaps be conſidered in this ambiguous race leſs definitive than the time of its appearance in the winged ſtate ; for if the firſt be conſtantly found only in the middle of the ſummer, and the other in ſpring, we ſhould admit them to be diſtinct. It further merits obſervation that Latreille deſcribes an inſect which he imagines to be the true female, " La femelle, &c."—" The female, or, at leaſt, that which I regard as ſuch, and of which I have

have feen an individual in the collection of the naturalift Baumhaaver, differs only in the fhortnefs of the antennæ; the head entirely black, and the pofterior feet very downy." The fpecies inhabits Europe.

ATRICORNIS. Antennæ black, as long as the body, which is hairy and ferruginous. Fabr.

Native of Barbary.

GLAUCA. Antennæ ferruginous, as long as the body, the latter hairy and glaucous. Fabr. Sp. Inf. &c.

Inhabits the Eaft; two firft fegments of the abdomen with a black band.

LINGUARIA. Antennæ black, length of the abdomen; thorax cinereous; abdomen black. Fabr.

Native of Europe, on flowers.

TUMULORUM. Antennæ length of the abdomen: body black; legs and jaws yellowifh. Linn. Fn. Suec. *Eucera tumulorum*, Fabr.

An European infect, alfo found on flowers.

GRISESCENS. Antennæ black, as long as the body; the latter hairy and cinereous. Fabr.

Inhabits Barbary.

ANTENNATA. Antennæ as long as the body; abdomen black, with whitifh ftreaks. Fabr.

A fmall infect, found in abundance in the environs of Paris in autumn, and alfo in other parts of Europe. The lip is marked with a trilobate fpot of yellow; the head and thorax cinereous; abdomen glabrous; edges of the fegments fringed with white, legs teftaceous.

CURVICORNIS. Blackifh-grey; antennæ convoluted, fub-clavated; abdomen roundifh; margin of the wings black. Scopoli. Native of Carniola.

BREVICORNIS. Ferruginous hairy; abdomen braffy; antennæ fhort and black. Fabr. Suppl.

This is an inhabitant of Italy, and is defcribed by Fabricius from the cabinet of Dr. Allioni. The head, thorax, and legs with ferruginous hairs.

CRASSIPES. Hairy cinereous; abdomen black, with the margins of the fegments greenifh; pofterior thighs thick. Fabr. Suppl.

Native of Tranquebar in the cabinet of Lund. The antennæ of this infect are fhort; the wings are dufky with fufcous tip; legs yellowifh; thighs of the pofterior pair thick, dentated, and black; fhanks incurvated, toothed, and yellow. Whether this and the fpecies immediately preceding ought ftrictly to be placed with the Euceræ, (fo named from the length of their antennæ,) if they fhould be of the male kind, may be fubmitted with deference; the fex is not mentioned in either inftance. Fabricius defcribed them as Euceræ, and they agree in every refpect with that genus, except in the remarkable brevity of the antennæ.

EUCHARIST, EUCHARISTIA, the facrament of the Supper, or a participation of the body and blood of Chrift, under the fpecies or figures of bread and wine. See COMMUNION, SACRAMENT, SPECIES, TRANSUBSTANTIATION, and CONSUBSTANTIATION.

The word in its original Greek, Ευχαριϛια, literally imports *thankfgiving*, being formed of ευ, *bene*, *well*, and χαρις, *gratia*, *thanks*.

EUCHENDORF, in *Geography*, a town of Lower Bavaria, on the Vils; 14 miles W. of Vilzhofen.

EUCHERIUS, in *Biography*, a bifhop of Lyons in the fifth century, began his career in fecular life, in the various offices of which he acquired wealth. He fuftained the rank of fenator, and having married, had feveral children, among whom were two fons, whom he lived to fee advanced to the epifcopal dignity. Wearied with the purfuits of the world, he embraced a monaftic life, which he quitted for the bifhopric of Lyons in the year 434. He attended the deliberations of the firft council of Orleans in the year 441, and was diftinguifhed for his learning and fagacity. He was a popular preacher, upon thofe principles of grace which were vindicated by St. Auguftine. He died about the year 454. Among the various pieces attributed to Eucherius, may be noted "Epiftola de Laude Eremi, feu de Vita Solitaria," intended to extol the advantages of afcetic life, written, for the times, with uncommon beauty and purity of language: "Epiftola Parænetica de contemptu Mundi, et Sæcularis Philofophiæ ad Valerianum Cognatum fuum," which was publifhed by Erafmns, with annotations, at Bafil in the year 1520, and pronounced to be one of the moft elegant pieces of antiquity. To thefe may be added two treatifes intended to illuftrate difficult paffages of Scripture, of lefs value than thofe mentioned above. Thefe, and fome others attributed to Eucherius, were collected and publifhed at Bafil in 1531, at Rome in 1564, and are likewife to be found in the fixth volume of the "Bibliotheca Patrum." There was another Eucherius who was likewife a bifhop of Lyons, and affifted at the fecond council of Orleans about the year 529. Moreri.

EUCHITES, or EUCHITÆ, in *Ecclefiaftical Hiftory*, a fect of ancient heretics, who were firft formed into a religious body towards the end of the fourth century, though their doctrine and difcipline fubfifted in Syria, Egypt, and other eaftern countries before the birth of Chrift; they were thus called becaufe they prayed without ceafing, imagining that prayer alone was fufficient to fave them.

Their great foundation was thofe words of St. Paul, Epift. i. to the Theffalonians, chap. v. ver. 17. *pray without ceafing*.

The word is formed of the Greek, ευχη, *prayer*, whence ευχιται, the fame with the Latin, *precatores*, *prayers*. They were alfo called *Enthufiafts* and *Meffalians*, a term of Hebrew origin, denoting the fame as Euchites.

The Euchites were a fort of myftics who imagined, according to the oriental notion, that two fouls refided in man, the one good and the other evil; and who were zealous in expelling the evil foul or dæmon, and haftening the return of the good fpirit of God, by contemplation, prayer, and finging of hymns. They alfo embraced the opinions nearly refembling the Manichean doctrine, and which they derived from the tenets of the oriental philofophy. The fame denomination was ufed in the twelfth century, to denote certain fanatics who infefted the Greek and Eaftern churches, and who were charged with believing a double Trinity, rejecting wedlock, abftaining from flefh, treating with contempt the facraments of Baptifm and the Lord's Supper, and the various branches of external worfhip, and placing the effence of religion folely in external prayer, and maintaining the efficacy of perpetual fupplications to the Supreme Being for expelling an evil being or genius, which dwelt in the breaft of every mortal. This fect is faid to have been founded by a perfon called Lucopetrus, whofe chief difciple was named Tychicus. By degrees it became a general and invidious appellation for perfons of eminent piety and zeal for genuine Chriftianity, who oppofed the vicious practices and infolent tyranny of the priefthood; much in the fame manner as the Latins comprehended all the adverfaries of the Roman pontiff under the general terms of *Waldenfes* and *Albigenfes*. Mofh. Eccl. Hift. Eng. edit. 8vo. vol. i. p. 350. and vol. ii. p. 441.

St. Cyril of Alexandria, in one of his letters, takes occafion to cenfure feveral monks in Egypt, who, under pretence of refigning themfelves wholly to prayer, led a lazy,

lazy, fcandalous life. A cenfure likewife applicable to monafteries in general.

EUCHOLOGIUM, Ευχολογιον, a Greek term, fignifying, literally, *a difcourfe on prayer*.

The word is formed of ευχη, *prayer*, and λογος, *difcourfe*.

The Euchologium is properly the Greek ritual, wherein are prefcribed the order and manner of every thing relating to the order and adminiftration of their ceremonies, facraments, ordinations, &c.

Fa. Goaar has given us an edition of the Greek Euchologium in Greek and Latin, with notes, at Paris.

EUCHROO'N, in *Surgery*, a plafter mentioned by Scribonius Largus.

EUCHYMIA, from ευ, *good*, and χυμος, *juice*, in *Medicine*, a good temper of the blood, or other juices and fluids in an animal body.

EUCLABRIS, in *Antiquity*, a table whereon the flaughtered victim was fpread, in order to have its inteftines carefully infpected. It was from this table that the veffels ufed in facrifices were called *euclabria*.

EUCLASE. The colour of this mineral is a very clear fea-green. It occurs only cryftallized. Its primitive form is that of an oblique quadrilateral prifm, but its fummits are generally fo complicated by truncatures and bevellings as to render a mere verbal defcription of it wholly unintelligible: in this ftate it refembles certain varieties of topaz, but may readily be diftinguifhed by meafuring the obtufe angles of the prifm, which in this mineral are 133°, whereas in the topaz they are 124°; its lamellæ alfo are not perpendicular to the axis of the prifm. It has a brilliant vitreous luftre. Its fracture in the direction of its axis and parallel to the fmall diagonal of its bafe is perfectly lamellar; but when parallel to the large diagonal is very imperfectly fo. Its crofs fracture is fomewhat conchoidal. It is tranfparent and has a double refraction. It is fufficiently hard to fcratch quartz, but is remarkably brittle. Sp. gr. = 3.06.

When expofed to the blowpipe, it firft lofes its tranfparency, and then melts into a white enamel. It has been analyfed by Vauquelin, with the following refult:

Silex - - - -	35 to	36
Alumine - - - -	18 —	19
Glycine - - - - - -	14 —	15
Iron - - - -	2 —	3
	69 —	73
Lofs - - - - -	31 —	27
	100 —	100

This mineral is fo very rare that only a fmall portion could be afforded for analyfis; of the lofs, Vauquelin attributes the greateft part to water of cryftallization, and the reft is probably alkali.

The euclafe was found in Peru by Dombey, and all the fpecimens in the cabinets of Europe were brought over by this naturalift.

EUCLEA, in *Botany*, is derived by Profeffor Martyn from ευκλεια, *glory*, or *celebrity*, which feems in no refpect applicable to this plant. We would rather explain it by ευ, *well*, and κλειω, *to fhut up*, becaufe of the manifold coverings of the feeds, each of which is enclofed in an arillus, within the cell of a capfule, whofe outfide moreover is protected with a covering of pulp. To all this indeed L'Heritier firft adverted, and not Linnæus nor Thunberg, one of whom probably invented the name. Linn. Suppl. 67. Thunb. Nov. Gen. 84. L'Herit. Sert. Angl. 31. Schreb. 699, 700. Juff. 432. Clafs and order, *Dioecia Dodecandria*, or perhaps, as the Linnæan Syftem now ftands, *Polygamia Monoecia*. Nat. Ord. uncertain, Juff.

Gen. Ch. *Cal.* Perianth inferior, fmall, with five teeth, permanent. *Cor.* of one petal, larger than the calyx, in five deep, ovate, obtufe, equal, fpreading fegments. *Stam.* Filaments about fifteen, fhort, inferted into the receptacle; anthers erect, fquare, flightly downy, fhorter than the corolla. *Pift.* Germen fuperior, ovate, fomewhat pyramidal; ftyles two, the length of the ftamens; ftigmas fimple. *Peric.* Capfule with a pulpy coat, roundifh, with three horns, three cells, and three valves. *Seeds* folitary, roundifh, each enclofed in an arillus; one or two of them frequently proving abortive.

Eff. Ch. Calyx with five teeth. Corolla in five deep equal fegments. Stamens 15. Styles two. Capfule fuperior, of three cells, pulpy-coated. Seeds folitary, enclofed in an arillus.

Obf. L'Heritier, from whom the above characters are taken, remarks that fome flowers have an abortive germen, but he never faw any that were entirely female without ftamens. Thunberg defcribes diftinct male and female flowers, and afferts that the former are moft frequently five-cleft, the latter four-cleft. Linnæus does not advert to any fuch difference.

Thunberg defines three fpecies, all natives of the Cape of Good Hope, in his Prodromus, p. 85.

1. E. *lancea*. " Leaves lanceolate, flat."

2. E. *racemofa*. " Leaves ovate, flat."—E. racemofa; Linn. Suppl. 428. L'Herit. Sert. Angl. 32. Ait. H. Kew. v. 3. 411. (Padus foliis fubrotundis, fructu racemofo; Burm. Afric. 238. t. 84. f. 1: and Euonymus foliis fubrotundis integris, fructu corniculato; ibid. 260. t. 97. f. 1. E. africanus, foliis laurinis, fructu aculeato; Breyn, Ic. 31. t. 22. f. 3.) A fmooth branching fhrub, with alternate, obovate, thick, fomewhat revolute *leaves*, about an inch long, on fhort footftalks. *Flowers* eight or ten in each axillary drooping clufter, about as long as its correfponding leaf. *Petals* fnow-white. *Fruit* red, the fize of a pea.

3. E. *undulata*. " Leaves ovate, undulated."—Much like the laft in general afpect. Its red fruit is eaten by the Hottentots, who call the plant Guarri-bofches.

EUCLID, in *Biography*, a native of Megara, and founder of the Megaric or Eriftic fect, was diftinguifhed by his fubtle genius, and early application to the ftudy of philofophy. Having acquired fome knowledge of the art of difputation from the writings of Parmenides, he was induced by the fame of Socrates to remove from Megara to Athens, where he became the auditor and difciple of this eminent philofopher. Notwithftanding the terror of the decree which enacted, that any inhabitant of Megara who fhould be feen at Athens fhould forfeit his life, he frequently came to Athens by night, from the diftance of about 20 miles, concealed in a long female cloak and veil, to vifit his mafter. He alfo frequently engaged in the bufinefs and difputes of the civil courts, by which proceeding he offended Socrates, who defpifed forenfic contefts; and this circumftance feems to have occafioned a feparation between them. Afterwards he put himfelf at the head of a fchool in Megara, where his chief employment was to teach the art of difputation. Although he was much addicted to vehement debates, he poffeffed fo great a command of temper, that in a quarrel with his brother, who faid to him, " Let me perifh if I be not revenged upon you," Euclid replied, " And let *me* perifh, if I do not fubdue your reſentment by forbearance, and make you love me as much as ever."

Averſe from the analogical method of reaſoning, Euclid was of opinion that legitimate argumentation conſiſts in deducing fair concluſions from acknowledged premiſes. He held, that there is one ſupreme good, which is called by the different names of Intelligence, Providence, God; and that evil, conſidered as an oppoſite principle to the ſovereign good, has no phyſical exiſtence. The ſupreme good he defined to be that which is always the ſame. Good he therefore conſidered abſtractedly, as reſiding in the Deity, and he ſeems to have maintained, that all things which exiſt are good by their participation of the firſt good, and that in the nature of things there is no real evil. When Euclid was aſked his opinion concerning the gods, he replied, "I know nothing more of them than this: that they hate inquiſitive perſons." Brucker's Hiſt. Phil. by Enf. v. i.

Euclid, known to every well educated youth by his "Elements," was, according to the teſtimony of Pappus and Proclus, a native of Alexandria, in Egypt, where he flouriſhed and taught the mathematics in the reign of Ptolemy Lagus, about 300 years before Chriſt His was the firſt mathematical ſchool in that far famed city, where, till its conqueſt by the Saracens, moſt of the eminent mathematicians were either born, or ſtudied. To Euclid, and to thoſe immediately educated by him, the world has been indebted for Eratoſthenes, Archimedes, Apollonius, Ptolemy, &c. "The Elements," to which we have already referred, are not to be wholly attributed to Euclid, many of the invaluable truths and demonſtrations contained therein were diſcovered and invented by Thales, Pythagoras, Eudoxus, and others; but Euclid was the firſt who reduced them to regular order, and who probably interwove many theorems of his own, to render the whole a complete and connected ſyſtem of geometry. "The Elements" conſiſt of fifteen books, but the laſt two are ſuſpected to have been written 200 years after Euclid's death, by Hypſicles of Alexandria. The beſt edition publiſhed in this country is that printed at Oxford, in folio, in 1703; but the moſt common edition in our ſchools is that by the late learned Dr. Simſon. Euclid is ſaid to have been a perſon of agreeable and pleaſing manners, and admitted to habits of friendſhip and familiarity with king Ptolemy, who once demanded of the mathematician if he could not direct him to ſome ſhorter and eaſier way of acquiring a knowledge of geometrical truths, than that which he had exhibited in his "Elements," to which Euclid replied, that "there was no royal road to geometry."

Euclid, as a writer on muſic, has ever been held in the higheſt eſtimation by all men of ſcience who have treated of harmonics, or the philoſophy of ſound. As Pythagoras was allowed by the Greeks to have been the firſt who found out muſical ratios, by the diviſion of a monochord, or ſingle ſtring, a diſcovery which tradition only had preſerved, Euclid was the firſt who wrote upon the ſubject, and reduced theſe diviſions to mathematical demonſtration.

His "Elements" were firſt publiſhed at Baſil, in Swiſſerland, 1533, by Simon Grynæus, from two MSS. the one found at Venice, and the other at Paris. His "Introduction to Harmonics," (Εισαγωγη ἁρμονικη,) which in ſome MSS. was attributed to Cleonidas, is in the Vatican copy given to Pappus; Meibomius, however, accounts for this, by ſuppoſing thoſe copies to have been only two different MS. editions of Euclid's work, which had been reviſed, corrected, and reſtored from the corruptions incident to frequent tranſcription by Cleonidas and Pappus, whoſe names were, on that account, prefixed. It firſt appeared in print with a Latin verſion, in 1498, at Venice, under the title of "Cleonidæ Harmonicum Introductorium:" who Cleonidas was, neither the editor, George Valla, nor any one elſe pretends to know. It was John Pena, a mathematician in the ſervice of the king of France, who firſt publiſhed this work at Paris, under the name of Euclid, in 1557. After this, it went through ſeveral editions with his other works.

His "Section of the Canon," (Κατατομη κανονος,) follows his "Introduction;" it went through the ſame hands and the ſame editions, and is mentioned by Porphyry, in his Commentary on Ptolemy, as the work of Euclid. This tract chiefly contains ſhort and clear definitions of the ſeveral parts of Greek muſic, in which it is eaſy to ſee that mere *melody* was concerned; as he begins by telling us, that the ſcience of *harmonics* conſiders the nature and uſe of melody, and conſiſts of ſeven parts: ſounds, intervals, genera, ſyſtems, keys, mutations, and melopœia; all which have been ſeverally conſidered in the diſſertation.

Of all the writings upon ancient muſic, that are come down to us, this ſeems to be the moſt correct and compreſſed: the reſt are generally looſe and diffuſed; the authors either twiſting and diſtorting every thing to a favourite ſyſtem, or filling their books with metaphyſical jargon, with Pythagoric dreams, and Platonic fancies, wholly foreign to muſic. But Euclid, in this little treatiſe, is like himſelf, cloſe and clear; yet ſo mathematically ſhort and dry, that he beſtows not a ſyllable more upon the ſubject than is abſolutely neceſſary.

His object ſeems to have been the compreſſing into a ſcientific and elementary abridgment, the more diffuſed and ſpeculative treatiſes of Ariſtoxenus. He was the D'Alembert of that author, explaining his principles, and, at the ſame time, ſeeing and demonſtrating his errors. The muſical writings of Rameau were diffuſed, obſcure, and indigeſted; but M. D'Alembert, extracting the eſſence of his confuſed ideas, methodized his ſyſtem of a *fundamental baſe*, and compreſſed, into the compaſs of a pamphlet, the ſubſtance of many volumes. See Elemens de Muſique, ſuivans les Principes de Rameau.

According to Dr. Wallis, (Phil. Tranſ. No. 242, and Lowthorp's Abridg. v. i.) Euclid was the firſt who demonſtrated that an octave is ſomewhat leſs than *ſix whole* tones; and this he does in the 14th theorem of his "Section of the Canon." In the 15th theorem he demonſtrates that a fourth is leſs than two tones and a half, and a fifth leſs than three and a half; but though this proves the neceſſity of a temperament upon fixed inſtruments, where one ſound anſwers ſeveral purpoſes, yet he gives no rules for one, which ſeems to furniſh a proof that ſuch inſtruments were at leaſt not *generally* known or uſed by the ancients.

What Ariſtoxenus called a *half-tone*, Euclid demonſtrated to be a ſmaller interval, in the proportion of 256 to 243. This he denominated a *limma*, or *remnant;* becauſe giving to the *fourth*, the extremes of which were called *ſoni ſtabiles*, and were regarded as fixed and unalterable, the exact proportion of 4 to 3, and, taking from it two major tones $\frac{8}{9} \times \frac{8}{9}$, the limma was all that remained to complete the diateſſaron. This diviſion of the diatonic genus being thus, for the firſt time, eſtabliſhed upon mathematical demonſtration, continued in favour, ſays Dr. Wallis, for many ages. But this is further explained in other articles.

EUCOMIS, in *Botany*, from ευκομης, *having beautiful hair*, alluding to the leafy tuft of barren bracteas, which crowns the ſpike of flowers. See Coma.—L'Herit. Sert. Angl. 17. Ait. Hort. Kew. v. 1. 432. Schreb. 798. Willd. Sp. Pl. v. 2. 92. Mart. Mill. Dict. v. 2. (Baſilæa; Lamarck Encycl.

Encycl. v. 1. 382. t. 239. Juff. 52. Venten. v. 2. 163. Fritillaria; Linn. Gen. 164.) Clafs and order, *Hexandria Monogynia*. Nat. Ord. *Coronariæ*, Linn. *Afphodeli*, Juff.

Gen. Ch. *Cal.* none. *Cor.* of one petal, inferior, bell-fhaped, regular, permanent, in fix deep, equal, oblong, obtufe, fpreading fegments. *Stam.* Filaments fix, fhorter than the corolla, awl-fhaped, dilated at the bafe and united by that part into a concave nectary, attached to the bottom of the corolla; anthers oval. *Pift.* Germen fuperior, ovate, with three furrows; ftyle awl-fhaped; ftigma fimple. *Peric.* Capfule ovate, three-lobed, of three cells. *Seeds* numerous, fmall, ovate.

Eff. Ch. Calyx none. Corolla inferior, in fix deep, fpreading, permanent, equal fegments. Filaments united at their bafe into a concave nectary, attached to the corolla.

1. E. *nana*. Ait. Hort. Kew. v. 1. 432. Jacq. Hort. Schoenbr. v. 1. 47. t. 92. (Fritillaria nana; Linn. Mant. 223.) Stalk club-fhaped. Leaves numerous, broad-lanceolate, crenate. Barren bracteas elliptical.—Native of the Cape of Good Hope, as are all the known fpecies. *Bulb* ovate, rather large. *Leaves* radical, about eight, pale-green, fpreading, recurved, obovato-lanceolate, fomewhat acute. *Stalk* folitary, a fpan high, green, fwelling confiderably upwards, bearing a fhort fpike of green drooping *flowers*, furmounted with a tuft, about as long as the fpike, confifting of elongated, elliptical, barren *bracteas*. It is kept in the greenhoufe, and flowers in the fpring, but is fcarcely cultivated except for the fake of curiofity.

2. E. *bifolia*. Jacq. Ic. Rar. v. 2. t. 449. Coll. v. 4. 215. Curt. Mag. t. 840. (Melanthium maffoniæfolium; Andr. Repof. t. 368.)—Stalk club-fhaped. Leaves two, elliptical, depreffed. Bracteas all longer than the flowers, pointed, recurved.—The *leaves* are ribbed, entire, very broad. *Stalk* very fhort, green. Barren and fertile *bracteas* uniform, and all longer than the *flowers*, which are feffile and erect.

3. E. *purpurea*. (E. purpureocaulis; Andr. Repof. t. 369.) Stalk club-fhaped. Leaves numerous, obovate, obtufe, depreffed. Fertile bracteas fhorter than the flowers; barren ones linear-lanceolate.—Drawn by Mr. Andrews in the garden of G. Hibbert, efquire.—The broad, depreffed, numerous *leaves*; thick, violet *ftalk*; and numerous, narrow, purple-edged leaves of the crown, readily diftinguifh this fpecies.

4. E. *regia*. Ait. H. Kew. v. 1. 433. (Fritillaria regia; Linn. Sp. Pl. 435. Corona regalis, lilii folio crenato; Dill. Elth. t. 92, 93.)—Stalk cylindrical. Leaves tongue-fhaped, crenate, depreffed. Barren bracteas elliptical.—This moft refembles the firft fpecies in fize, habit, colour, and the crenate edges of its *leaves*; but differs in its longer cylindrical *ftalk*. It has been much longer cultivated than any other of the genus.

5. E. *undulata*. Ait. ibid. Curt. Mag. t. 1083. (E. regia; Redout. Liliac. v. 3. t. 175. Bafilæa; Lamarck f. 1.)—Stalk cylindrical. Leaves ovate-oblong, undulated, fpreading. Barren bracteas almoft as long as the fpike.—Introduced in 1760 by Mr. Miller, who, from its bloffoming in autumn, which is not invariable, named it *Fritillaria autumnalis*. *Stalk* taller than in the laft. *Leaves* narrower and longer. Mr. Gawler obferves that their undulations difappear as they decay.

6. E. *punctata*. L'Herit. Sert. Angl. t. 18. Curt. Mag. t. 913. (Bafilæa; Lamarck f. 2.)—Stalk cylindrical. Leaves lanceolate, channelled, fpreading. Spikes many times longer than the barren bracteas.—The long narrow *leaves*, *ftalk* elegantly fpeckled with violet, and efpecially the great extent of the *fpike*, which is about a foot in length, render this fpecies very diftinct. The *corolla* is of a very pale green. *Germen* violet. The bafes of the *leaves* are externally fpotted like the ftalk. It flowers in June or July, and is eafy of cultivation.

EUCRASY, of ευ, *well*, and κρασις, *temperature*, an agreeable, well-proportioned mixture of qualities, whereby a body is faid to be in good order, and difpofed for a good ftate of health.

EUCRYPHIA, in *Botany*, from ευ, *well*, and κρυφιος, *covered*, becaufe the flower-buds are concealed by a peculiar covering. Cavan. Ic. v. 4. 48. Clafs and order, *Polyandria Polygynia*. Nat. Ord. *Tiliaceæ*, Juff.

Gen. Ch. *Cal.* Perianth inferior, of five minute, ovate, equal, permanent leaves. *Cor.* Petals five, large, obovate, equal, fpreading; covered before expanfion with a deciduous veil, feparating from the bafe into four fegments. *Stam.* Filaments inferted into the receptacle, numerous, awl-fhaped, fhorter than the petals; anthers roundifh, of two cells. *Pift.* Germen fuperior, ovate, ftriated; ftyles about 12, fhorter than the ftamens; ftigmas fimple. *Peric.* Capfule ovate, with a woody furrowed bark, burfting at the top and bottom into as many cells as there are ftyles, each remaining attached by two fibres to the receptacle. *Seeds* feveral, obovate, imbricated, each terminated by a fmall membranous wing.

Eff. Ch. Calyx of five fmall leaves. Petals five, covered before expanfion with a deciduous veil. Capfule of many cells, feparating at top and bottom. Seeds winged, imbricated.

1. E. *cordifolia*. Cavan. Ic. v. 4. 49. t. 372.—A fine tree gathered in Chili, by Louis Née, from whofe herbarium Cavanilles defcribed it. *Wood* red. *Branches* downy when young. *Leaves* oppofite, on fhort ftalks, ovate, obtufe, undulated and bluntly crenate, veiny, coriaceous; heart-fhaped at the bafe; fmooth above; downy and white beneath; fcarcely two inches long. *Stipulas* none. *Flowers* axillary, folitary, each on a ftalk about an inch long, with a few fcales at its bafe. *Petals* white, turning red in drying. *Veil* of the flower externally downy.—It is commonly called in the country *Roble di Chile*, or Chili Oak.

EUDEMIA, in *Ancient Geography*, a fmall ifland of the Ægean fea, placed by Pliny in the Thermaic gulf.

EUDÆMON, John Andrew, in *Biography*, a learned Jefuit, was a native of Candia, and went to Rome in purfuit of knowledge, where he entered himfelf a member of the fociety of Jefus. He was afterwards profeffor of philofophy, and then of theology in the univerfity of Padua. He was honoured with the efteem and friendfhip of Pope Urban VIII. who appointed him the chaplain to his own nephew cardinal Barberini, when he was fent papal legate into France. He died at Rome in 1625, leaving behind him in various publications many teftimonials to his talents and learning. He was fufpected to be the author of a work entitled "Admonitio ad Regem Ludovicum XIII." which attacked the authority of the kings of France, in matters of an ecclefiaftical nature. This treatife brought the fociety, of which Eudæmon was a member, into great and general difrepute; it was likewife cenfured by the faculty of the Sorbonne, and the affembly of the clergy at Paris, and condemned by the parliament. Moreri.

EUDEMUS, in *Biography*, a name, it would appear, common to feveral phyficians in different ages, of whom little is known with any degree of certainty or precifion. One Eudemus is mentioned by Galen as contemporary with Herophilus, in the 37th age, and is compared with the latter in refpect to his anatomical fkill, efpecially relative to the

the nerves. Another Eudemus is said to have suffered death for his crimes, in the year 31 of the Christian era. And others of the same name, as Eudemus the vender of antidotes, Eudemus of Chio, are occasionally mentioned. See Eloy. Dict. Hist.—Le Clerc Hist. de la Medecine.

Eudemus of Rhodes was a pupil of Aristotle. The Ethics of Aristotle are inscribed to him, and some suppose them to have been written by him.

EUDES, duke of Aquitain, succeeded to his dukedom towards the close of the seventh century. When Pepin Heristal laid claim to the royal authority in France, Eudes declared himself independent, and seized upon the remainder of Aquitain, and in a short time by force of arms made himself master of all the country lying between the Loire, the Ocean, the Pyrenées, Septimania, and the Rhone. In 721 he defeated Zama, lieutenant of the Saracen caliph, who had invaded Gaul, under the walls of Toulouse, but in a few years afterwards he found it necessary to make an alliance with Munuza, another Saracen general, to whom he gave his daughter in marriage. After this his country was completely over-run by the Saracens, over whom, by the aid of Charles Martel, he obtained, in 732, a complete victory, which delivered France from the Mahometan yoke. Eudes died in 735, leaving behind him three sons by his wife Valtrude, who was the near relation of Pepin. Moreri. Univer. Hist.

Eudes, John, born at Rye in Lower Normandy, in the year 1601, was brother of the celebrated historian Mezerai, and received his education at Caen, under the care of the Jesuits, where he was afterwards entrusted with the superiority of the house belonging to the congregation. In 1643 he quitted the duties of this institution, and undertook the establishment of another, of which he became the first superior as well as founder. This was denominated "The congregation of Jesus and Mary," and the principal object of it was to provide a seminary for the instruction of young persons in piety and sacred knowledge, and to form a body of religionists, influenced by greater fervour and exaltation in their devotional feelings, than was encouraged by the regulations of the society of which he had been a member. He died in 1680, at the age of seventy-nine. He is described as having been an excellent and well meaning man, but mystical and highly enthusiastic. As a preacher and instructor of youth, he was very popular; but his writings evince little knowledge and less judgment, though they exhibit a devotional spirit, tinctured with large portions of superstitious credulity. The most remarkable of his pieces are (1) A treatise "On the Devotion and Office of the Heart of a Virgin; (2) "Man's contract with God;" and, (3) some particulars concerning a peasant in Normandy, whom he regarded as under divine inspiration, entitled "The life of Mary of the Vallies." Moreri.

EUDIOMETRY. This term is applied to those processes which have been employed to ascertain the purity, or, in other words, the degree of oxygenation of any gaseous mixture, and especially of atmospherical air.

A considerable variety of methods have been used by chemists, all of which, though essentially different, agree in acting upon the oxygenous portion alone, the azot being in all cases left as the unchanged residue. The following are the several methods employed.

Of nitrous gas as an eudiometer.—This was the first eudiometer used by Dr. Priestley in his original experiments on air, which immediately followed the discovery of oxygen by this illustrious philosopher. If nitrous gas be mixed with *oxygen gas*, in a glass jar over water, in the proportions in which they saturate each other, to form nitric acid, the gases will totally disappear, a ruddy fume is seen at the moment of mixture, and the water will rise to the top of the jar, leaving unabsorbed only the unavoidable impurities of the gases. If, on the other hand, nitrous gas be mixed with *atmospherical air*, or any other admixture of oxygen and azot, the former alone of the two will be condensed by and with the nitrous gas, and the azot will remain unaltered. Hence by measuring the respective quantities of the gases employed, and the quantity absorbed, the purity of the atmospherical air may be ascertained, (supposing it known by previous experiment what are the exact proportions in which nitrous gas and oxygen saturate each other, and become totally absorbable by water.) Thus, for example, if 100 measures of nitrous gas be added to the same quantity of common air, and the two compleatly mixed, the bulk after such mixture will not be 200 measures, but only about 108, and consequently 92 measures will have been absorbed; which last, therefore, consist of all the oxygen of the air, with so much of the nitrous gas as has been employed to saturate it. This result Dr. Priestley was in habit of denoting, for brevity sake, by the expression that the air was of the purity of 108, by which he always meant that when 100 of nitrous gas, and 100 of the air to be examined were mixed, the residue after the mutual action of the airs was over, was of the number specified. The quantity of the two airs absorbed being known, the portion which is estimated to belong to the oxygen must therefore depend on the proportion in which nitrous and oxygen gases saturate each other, which requires another elementary experiment. Thus in the instance before us, if three parts of nitrous gas saturate one part of oxygen, the 92 parts which have disappeared are composed of 69 of the former gas, and 23 of the latter, and hence the composition of the 100 parts of atmospherical air examined, will be 23 of oxygen, and the remainder unabsorbed residue chiefly azotic.

A number of valuable experiments by Fontana, Ingenhouz, and especially by Mr. Cavendish, made on this subject, have shewn that different portions of the very same mixture of nitrous gas and oxygen will experience a prodigious difference of absorption according to the width of the tube in which they are mixed, the order of mixture, the time of standing together, the degree of agitation used, and other manipulations. Thus Mr. Cavendish observed, that if one measure of nitrous gas and as much common air be rapidly mixed, and immediately shaken, the absorption will be nearly half the entire contents, but if the airs are suffered to remain in contact for about a fourth of a minute before they are shaken, the absorption will be no more than about .8. The nature of the water also in which the experiment is made is found very materially to influence the result. By attending to every circumstance of the kind, Mr. Cavendish, with that admirable accuracy which distinguishes all the researches of this eminent philosopher, was enabled to obtain very satisfactory results as to the uniform nature of atmospherical air.

Still, however, the difficulties of employing this mode of analysis with sufficient precision in all admixtures of oxygen and azot have been found so great, and the apparent anomalies so numerous, that it has been long nearly abandoned by chemists, till of late the subject has been revived by Mr. Dalton, who has added some important observations, which require some notice in this place. (See the Manchester Transactions. New series.)

Mr. Dalton gives the following experiments:

If 100 measures of common air be thrown up to 36 measures of nitrous gas in a tube only 3-10ths of an inch wide,

wide, and 5 inches long, and no agitation be ufed, in a few minutes the whole will be reduced to 79 or 80 meafures, and exhibit no figns of either oxygen or nitrous gas, but will confift entirely of azot.

If on the other hand 100 meafures of common air be thrown up to 72 of nitrous gas, in a wide veffel over water, fuch as to form a thin ftratum of air, and an immediate agitation be ufed, both the oxygen and the nitrous gas will, as before, totally difappear, and the refidue, as before, will alfo be 79 or 80 meafures of azot.

If in the laft experiment lefs than 72 meafures of nitrous gas be ufed, there will be a refiduum containing fome oygen; if more, the refidue will contain nitrous gas.

From thefe elementary experiments Mr. Dalton infers that the oxygen, contained in 100 parts of common air, may unite totally either with 36 parts of nitrous gas, or with 72, double that quantity, but with no intermediate portion. To infure the former effect, the gafes muft be mixed in a narrow veffel without agitation; to infure the latter the veffel muft be large, and the points of contact between the ingredients muft be increafed by agitation. But in the ordinary circumftances of the experiment, Mr. D. fuppofes that both thefe effects partially take place, fo that one part of the oxygen unites with the nitrous gas in the fmaller proportion, and another in the larger; and hence he accounts in a very ingenious and fatisfactory manner for the greater part of the apparent anomalies which have been obferved in the employment of nitrous gas in eudiometry. Therefore, he obferves, to ufe nitrous gas for the purpofe of eudiometry, we muft attempt to form one or other of thefe combinations wholly, and he prefers that with the fmalleft proportion of nitrous gas, in the following way:

Take a narrow tube of the dimenfions above given, add 100 parts of common air to about 36 of nitrous gas, and when the diminution is complete, without agitation, transfer the refidue to another tube and meafure it; then 7-19ths of the lofs will be due to the oxygen prefent.

But a ftronger objection arifes againft the employment of nitrous gas in its aeriform ftate, owing to the difficulty of obtaining this gas of uniform purity. From a very elaborate feries of experiments on this fubject, undertaken by Humboldt and Vauquelin, (Ann. Chem. tom. 28.) it appears that when nitric acid of any ftrength is poured upon copper wire (which is the ufual mode of obtaining nitrous gas,) an effervefcence more or lefs vehement takes place, and a gas is difengaged, confifting of nitrous gas, but always mixed with more or lefs of azotic gas, and fometimes nitrous oxyd, and it is this varying portion of azot which conftitutes the chief difficulty and trouble in the employment of nitrous gas in eudiometry. The quantity of azot is found to depend largely on the ftrength of the acid being from about one-tenth or lefs to nearly half the entire gas. According to Humboldt, the degree of ftrength of acid which produces the pureft nitrous gas, is that in which the fpecific gravity is about 1.15 to 1.17, or from 17 to 21 of Beaume's areometer. Mr. Dalton finds that nitric acid diluted with an equal bulk of water poured on copper and mercury, without any artificial heat being ufed, gives a nitrous gas nearly pure, or with only from two to three per cent. of azot.

The proportion of azotic impurity in any mixture of this with nitrous gas, is moft conveniently afcertained by agitating the gas with a folution of green fulphat of iron, which abforbs the nitrous gas without materially affecting the other. This experiment was firft made by Dr. Prieftley, who found that the folution of iron acquired thereby a reddifh or olive brown colour, and a very acid ftyptic tafte. Other chemifts have alfo found a certain quantity of ammonia in the folution.

To obviate the objections brought againft the ufe of nitrous gas, in the gafeous form, as an eudiometer, Mr. Davy has ingenioufly applied to this purpofe the folution of fulphat or muriat of iron, faturated with nitrous gas as above-mentioned, and this, with a few precautions, is found to anfwer with great precifion, and to be applicable with little trouble to all cafes of the analyfis of gafes where oxygen is one of the fubftances fought for. The mode of ufe in ordinary cafes is as fimple as poffible. The gas is put into a graduated eudiometer tube, fome of the folution is poured in, and by very gentle agitation for about a minute, the whole of the oxygen is abforbed. The chief precautions required are, not to ufe the fame folution twice, to keep it in a well-ftopped bottle, and particularly to remove it from the gas under analyfis as foon as the utmoft degree of abforption is produced, as after this time a fmall increafe of bulk is again obfervable in the refidue, owing probably to fome evolution of gas from the folution. It is alfo found that if the folution be very highly impregnated with the nitrous gas, and much hafty agitation be ufed, a little of the nitrous gas efcapes in the gafeous form into the eudiometer tube, which may be removed by the application of a little fulphat or muriat of iron. One cubic inch of the impregnated folution of moderate ftrength will abforb about five or fix cubic inches of oxygen gas.

Of the fulphurets as eudiometers.—The eudiometer firft employed by the illuftrious Scheele, in his original experiments on the conftitution of the atmofphere, fo early as the year 1779, was a mixture of iron filings and flowers of fulphur, moiftened with a little water. By confining a cup of this mixture under a jar of common air over water, this excellent chemift obferved an abforption foon to begin, the water gradually rifing in the jar for about eight hours, after which no further diminution took place, and the refiduary gas confifts chiefly of azot.

This valuable elementary experiment has been employed in eudiometry with great advantage, but modified confiderably, and a few precautions muft be taken to avoid inaccuracies. In the firft place it is to be obferved that this mixture of iron filings and fulphur is flow in its operation, and moreover, a quantity of hydrogen gas is given out towards the end, which mixes with the refiduary azotic gas. To leffen the duration of the experiment the liquid alkaline or earthy fulphurets have been fubftituted to the mixture of iron filings and fulphur, with great advantage. When atmofpherical air, confined in a tube, is fhaken for a few minutes with a little of the liquid fulphuret of lime, potafh, or foda, the whole of the oxygen is abforbed in a few minutes.

Guyton has propofed to haften the abforption by heating the folution, but it has been found that in this cafe there is fome danger of expelling from it a portion of fulphurated hydrogen gas, which would impair the accuracy of the experiment.

A more important fource of error has been mentioned by Marti, (Journal de Phyfique, tom. 52.) which muft be avoided. It appears from his experiments that liquid fulphuret of lime, (and probably the other liquid fulphurets,) when recently made, is capable of abforbing a portion of azot as well as oxygen, which, though fmall, is fufficient to affect materially the refult of a delicate experiment. Marti found that when one meafure of common air was fhaken with 20 meafures of the liquid fulphuret of lime, the entire abforption amounted to as much as 26 per cent. of the air. But of thefe it is known that only about 21 can be be oxygen, and confequently about 5 of azot muft have been abforbed. The experiment being repeated with the fame folution, only 21 per cent. were now abforbed, fo that the folution had been faturated with azot by the previous experiment. The fame folution was then fhaken with pure azot, but no abforption took place, which confirmed the fact of the previous faturation of the fulphuret with azot. On the other hand, when a perfectly frefh folution was ufed, which immediately after being prepared, had been allowed to cool in a well-clofed bottle, and only a twentieth of its bulk of common air was confined with it, the latter in a few minutes had diminifhed full one-half.

It is eafy to avoid errors from this circumftance. All that is neceffary is, previoufly to ufing the liquid fulphuret as an eudiometer, to fhake it for a few minutes in a bottle of common air, and it is never neceffary to ufe more than about two meafures of the fulphuret to one of common air. With thefe precautions, the fulphuret proves a very ufeful and accurate eudiometer.

Of hydrogen gas as an eudiometer.—This ingenious method was propofed and employed with great fuccefs by the celebrated Volta. It confifts in mixing known proportions of pure hydrogen gas with the air to be examined in a very ftrong glafs tube, through which a metallic communication is made, and detonating the contents by the electric fpark. After the fhock, a fudden diminution takes place, owing to the production of water by the detonation of the hydrogen with the oxygen contained in the air examined. The exact faturating proportion between the two gafes has been varioufly given, but an excefs of hydrogen fhould be ufed. One hundred parts of oxygen require at the higheft eftimation fomewhat lefs than 200 of hydrogen for faturation; fo that when equal bulks of hydrogen and *atmofpheric air* are ufed, there is an abundant allowance of hydrogen. Mr. Dalton finds 60 of the latter fufficient for 100 of common air, and the diminution is very uniformly 60 parts with the above proportions; and hence, if common air contains 21 per cent. of oxygen, the faturating proportions of oxygen and hydrogen are 21 of the former to 39 of the latter.

The chief objection to the univerfal ufe of Volta's eudiometer is, that it requires an apparatus to give the electric fpark, which cannot be always procured; and in all experiments of this kind it is particularly defirable to employ one uniform mode of experimenting where general refults are to be eftablifhed.

Of phofphorus as an eudiometer.—Phofphorus has two diftinct modes of combuftion in common air, according to the temperature to which it is raifed. One of thefe is rapid, and attended with the evolution of a prodigious quantity of light and heat, and it occurs when phofphorus is heated a little above its melting point, or in common language is fet fire to. The other takes place in a temperature not exceeding from 90° to 100° at the utmoft, and is that in which the phofphorus emits copious fumes, white in the day-time but highly luminous in the dark, and without any fenfible emiffion of heat. In either cafe the phofphorus is *confumed*, or oxygenated; but it is the flow combuftion without fenfible heat that is alone employed in eudiometry. The whole apparatus required for the purpofe is fimple and convenient of application. Nothing more is neceffary than to fix a ftick of phofphorus in a portion of glafs tube run through a cork, which loofely fits the open end of the fmall jar which is to contain the air to be analyzed, and confine it by water. If the temperature is very cold, the procefs may be affifted by the warmth of the hand. The phofphorus is immediately furrounded by the white luminous fume, which flowly falls down to the furface of the water, during which time the oxygen of the air is gradually abftracted by the vaporized phofphorus, and in confequence the bulk of the contained air is diminifhed. The abforption of oxygen is complete when the contained gas is no longer luminous, which, in a fmall jar with a ftick of phofphorus that traverfes nearly its whole length, requires about half an hour at the heat of from 70° to 80°. The procefs fucceeds equally well at a lower temperature, though a longer time is required. The heat cannot be fafely raifed more than about 85° or 90°, without danger of kindling the phofphorus, which may be avoided by obferving that it melts and becomes gloffy juft before it catches fire.

The exact operation of the flow combuftion of phofphorus ufed in this experiment has been very happily explained by Goettling and Berthollet. When phofphorus is expofed to air at any temperature below that of rapid combuftion, the firft effect feems to be a folution of the furface in the azot of the furrounding air, and this phofphorized azot inftantly unites with the oxygen, becomes thereby luminous, and phofphorus acid abforbable by water is generated. Hence it is (ftrictly fpeaking) only that portion of phofphorus which becomes diffolved in the azot which is the eudiometrical fubftance; and in confirmation of this it may be added that phofphorus inclofed in pure oxygen gas is not in any degree luminous, but remains perfectly inactive till the heat is raifed to the point of ftrong combuftion. On the other hand, if the pureft poffible azot is paffed into a jar full of water, and containing a ftick of phofphorus, the gas only becomes luminous for a very fhort time, after which this appearance ceafes, but the azot continues to faturate itfelf with phofphorus. If now a bubble of common air or oxygen is let up into this phofphorized azot, the luminous appearance immediately returns, and continues fo till all the oxygen is exhaufted. Phofphorus, therefore, furnifhes alfo an ufeful teft of the purity of azot, by not becoming luminous in it, but by enabling it to become luminous as foon as a particle of oxygen is added.

One circumftance of importance fhould be added, which is, that azotic gas in faturating itfelf with phofphorus is found to expand about 1-40th of its bulk, which accounts for the apparent difference in the compofition of common air as determined by phofphorus or by other eudiometrical fubftances. After all abforption has ceafed, when phofphorus is ufed, the apparent lofs is not more than from 20 to 21 per cent. of the atmofpherical air employed, whereas with all the other eudiometrical proceffes the lofs is from 21 to 22 per cent., but this difference may be chiefly accounted for by the expanfion of the refidual azot from its faturation with phofphorus. It is therefore more accurate to diminifh the bulk of the refiduum by 1-40th, and this diminution muft be thrown into the fide of the oxygen abforbed. In analyzing an air much more oxygenous than the atmofphere, in proportion as the azotic ingredient diminifhes, the operation of the phofphorus in removing the oxygen becomes lefs rapid and powerful, and hence either a dilution with pure azot is adviseable, or fome other eudiometrical teft fhould be preferred.

The general refults of all the operations of atmofpherical air have eftablifhed it as an inconteftible truth, that fcarcely any difference exifts in the proportion of oxygen, whatever be the height, feafon of the year, climate, and temperature at which the experiment is made, and even where the greateft changes would be expected from vitiation of air by the refpiration of crowded affemblies of people, and the like, the lofs of oxygen is much lefs than would have been generally expected. Hence the utility of eudiometry as a meafure of the purity of the atmofphere has much diminifhed fince this

fact

faſt has been eſtabliſhed, but the numerous and acute reſearches to which the ſubjeſt has led, have been of high importance to this difficult part of chemical reſearch.

Several kinds of apparatus are uſed in eudiometrical experiments, ſome of which may be here deſcribed.

Dr. Hope's eudiometer is the following. (*Plate* X. *Chemiſtry*, *fig.* 1.) It conſiſts of two parts, the lower of which is a ſhort thick bottle, with an upper and a ſide opening, the latter cloſed by a glaſs ſtopper, and the other receiving a graduated tube cloſed at the top, and accurately fitted by grinding. To uſe it, take off the tube, and fill it quite full of the gas to be examined, and alſo fill the bottle with liquid ſulphuret of lime, and, without ſhaking, ſink it in water, and then immerſe the open end of the graduated tube in the ſame water, and ſlide it upon the bottle and thruſt it in. Then take out the bottle and tube, and ſhake them, to bring the ſulphuret thoroughly in contaſt with the contained gas, and immerſe the bottle from time to time in water, opening the ſide ſtopper to allow the water to ruſh in, and ſupply the vacuum made by the abſorption of oxygen. This will indeed ſomewhat dilute the eudiometrical liquor, but not ſo much as to prevent it from aſting. When all abſorption is over, the quantity of reſidual gas is found by inſpeſtion of the ſcale of the graduated jar.

The apparatus for detonating oxygen and hydrogen, which forms Volta's eudiometer, conſiſts of a very thick graduated glaſs tube, open at bottom, and towards the top are two ſealed holes, admitting the wires by which the eleſtric ſpark is taken. A very uſeful improvement in this apparatus has been introduced by Mr. Pepys, to prevent the violence of the ſhock, either from breaking the glaſs (with moderate quantities) or from throwing out any of the mercury when confined by this fluid. In this improved apparatus, the thick graduated jar is fixed to a heavy iron ſtand, which has a ſtrong ſpring near the foot, that draws out in the manner of the ſteel-yard, when the concuſſion is given, and thus takes off the recoil. *Fig.* 2.

An improved and very uſeful apparatus for nice eudiometrical experiments, is given by Mr. Pepys in the Phil. Tranſ. for 1807, to which we ſhall refer our readers for a full deſcription. It conſiſts of a graduated tube, an elaſtic gum-bottle, furniſhed with a perforated glaſs ſtopper, cloſely fitting to the end of the tube, and another very ſmall tube with a ſurrounding jar for the purpoſe of meaſuring quantities leſs than the ſmalleſt ſubdiviſions of the larger graduated tube. The eudiometrical liquor is put into the elaſtic gum-bottle, and by preſſure is injeſted ſtrongly up into the larger tube, by which means the aſtion is facilitated, and none of the liquor is ſpilled or waſted.

EUDOCIA, in *Biography*, a Roman empreſs, wife of Theodoſius the younger, was daughter of Leontius, an Athenian philoſopher. She was educated in the ſciences and religion of ancient Greece, and ſo great were her mental acquirements and perſonal beauty, that Leontius divided his property between his ſons, conceiving ſhe could ſtand in need of nothing to recommend her to a proper huſband. About the year 421 ſhe was married to Theodoſius, when ſhe renounced the errors of paganiſm, and received the baptiſmal name of Eudocia, having previouſly been called Athenais. She was reconciled to her brothers; and, having invited them to court, conferred upon them offices of rank and power. Upon the throne, as in a more humble ſtation, ſhe cultivated letters, and employed her talents in the ſervice of the religion to which ſhe was a convert. She put into verſe ſeveral of the books of the Old Teſtament, and wrote paraphraſes on ſome of the Jewiſh prophets. She lived for a conſiderable time in harmony with her conſort; and after the marriage of her daughter to the emperor Valentinian III. ſhe was permitted to pay her vows in a ſplendid pilgrimage to Jeruſalem; and at Antioch ſhe pronounced an oration to the ſenate from a throne of gold. After her return, ſuſpicions were excited of her fidelity in the breaſt of her huſband by his ſiſter Pulcheria, who had been the means of bringing them together by marriage. The objeſt of theſe ſuſpicions was Paulinus, a handſome and accompliſhed man, who held high offices at court, and who was put to death on the occaſion. Eudocia was reduced to a private condition, and allowed to ſeek a retreat in the Holy Land, where ſhe had formerly obtained a high degree of credit by the magnifience of her preſents. Here ſhe devoted herſelf to religious and devotional ſtudies, and died in 460 at the age of 67. In her laſt illneſs, ſhe aſſerted in the moſt ſolemn manner her innocence of the crime for which ſhe had been dethroned and ſuffered baniſhment. Moreri. Gibbon's Hiſt.

EUDOCIAS, in *Ancient Geography*, an epiſcopal town of Aſia, in Pamphylia.—Alſo, an epiſcopal town of Aſia, in the ſecond Galatia.

EUDON, a river of Aſia, in Caria.

EUDOXIANS, a party or ſeſt of heretics in the fourth century, ſo denominated from their leader Eudoxius, a native of Arabiſſus in Armenia Minor, and patriarch of Antioch, to which he was advanced in 356, and Conſtantinople, to which he was promoted in 359, and which he retained till his death, in 370. He was a great defender of the Arian doſtrine, though repreſented as ſomewhat fluſtuating and unſteady in his principles. He is charged with being a bitter perſecutor of the Catholics. Of his works, no remains are extant, except ſome fragments of a treatiſe "De Incarnatione Dei verbi;" to which Cave (Hiſt. Lit.) has referred.

The Eudoxians adhered to the errors of the Arians and Eunomians, maintaining that the Son was created out of nothing; that he had a will diſtinſt and different from that of the Father, &c.

EUDOXIOPOLIS, in *Ancient Geography*, an epiſcopal town of Aſia, in Piſidia.

EUDOXUS, the *Cnidian*, in *Biography*, was celebrated as an aſtronomer, a geometrician, a phyſician, and legiſlator, but was moſt particularly diſtinguiſhed in the firſt of theſe charaſters. His firſt preceptor was Archytas, by whom he was inſtruſted in the principles of geometry and philoſophy: about the age of 23 he came to Athens. His knowledge of medicine is ſaid to have been obtained in this way. A phyſician, named Theomodonus, obſerving the ardent deſire which he manifeſted for ſtudy, notwithſtanding his extreme poverty, preſumed that he poſſeſſed talents which deſerved cultivation, and therefore took him to his houſe, and afforded him every means of accompliſhing his wiſhes, enabling him, as his own patrimony was ſmall, to attend the ſchools of the philoſophers, particularly that of Plato. Eudoxus afterwards went into Egypt, accompanied by a pupil, named Chryſippus, and here he was introduced by Ageſilaus to king Neſtanebis II., and by him to the Egyptian prieſts. He is highly celebrated by the ancients for his ſkill in aſtronomy; but none of his writings on this or any other ſubjeſt are extant. Aratus, who has deſcribed the celeſtial phenomena in verſe, is ſaid to have followed Eudoxus; to whom is attributed the honour of bringing the celeſtial ſphere and the regular aſtronomy from Egypt into Greece. Having left Egypt he taught aſtronomy and philoſophy with great applauſe at Cyzicus, on the Propontis; and he afterwards removed to Athens, where he opened a ſchool, and gained ſo high a degree of reputation,

reputation, that he was consulted on subjects of policy as well as sciences, by deputies from all parts of Greece. His death is generally referred to the first year of the 107th olympiad, 352 years before Christ. See Le Clerc. Hist. de la Med. Eloy.

Eudoxus is said by Fabricius (Bibl. Græc. lib. iii. c. 5.) to have written upon music, and he gathers from Theon of Smyrna, p. 94, that Eudoxus was the first who expressed the ratios of concords by numbers, and who discovered that grave and acute sounds depend on the slow or quick vibrations of the sounding body.

EUDRACINUM, in *Ancient Geography*, a town placed by the Itinerary of Antonine on the Alps, between Summus Penninus and Augusta Prætoria.

EUDRAPA, Eder, or *Edir*, a town of Asia, situated in Mesopotamia, W.S.W. from the town of Carmanda.

EUDROME, in the *Ancient Music*, the name of an air played by hautbois at the Sthenian games, instituted at Argos in honour of Jupiter. Hicorax the Argian was the inventor of this air.

EVE, the first woman, and mother of the human race. The history of her formation and other particulars is recorded in the Hebrew Scriptures (Gen. ii. iii. iv.); and it is needless to recite from Bayle and others the absurd fables invented concerning her by the Jewish rabbis.

Eve. See Vigil.

EVEA, or Eva, in *Ancient Geography*, the ancient name of Byblos, a town of Phœnicia.

Evea, in *Botany*, Aublet Guian. v. 1. 100. t. 39. Juss. 208. See Callicocca, spec. 10.

EVECTION, in *Astronomy*, the most considerable of the lunar irregularities, and the first that was known to the ancient astronomers. It was discovered by Ptolemy. Its general and constant effect is to diminish the equation of the centre in the syzygies, and to increase it in the quadratures. If this diminution and augmentation were always the same, the evection would depend alone on the angular distance of the moon from the sun; but the absolute value of the evection depends likewise on the distance of the moon from the perigee of her orbit. After a number of trials and observations, it was found that this inequality could be represented very exactly by supposing it proportional to the sine of double the angular distance of the moon from the sun, *minus* the mean anomaly of the moon. The co-efficient to this proportion is 1° 20′ 30″.

The period of the evection differs but little from the periodic revolution of the moon: it is 27.178533 days. The evection is caused by the action of the sun upon the moon, and may be explained by supposing a change to take place in the excentricity of the moon's orbit, and at the same time a motion in the apogee.

Ptolemy supposed the epicycle of the moon to be carried along in an excentric circle, and that it was nearer to us in the quadratures than in the conjunctions and oppositions; so that to explain this inequality at the same time with the equation of the centre, he imagined an excentric and an epicycle. It is curious to trace the progress of these discoveries, and the history of the first observations of the evection has been transmitted in the words of Ptolemy himself. (Almagest. lib. v. cap. 1.)

In observing, says he, with care, the order of this inequality, we took notice that there was no other than the first and simple inequality in the conjunctions and oppositions, and even in the quadratures when the moon was in apogee or perigee, (meaning by the simple inequality the equation of the centre); but we may be assured that this is not sufficient to calculate the particular motion of the moon in other aspects. The second inequality, (*i.e.* the evection,) is connected with the distance of the moon from the sun, and is re-established and disappears in the conjunctions and oppositions, and is greatest in certain quadratures. We discovered this inequality by the observations transmitted by Hipparchus, and by those which we have made by means of an instrument constructed for the express purpose of measuring the difference of longitude on the zodiac between the moon and the sun.

Ptolemy found that there was a difference of $2\frac{2}{3}°$ between the observed and the calculated place (when the first inequality or equation of the centre was only used) when the moon in quadrature was three signs from the apside. (Almagest. v. 3.) Then the sun being in the apogee or perigee of the moon, the inequality, which should have been 5°, was found $7\frac{2}{3}°$; to explain which he supposed the epicycle as above-mentioned.

Copernicus, to explain the evection, employed two epicycles. The small epicycle is supposed to describe the circumference of the great one in the space of an anomalistic revolution, and contrary to the order of the signs; while the moon describes the small epicycle contrary to the order of the signs in $14^d\ 18^h$, or in the space of half a synodical revolution.

It was in this manner that the second inequality of the moon, called now the evection, was explained till the time of Tycho. It was called by Ptolemy "προσνευσιν, epicycli quasi annutum," by Copernicus "prostaphæresim secundi vel minoris epicycli," by Tycho "prostaphæresim excentricitatis," and by Bouilliaud "evection," which name it still retains.

The evection was explained in a different manner by Horrox about the year 1640; but his theory was not made known till 1673, when Flamstead calculated his new tables of the moon, upon the principles and numbers given him by Horrox. These tables were published in the posthumous works of Horrox in 1673. This hypothesis is the same with that of Arzachel, an astronomer who flourished in Spain in 1080, when that country was possessed by the Arabians, and who applied it to the motion of the sun. Let T be the centre of the earth (*Plate* XII. *Astronomy*, *fig.* 107.), C the mean place of the centre of the orbit which a planet is supposed to describe; so that T C A may be the line of the apsides, and T C the excentricity of the planet. If the centre of the orbit, instead of being fixed in C, be supposed to describe the circumference of a small circle A C B, there will result a double effect: 1. The line of apsides T A will change its position, and instead of remaining constantly in the direction T C A, it will pass, for example, into the position T G, and will make with the first position an angle A T G. 2. The excentricity, instead of being equal to the original quantity T C, will become T G, T B, &c. This hypothesis was invented by Arzachel to explain a supposed diminution of the excentricity of the sun's orbit, which he had inferred from some defective observations, and has not only been adopted by Horrox to deduce this inequality of the moon, but by Flamstead, Halley, and Newton, for the same purpose.

Kepler had already announced that he employed an excentricity of the lunar orbit which varied every year; but Horrox was led likewise to this hypothesis by observations of the diameter of the moon; for about this time the application of micrometers to telescopes enabled astronomers to determine the apogee and perigee of the moon much more exactly than formerly. From these observations he perceived that the apogee of the moon was about 25° more advanced when the distance from the sun to the apogee of of the moon was 45° or 225°, than when it was 135° or 315°; hence the motion of the apogee, inftead of being uniform, feemed to have an annual libration of more than 12°. This variation in the motion of the apogee being once known, its connection with a change of excentricity was not difficult to be difcovered. Both Halley and Newton employed the above hypothefis. According to the method of Newton the centre A of the orbit of the moon (*fig.* 108.) defcribes a circle A C B, the earth being at T. Thus T C expreffes the mean excentricity of the moon; T A the greateft excentricity, and T B the leaft; T C being to C B as the mean excentricity is to its difference from the leaft, or as the total fine is to the fine of $12^\circ\ 18'$, which is the greateft equation of the apogee. It is likewife fuppofed that if the angle A C G be taken equal to double the annual argument, or the diftance between the fun and the mean apogee of the moon for a given time, the angle C T G will be the equation of the apogee, and T G the excentricity for the fame time. Then in the triangle T C G, the two fides and included angle being given, we have the fum of T C, and C G is to their difference as the tangent of half A C G, (or the annual argument, whofe double is A C G,) is to the tangent of half the difference of the unknown angles. This is reduced to a conftant logarithm, which added to that of the tangent of the mean annual argument, gives the annal argument corrected; and this, added to the place of the fun, gives the true place of the apogee of the moon. This is the form which Halley employed in his lunar tables.

It efcaped the obfervation of Flamftead, Halley, and Newton, that this equation might be calculated without fuppofing a variable excentricity and libration of the apogee. Euler employed this method, of which the following is the demonftration.

Let L (*fig.* 109.) be the moon, T the earth, C the mean centre of the lunar orbit, G the centre for a given moment; C T the mean excentricity of the moon, C L T the half of the mean equation of the orbit, becaufe it is the double excentricity which produces the whole equation; G L T the half of the evection for the time given, and reprefented in Newton's method by an augmentation of excentricity; C L G is the difference of thefe two equations, or the effect which the change of excentricity, and the libration of the apogee, produce upon the half equation. To find by a fimple operation this angle C L G, which is the half of the evection, it muft be remembered that when this angle is the greateft, or when L C is perpendicular to C G, the angle C L G is 40′, that is, the conftant relation between C L and C G is fuch, that the value of L can only be 40′ when it is the greateft, or $1^\circ\ 20'$ for the whole evection. When the angle L C G is oblique, the angle C L G will diminifh, and that in the ratio of the perpendicular G D to the line C G, or as the fine D C G to radius. Hence the evection will be 80′ fin. D C G; but the angle D C G = A C L − A C G is the mean anomaly of the moon, minus twice the diftance of the fun from the moon's apogee, or what is the fame, twice the diftance of the moon from the fun, minus the mean anomaly of the moon, which forms the argument of evection.

The half evection, or angle G L C, is equal 40′ fin. (2 dift. ☾ ☉ — m. anom. ☽.) This is the form in which it is ufually found in the lunar tables.

When we come to treat of the theory of the moon, and the lunar inequalities, we fhall have occafion to refume this fubject, and to fhew how correctly this equation is derived from the law of univerfal gravitation; we fhall confine ourfelves at prefent to a very general explanation of the phyfical caufe of this phenomenon.

When the fun correfponds to the apogee or perigee of the moon, that is, when the line of apfides of the moon coincides with the line of the fyzygies, the central force of the earth upon the moon, which is the weakeft in the fyzygy apogee, receives the greateft diminution, and the central force, which is the ftrongeft at the fyzygy perigee, there receives the leaft diminution, therefore the difference between the central force perigee and the central force apogee will then be the greateft, and the difference of the diftances will be augmented, that is, the excentricity will become greater, and obfervation fhews that the equation is then $7^\circ\ 40'$, whereas it does not exceed 5° when the line of the quadratures coincides with the line of the apfides.

The formula for the evection in the lateft tables is $1^\circ\ 20'\ 28''$ fin (2 dift. ☾ ☉ — mean anomaly ☽); from which it is eafy to follow the fucceffive variations of this equation, for it is only requifite to confider the different values which its argument can take. If it be required, for inftance, to determine when it arrives at its maximum, we have only to inveftigate the cafe in which the angle 2 dift. ☉ ☽ — m. anom. ☽ becomes equal to 90°, or 270°, or its fine equal to unity, the evection will then be equal $1^\circ\ 10'\ 21''$: the firft of thefe values will happen in the quadratures, when the mean anomaly is equal 90°, for then 2 dift. ☾ ☉ = 180° 2 dift. ☉ ☽ — m. anom. ☽ = $180^\circ - 90^\circ = 90^\circ$; on the contrary, the evection will difappear, when the argument is zero or 180°, this will happen in the fyzygies when the moon is either perigee or apogee, for then the diftance of the moon from the fun is equal 0° or 180°, and the fame of the mean anomaly. But by the various combinations of the two angles which form the argument of evection, the greateft and leaft values will arrive, even in feveral other points of the orbit. In general, in the conjunctions, the evection will have a contrary fign to the equation of the centre, for its argument is reduced to — mean anom. ☽, which gives a negative fign if the anomaly is lefs than 180°, and a pofitive fign if it is greater; but in the firft cafe the equation of the centre is additive, and in the fecond it is fubtractive. It is eafy to comprehend that it will be the fame in the oppofitions, hence it follows that in the fyzygies the evection is fubtractive from the equation of the centre, on the contrary it is additive in the quadratures. Thus the firft obfervers that examined the theory of the moon's motion only by means of eclipfes, and with no other view but to predict thofe phenomena, always found the equation of the centre too fmall, by the quantity of the evection in the fyzygies.

It is not difficult to find the period of the evection from the variations of the value of the angle on which it depends; it is fufficient to calculate the variations of this angle in a given time; and to conclude, by a fimple proportion, the number of days neceffary for it to vary 360°.

The fynodical motion of the moon in one century is $445267^\circ\ 6'\ 55''.46$, multiplying this by two, we have $890534^\circ\ 13'\ 50''.92$ for the double of the diftance of the moon from the fun, after a hundred Julian years. If from this we take the anomaliftic motion of the moon, in the fame interval, or $477198^\circ\ 41'\ 30''.6$; the difference $413335^\circ\ 32'\ 20''.3$ will be the value of the argument of evection, after 100 Julian years; from whence it appears, that this argument increafes 360° in a number of days expreffed by 360.36525, or 27.178533 days; this is the period of the evection, after which period it fucceffively takes again the fame values.

From this it appears, that fubftituting, inftead of thefe angles, their values calculated as above, the argument may be put in the form of a quantity proportional to the time; for

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For example, if we name the number of days elapſed ſince a given epoch as that of the tables t. The angle 2 diſt. ☽ ☉ —m. anom. ☽ will become $\frac{t \cdot 360}{27.178533}$, and the evection may be repreſented under this form $1° \; 20' \; 28'' \left(\frac{360 \cdot t}{27.178533}\right)$ or ſimply $1° \; 20' \; 28''$ ſin. m. t. making $m = \frac{360}{27.178533}$.

EVEILLON, James, in *Biography*, was born at Angers in the year 1542; he was diſtinguiſhed at a very early age for his literary acquirements, and obtained conſiderable eccleſiaſtical preferment, in the place of his birth, till at length he was made grand-vicar to the biſhop. Eveillon was looked up to for his ſuperior knowledge of the rights and uſages of the church; and of every ſubject connected with the councils, the fathers, and the canon law. He was not unfrequently employed in matters relating to church diſcipline, the reformation of breviaries, rituals, and monaſtic inſtitutions. His principal works were entitled "De Proceſſionibus Eccleſiaſticis, in quo earum Inſtitutio, Significatio, Ordo, et Ritus explicantur."—"De recta Pſallendi Ratione;" and "A Treatiſe on Monitions and Excommunications," which has borne a high character in the Catholic communion. Eveillon died at the age of 79, in the year 1621. He was a man of extenſive benevolence, having obtained the title of father to the friendleſs, and the poor, to whoſe relief he devoted the whole of a liberal income, excepting what was abſolutely neceſſary for his own ſupport. Moreri.

EUELPIDIUM, a kind of fluid collyrium.

EUELPISTI, a plaſter deſcribed by Scribonius Largus.

EVELYN, John, in *Biography*, the ſon of Richard Evelyn, eſq. was born at Wotton, in Surrey, in 1620. He received the early part of his education at Lewes, from thence he went to Chriſt church, Oxford. During the civil wars he ſpent his time on the continent, particularly in France and Italy. He married in the year 1647 the only daughter of ſir Richard Browne, the king's miniſter at Paris, and returned to England about the year 1651, where he employed himſelf in literary occupations, chiefly in tranſlating from the French and Latin. He was much inclined to a life of learned leiſure; and in his zeal to forward a ſimilar plan for others he formed a ſcheme for the erection of a college, where perſons might live together in philoſophical retirement, and in the purſuit of common ſtudies. In 1657 he publiſhed a favourable account of the king's character, with a view of preparing his countrymen for the reſtoration of monarchy, and on the return of the exiled Charles, he was graciouſly received, and introduced into public life, though without abandoning his literary purſuits. In 1662 he publiſhed a curious and learned work, containing much uſeful and important information, entitled "Sculptura, or the Hiſtory and Art of Chalcography, or Engraving on Copper." This piece was reprinted in 1755, with additions. Mr. Evelyn practiſed the art himſelf, and is introduced by Mr. Walpole into his catalogue of Engliſh engravers. On the inſtitution of the Royal Society, he was nominated among the firſt fellows and members of the council, and he ever after continued a zealous and truly active member of that learned body. At ſome of the early meetings of the ſociety was read his diſcourſe on foreſt trees, which was the baſis of the treatiſe entitled "Sylva, or a Diſcourſe of Foreſt Trees, and the propagation of Timber in his Majeſty's Dominions, to which is annexed Pomona, or an Appendix concerning Fruit Trees, in relation to Cyder, &c." As a ſequel to this work, he afterwards publiſhed his "Terra, a Philoſophical Diſcourſe of Earth, relating to the Culture and Improvement of it for Vegetation, and the Propagation of Plants." Both theſe works have been reprinted ſeveral times. The edition of the Sylva by Dr. Andrew Hunter, of York, is with plates of all the trees, in which their parts of fructification are accurately diſplayed according to the Linnæan ſyſtem. Mr. Evelyn was appointed, at the deſire of the king, in 1664, one of the commiſſioners of the ſick and wounded ſeamen, and likewiſe a commiſſioner for rebuilding St. Paul's cathedral. How well fitted he was for the latter office was ſhewn by a work which he publiſhed, entitled "A Parallel of the Ancient Architecture with the Modern," tranſlated from the French of Roland Freart, ſieur de Chambray; with additions from Alberti and others. He reſided at this period at his houſe of Sayes-court, near Deptford, which he had in right of his wife; here he cultivated a garden, and was regarded as a great improver of the art of horticulture, and celebrated for the pains which he took in the introduction of exotics into this country. During the reign of Charles, a board of trade was formed, and Mr. Evelyn was appointed one of its members. On this occaſion he drew up a ſmall treatiſe on the origin and progreſs of navigation and commerce, with an aſſertion of the king's title to the dominion of the ſea. Among the papers which he communicated to the Royal Society is a curious letter, given at length in the Biographia Britannica, deſcribing the miſchiefs done to his garden by the ſevere winter of 1683–4. This letter will be read with intereſt, as affording information of the perennials at that time chiefly cultivated in England, and as ſtating the dire effects of rigorous froſt. We ſhall give the concluding paragraph:

"The vines have eſcaped, and of the eſculent plants and ſallads, moſt, except artichokes, which are univerſally loſt; and what I prefer before any ſallad whatever, eaten raw when young, my ſampier is all rotted to the very root. The arboreſcent and other ſedums, aloes, &c. though houſed, periſhed with me, but the yucca and opuntia eſcaped. Tulips, many are loſt, and ſo the Conſtantinople-narciſſus, and ſuch tuberoſæ as were not kept in the chimney corner, where was a continual fire. Some anemonies appear, but I believe many are rotted. My tortoiſe, which by his conſtant burying himſelf in the earth at the approach of winter, I looked upon as a kind of plant animal, happened to be obſtructed by a vine-root from mining to the depth he was uſually wont to inter, is found ſtark dead, after having many years eſcaped the ſevereſt winter. Of fiſh I have loſt a few, and the nightingales, which for being a ſhort winged bird, and ſo exceedingly fat at the time of the year, we commonly ſuppoſe them to change the climate, whereas indeed they are then hardly able to fly an hundred yards, are as briſk and frolic as ever; nor do I think they alter their ſummer ſtations whatever may become of them all the winter."

In the reign of James II. Mr. Evelyn was, during the abſence of the earl of Clarendon in Ireland, made one of the commiſſioners for executing the office of lord privy ſeal, and after the revolution he was appointed treaſurer of Greenwich hoſpital. In 1697 he publiſhed a diſcourſe on medals, entitled "Numiſmata, &c." and his laſt work was "Acetaria, a Diſcourſe of Sallets," in which he treats of the nature and properties of all plants which have been employed as ſallad herbs. This diſcourſe was inſcribed to lord chancellor Somers. The dedication, which is written with much elegance, was intended to procure, if poſſible, a public eſtabliſhment for the Royal Society. Mr. Evelyn died in Feb. 1706 in his 86th year, having paſſed his days in uſeful and elegant purſuits, and diſtinguiſhed by benevolence, piety, and integrity. Biog. Brit.

Evelyn, John, ſon to the former, was born Jan. 14, 1654, at his father's houſe at Deptford. He was at a very early age admired for his rapid progreſs in knowledge, ſo that in the year 1666 he was ſent to Oxford under the ſpecial care of Dr. Bathurſt, till he could be admitted a gentleman commonner, which was in the Eaſter term, 1688. It does not appear that he took his degrees there, but returned to his father's houſe, where he proſecuted his ſtudies with much diligence and ſucceſs. During his reſidence in Trinity college, he is ſuppoſed to have written the elegant Greek poem which is prefixed to the ſecond edition of the Sylva. He became deeply learned in the ancient and modern languages, and cultivated poetry, of which there is evidence by a tranſlation "Of Gardens, firſt written in Latin by Renatus Rapinus." This was publiſhed when the tranſlator was a youth of nineteen years of age only. He afterwards tranſlated Plutarch's life of Alexander the Great from the Greek; and from the French he gave a tranſlation of "The Hiſtory of the Grand Viziers, Mahomet, and Achmet Coprogli." He was likewiſe author of ſeveral poems, two of which have been chiefly admired, the one "On Virtue," and the other was entitled "The Remedy of Love," and have been inſerted in Dryden's Miſcellanies. Mr. Evelyn was a man of buſineſs as well as a cultivator of literature, and was appointed one of the commiſſioners of the revenue of Ireland. He died in the prime of life, in London, March 24, 1698, in the forty-fifth year of his age, leaving behind him two ſons and three daughters. Biog. Brit,

EUE'MBOLOS, (from ευ *well*, εν, *in*, and βαλλω, *to caſt*,) a perſon ſkilful in ſetting bones.

EVEN Foot, in *Poetry*. See Foot.

Even *number*, is that which may be divided into two equal parts or moieties. See Number.

EVENELADS, in *Geography*, a river of England, in the county of Oxford, which runs into the Iſis, about 5 miles W. of Oxford,

EUENES, a town of Norway, 18 miles N. of Drontheim.

EVENING Star, in *Aſtronomy*. See Vesper.

Evening *iſland*, in *Geography*, a ſmall iſland in the Pacific ocean. N. lat. 2° 46'. W. long. 133° 17'.

EVENLY *even number*, is that which is exactly diviſible by an even number taken an even number of times; ſuch is 32, ſince it is diviſible by 8, taken four times.

Evenly *odd number*, is that which an even number meaſures by an odd one; as 30, which is meaſured by 6, taken five times.

EVENUS, in *Ancient Geography*, a river of Aſia Minor, according to Pliny, who ſays that the towns of Lyrneſſa and Miletus were built upon its banks. The inhabitants of Adramyttium drew water from this river by means of canals. Strabo.

Evenus, *Fidari*, a river of Greece, in Ætolia, which took its riſe towards the north-eaſt in mount Pindus, on the frontiers of Theſſaly, and paſſing through the territories of the Bomiæi, Ophienſes, and Apodoti, watered Calydon, and diſcharged itſelf into the ſea; to the weſt is the town called Chalcis. It was on the banks of the Evenus that Hercules, according to the fable, ſlew the centaur Neſſus.

EVERARD'S *ſliding rule*. See Sliding.

EVERBODE, in *Geography*, a town of France, in the department of the Dyle; 5 miles N. of Dieſt.

EVERDINGEN, Cæsar Van, in *Biography*, a painter of hiſtories, portraits, and landſcapes, born at Alkmaer in 1606. The maſter under whom he ſtudied, Van Bronkhorſt, ſoon obſerved and encouraged his ſuperior talents from among the reſt of his diſciples. He had a lively invention, and painted with freedom and firmneſs, and a good force of colouring.

Many of his pictures are ſpoken of in terms of praiſe; but the one ſelected as his principal performance is the repreſentation of the victory of David over Goliath. It was painted on the folding doors of the organ in the great church at Alkmaer; and the ſketch of it was preſerved in the council chamber of that city; it was painted in 1648. He died in 1679, aged 73.

Everdingen, Aldret Van, a landſcape painter, whoſe merit was very conſiderable. He was the nephew of Cæſar Van Everdingen, and was born in the ſame city, Alkmaer, in 1621. Having firſt attended to the inſtructions of Roland Savery, he afterwards greatly improved by thoſe of Peter Molyn; whom at laſt he ſurpaſſed in ſkill. He delighted moſt in the grand ſcenes of nature, or rather her more romantic features, ſuch as rocks, torrents, and cataracts, which he executed with great freedom and variety of touch. In his time he had no ſuperior, but Jacob Ruyſdael followed him immediately, was indeed partly contemporary with him, and in his own ſtyle left him far behind in the brilliancy and force of his colours and execution, and the choice of his forms. However, Everdingen is highly deſerving of great praiſe for the care which he took to make himſelf acquainted with the effects of nature, and the truth with which he marked them. He made a voyage up the Baltic, and was much gratified by and made much uſe of the ſcenery, which the romantic coaſts of that ſea, and of Norway, (which he alſo viſited) afforded him. He died in 1675, and left behind him a great number of drawings, both of real views and compoſitions, which are very freely wrought. He was thought not to ſucceed ſo well in large works as in ſmaller ones, thoſe coming more within the management of the neatneſs of pencilling, which characterizes his ſtyle of execution. The latter are very highly and very deſervedly valued in Flanders and Holland.

Everdingen, in *Geography*, a town of Holland, in Guelderland; three miles W. of Culemburg.

EVERET'S Bridge, a place of Nanſemond county, in Virginia; where is a poſt-office; 266 miles from Waſhington.

EVERGEM, a town of France, in the department of the Eſcaut, and chief place of a canton in the diſtrict of Gand. The place contains 6878, and the canton 13,176 inhabitants, on a territory of $67\frac{1}{2}$ kiliometres and four communes.

EVERGETÆ, in *Ancient Geography*, a people of Aſia, placed by Strabo in the vicinity of Drangiana.

EVERGETES, Ευεργετης, a Greek term, ſignifying *benefactor*, being formed of ευ, *bene*, *well*, and εργον, *opus*, *work*. It is ſtill retained in our language by way of addition or epithet given to two princes or kings of Syria and Egypt, who ſucceeded Alexander. Thus we ſay Ptolemy Evergetes, king of Egypt, Antiochus Evergetes king of Syria.

EVERGREEN Thorn, in *Gardening*. See Mespilus *Pyracantha*.

Evergreen *Trees*, are ſuch trees, whether of tall or ſhrubby growth, as conſtantly retain their leaves during the whole year. There is a great number of this ſort of

plants,

plants, which will be particularly defcribed under their proper genera.

Thefe kinds of trees, fhrubs, &c. are increafed in different modes, according to their particular nature, as by feeds, layers, cuttings, fuckers, &c. which is fully fhewn under the culture of the different forts, but principally in the fpring feafon, though occafionally in the fummer, and frequently in the early autumn.

The proper feafons for planting them out are the early autumn or latter fpring months, according to the nature of the foil. Where the foils are of the more ftiff, retentive, moift kind, the more advanced fpring months are the beft; but where they are of the light, dry, loofe defcription, the beginning of the autumn is the moft proper period; as in the former cafe the plants will be in no danger of being injured by ftagnant moifture in the winter, and in the latter there will be no rifk of their being deftroyed by the heat and drynefs of the fummer, before they become perfectly eftablifhed in the ground.

In the planting of evergreen trees, it is feldom neceffary to put them into any great depth, as they are very liable to be deftroyed by deep planting. There is likewife another circumftance that ought to be regarded, which is that of having the mould in which they are to be fet fufficiently fine, and the roots well bedded in it, without being too much cut in or retrenched. In all cafes the loofe mould fhould be well trodden in about them; and the more tall growing kinds well fupported with ftrong ftakes, fo as to keep them perfectly fteady in their fituations. Numbers of trees of this, as well as other forts, are deftroyed for want of attention in this refpect, as when once they get loofe they foon die by the motion which takes place. The pruning or cutting in of this fort of trees, where it is neceffary, fhould be performed either in the more advanced fpring feafon, or the latter part of the fummer, but never in the winter feafon, as they are liable to much injury from cold. This is equally neceffary to be regarded in the clipping of hedges conftituted of plants of this fort.

Many of thefe forts of trees and fhrubs are fufficiently hardy to admit of being planted in moft forts of foils and fituations. The tall-growing kinds are well adapted for affording ornament and variety in mixture with thofe of the deciduous clafs in extenfive plantations, and fuch as are of a fhrubby growth in the borders, clumps, and other parts of ornamented grounds. In thefe fituations they fhould be fuffered as much as poffible to take their natural growth, efpecially the fir kinds, and in the others only very little cut in, and the dead wood removed from them.

In the forming of hedges various plants of this fort are employed; but the beft are thofe of the holly, yew, evergreen privet, and box kind; though the common laurel and lauruftinus may be the moft advifeable, where they are required to be lofty. Thefe are likewife capable of being trained fo as to cover naked walls, palings, or other unpleafant objects. Hedges formed of thefe plants fhould be clipped once or twice during the fummer feafon, fo as to keep them in perfect neat order.

Various ornamental devices were formerly made with thefe and other forts of evergreens in gardens; but thefe are at prefent little in ufe, as a better and lefs troublefome tafte prevails.

It has been remarked by the author of "The Philofophy of Gardening," that in thefe forts of trees and fhrubs the buds rife in the bofoms of the leaves, which, as they are not fhed in the autumn, continue to oxygenate the juice of the plants, and fupply nutriment to the buds during the fine days in the winter and fpring feafons, furviving till nearly the middle of fummer, when the new buds have expanded leaves of their own. It is hence conjectured, that evergreens provide no ftore of nourifhment in their roots, or alburnum in the fummer for the fupport of their enfuing vernal buds, and of courfe have probably no bleeding feafon, as is the cafe with thofe of the deciduous kind.

And there is another circumftance which has been ftated by Dr. Milne, in his botanical dictionary, to take place in refpect to evergreen trees, which is, that when they are engrafted on thofe of the deciduous fort, it determines the latter to retain their leaves. This is afferted to be confirmed by repeated experience, in grafting the laurel, (*lauro-cerafus*) an evergreen, on the common cherry, (*cerafus*), and the (*ilex*), an evergreen oak, on the common oak. And it is probable that many other facts of the fame kind may exift, though they have not been noticed by common gardeners.

EVERLASTING. See GNAPHALIUM.

EVERLASTING *Pea*. See LATHYRUS.

EVERLASTING *Pea*, in *Agriculture*, is the common name of a perennial plant of the vetch kind, which grows naturally in fome fituations in this country; and is capable of being cultivated with great care and advantage as a green food for cattle or other ftock, where the foils are inclined to be of the more heavy loamy kinds; as it affords a large produce of the moft nutritious fort of fodder. Where it is fuffered to ftand till the feeds are formed, it has been found in the few trials that have been made with it to poffefs a highly fattening property when confumed by animals.

EVERRIATOR, derived from *ex* and *verro, I cleanfe*, in *Antiquity*, an officer who was obliged in a folemn manner to cleanfe fuch houfes as were defiled by dead bodies, called *domus funeftæ*.

EVERRICULUM, (from *everro, to fweep away*,) a kind of inftrument, in *Surgery*, refembling a fpoon, and ufed for taking away any fmall fragments of the ftone, which may remain behind in the bladder, in the operation of lithotomy.

EVERS, in *Rural Economy*, a term fometimes provincially applied to thofe ftiles which open; in which cafe the top rail has a bolt of iron driven through it at one end, the other falling into a notch in the oppofite poft, by which contrivance an opening can occafionally be readily made.

EVERSBERG, in *Geography*, a town of Germany, in the kingdom of Weftphalia; 34 miles N. of Cologn.

EVERY YEAR'S-LAND, in *Agriculture*, is a term applied to fuch lands as have been cropped with what are termed brown and white crops, or pulfe and grain crops, in alternation or fucceffion for a very great length of time, without the intervention of any fort of fallow. Mr. Marfhall has remarked that extenfive common fields in Gloucefterfhire have been conducted under this fort of management for "perhaps centuries:" and the fame is the cafe in fome other countries.

EVES-DROPPERS, in *Law*. See EAVES-DROPPERS.

EVESHAM, or ESAM, in *Geography*, is a borough and market town, pleafantly fituated upon a rifing ground, above the banks of a navigable river, named the Warwickfhire Avon, in the hundred of Blakenhurft, and county of Worcefter, diftant from London ninety-fix miles. This place claims high antiquity, and is not lefs notable for its fubfequent celebrity. The firft notice of it upon record, like the origin of moft towns referable to the Saxon period, is the account of Egwin, bifhop of Worcefter, having founded a monaftery here in the year 709: and amply endowed it by the affiftance of Kenred, fon of Wulpher, king of Mercia. This was one of the mitred abbies; its abbot fat in the houfe of peers as a baron of the realm; its privileges were numerous and extenfive, and the revenues on the diffolution were valued at the annual fum of 1183*l.* Of the building, which from records appears to have been immenfe, few veftiges remain. The large elliptical arch, decorated with rich but mutilated imagery, is ftill ftanding; and the tower noticed by Leland. "Clement Lichfeild the laft abbot of Evefham fave one, did very much coft in buildinge of the abbey and other places longing to it.—He made a right fumptuoufe and high fquare towre of ftone in the cemitery of Eovefham. This tower had a great bell in it, and a goodly clocke, and was as a gatewav to one piece of the abbey." Itinerary, vol. iv. p. 108. This tower is a regular and beautiful ftructure, twenty-two feet by twenty-two, and one hundred and feventeen in height; and is generally confidered the laft monaftic building erected under papal influence in England. Though the churches have towers, this ftill continues the ftation for the clock and bells.

In that part of the town called Bengeworth, which may be viewed as a fuburb on the eaftern fide of the river, over which the communication is formed by a handfome ftone bridge of feven arches, ftood an ancient caftle, probably erected foon after the Norman conqueft. For in the year 1152, abbot William de Audville gained this fortrefs from lord William de Beauchamp, who held it for king Stephen, razed it level with the ground, and converted the fite into a place of interment.

Evefham is a very ancient borough, enjoying numerous privileges, both by prefcription and charter. It was one of the towns fummoned by writ to fend members to parliament, in the twenty-third year of king Edward the Firft's reign, when he bafely pretended to reftore the Saxon conftitution; and was one of the eight boroughs which had their elective franchife reftored in the time of James the Firft. That monarch at the fame time granted a charter to the town to be governed by a mayor, feven aldermen, twelve burgeffes, and twenty-four affiftants, recorder, chamberlain, who are alfo of the common council, and other fubordinate officers. The mayor and four fenior aldermen are juftices of the peace, form a *quorum*, and have power to hold a feffions of *oyer* and *terminer*, and gaol delivery, to punifh all crimes, except high treafon, and execute felons within their liberty.

The town is much altered fince Leland vifited it; the houfes, which then were what are called *half-timbered*, that is, timber frames, having the open parts filled up with wattle and dab, are moftly well built with brick, the ftreets are wide and fpacious, and the falubrity of the air, with the beauty of the fituation, induce many genteel families to take up their refidence here. In the town are three parifh churches, two in the part ufually called Evefham, and one in Bengeworth; a well endowed free grammar fchool, charity fchool, and alms-houfe. The market, held on Mondays, is well fupplied, and four annual fairs are held Febuary the fecond, the firft Monday after Eafter, Whit-Monday, and the twenty-firft of September. From the late returns to government under the Population act, the number of houfes appear to be 616, and of inhabitants 2837. The richnefs of the foil in the vicinity has been long an inducement to turn many of the fields into garden ground, and the peculiar finenefs of the vegetable productions of this place has rendered Evefham gardeners proverbial for unrivalled fkill. They not only fupply the neighbourhood, but alfo the city of Worcefter, fourteen miles diftant; Birmingham, thirty; and during the afparagus feafon Bath and Briftol, more than fifty. Tindal's Hiftory and Antiquities of Evefham.

Evesham, *Vale of.* The fine tract of land comprized under this denomination, unrivalled in fame or fertility, is fituated on the eaftern and weftern banks of the river Avon, extending for feveral miles in various directions into Warwickfhire, where it is bounded by the high land of the Ridgeway, and into Gloucefterfhire, where the Cotfwold hills form a terminating barrier; and the fouth is wafhed by the river Severn.

It is defcribed in Monaftic hiftory as having derived the name, which it gives to the town already defcribed, from *Eoves*, a Saxon, fwine-herd to Egwin bifhop of Worcefter, in the latter end of the feventh century: this ham having been Egwin's property till he was dethroned by the pope, and his eftates confifcated. Previoufly to this it was called Heth-holme, or Heath-field.

To thofe who wifh to fee what "fun and foil," unaffifted by art, can do, parts of this diftrict will furnifh ftriking fpecimens. And to the admirers of agriculture other portions will evince what wonders may be effected from aiding the efforts of nature by the application of art. The foil is principally a deep heavy loam, or rich loamy clay, of inexhauftible depth, equally calculated for corn, or pafturage. And whether it be placed under an arable, or a grazing fyftem, the produce and the profits alike exceed analogical belief. The vale of Evefham, fays Leland, "is, as it were, for fuch an angle, the horreum of Worcefterfhire, it is fo plentiful of corn;" and juftly has he characterized this prolific fpot. For the abundance of herbage is not equalled by the famous Tilney fneeth in the hundred of Marfhland and county of Norfolk; nor can the crops of corn be furpaffed, except by thofe defcribed in Brydone's Tour as produced in the vales of Sicily. The rent of lands in the farms of this diftrict is equal to that of accommodation lands in moft other parts of the kingdom; yet perfons who have occupied eftates in fome others, at an exceeding low rate on a comparifon of the net proceeds from both, do not hefitate in deciding in favour of the higher rental. In this vale, about a mile diftant from the town of Evefham, was fought the moft memorable battle recorded in the annals of Englifh hiftory, between Simon de Montfort, the powerful earl of Leicefter, and prince Edward, afterwards king Edward the Firft; in which the earl was completely defeated, and the refractory barons, with moft of their adherents, taken or flain. He has been not unaptly compared to the Roman confpirator Catiline, for, like him, he verified in his conduct the remark of Tiberius, recorded in Tacitus Ann. l. iv. c. 18. "Beneficia eo ufque læta funt, dum videntur exfolvi poffe." "Favours are only fo long properly beftowed as there appears a probability, or at leaft a capability of return." After king Henry the Third had conferred upon him an accumulation of honours and emoluments, and even permitted him to marry the princefs, his fifter; he experienced from the earl the moft ungrateful requital. He purfued the monarch with the moft inveterate hatred; and by inflammatory fpeeches, and other overt acts, excited the moft perplexing commotions, and diftreffing inteftine warfare, the kingdom ever experienced; under a pretence of reftraining the prerogative, reforming the government, and afcertaining and fecuring the liberties of the fubject. The conteft, however, was productive of good, intended by neither of the parties. The prince, when he had afcended the throne, determined to ftill further curtail the enormous power of the barons; and by his writs fummoned together, as his advifers, reprefentatives from numerous cities and boroughs, as well as counties; the battle of Evefham therefore may be confidered "as the origin of our prefent houfe of commons."

Evesham, a townfhip of America, in Burlington county, New

New Jerfey, fituated between the forks of Moore's creek, which runs north-wefterly to Delaware-river; 16 miles E. of Philadelphia.

EVESPERIDES, in *Ancient Geography*, a people of Africa, in the maritime part of Libya, to the weft of the Aufchifes: whofe country, according to Herodotus, was fingularly fertile; whence it has been fuppofed that the famous garden of the Hefperides was found in their territory. This name, in its grammatical acceptation, fignifies Occidentals.

EVESPERIS, a town on the coaft of Africa, which afterwards took the name of Berenice.

EVEST, in *Geography*, a river of Ruffia, which runs into the Dwina, near Kreutzburg.

EUEXIA, from ευ, *well*, and εξις, *habit*, in *Medicine*, a good found habit of body.

EUFEMIA, St., in *Geography*, a town of Naples, in the province of Otranto, two miles N.N.E. of Aleffano. —Alfo, a town of Naples, in Calabria Ultra, fituated on a bay of the Mediterranean, to which it gives name. N. lat. 39° 2'. E. long. 16° 30'.

EUFRA, a town of South Finland; 12 miles N.N.E. of Abo

EUGALENUS, Severinus, in *Biography*, a phyfician of Doccum, in Friefland, known chiefly as the author of a treatife on the fcurvy, which once maintained a confiderable character, and paffed through many editions. Its title is "De Scorbuto Liber, cum Obfervationibus quibufdam, brevique et fuccinctâ cujufque curationis indicatione, 1604." But the treatife of Dr. Lind, on the fame fubject, in which the abfurdities and ignorance of Eugalenus are pointed out, has fuperfeded it. Eloy. Mangeti Bibl. Script. Med.

EUGANEI, in *Ancient Geography*, a people of Italy, towards the Alps.

EUGANO, in *Geography*, a mountain of Italy, in the weft part of the Paduan, bordering on the Vicentin.

EUGENE, Francis, of Savoy, in *Biography*, generally denominated prince Eugene, grandfon of Charles-Emanuel, duke of Savoy, was born at Paris in 1663, and deftined for the church. His mother, on account of her ill-conduct, was obliged to leave Paris. She retired to Bruffels, and young Eugene being deprived of her fupport, and having been difappointed in his expectations of preferment, went as volunteer to ferve in Germany againft the Turks. He, with other French volunteers, was recalled on pain, in cafe of difobedience, of perpetual banifhment. He fet the order at defiance, and fo much diftinguifhed himfelf in his firft campaign that the emperor gave him a regiment. After the fiege of Vienna was raifed, he ferved in Hungary under the command of the duke of Lorrain and the elector of Bavaria. From this time his reputation increafed, with every action in which he engaged, till, in the year 1697, he was appointed to the command of the imperial army. In the autumn of this year he entirely defeated the Turks at the battle of Zeuta, in which the grand vizier and more than 20,000 men were left on the field, and the grand feignior was obliged to make a precipitate retreat with the broken relics of his army. Eugene had hazarded this engagement contrary to the exprefs orders of the imperial court; but he fo completely juftified his conduct, that Leopold gave him a written authority to act thenceforth according to his own judgment. He was now oppofed by all the great French generals, but in every battle his exertions and prowefs were crowned with fuccefs, and on returning to Vienna the emperor created him prefident of the council of war, and entrufted the military cheft to him; but that cheft was frequently ill fupplied, which occafioned him more trouble than the moft vigorous oppofition in the field. He was ftrictly united with the duke of Marlborough, and by their talents and concert they obtained a decifive fuperiority over the French in Germany. At the celebrated battle of Blenheim, Eugene commanded the imperial part of the army, and had no fmall fhare in the fuccefs. In 1705, he was defeated in Italy, but in the following campaign he regained his reputation by marching acrofs Lombardy in the face of the French army, and attacking the French in their intrenchments at Turin, over whom he obtained a complete victory, which fecured the duke of Savoy and reftored all the Milanefe to the emperor. In 1707, he invaded France, but without obtaining any decifive advantage, and in 1708 he was with the duke of Marlborough at the battle of Oudenard, and the capture of Lifle. He commanded the centre at the bloody battle of Malplaquet, where he was grievoufly wounded, but refufed to retire from the field, faying, "Of what ufe will it be if we are to die here;—if we are to furvive it will be time enough in the evening to be dreffed." When the politics of England took a turn and peace was determined on, Eugene carried on the war alone, till it was concluded by the peace of Radftadt in 1714. Shortly after this he was called on to contend again with the Turks, whom he fignally defeated in the year 1716. In the following year he undertook the fiege of Belgrade, when the Turks came to its relief, and invefted him in his camp. He fuffered them to approach very near, and then fuddenly quitting his lines fell upon them with fo much vigour, that he killed 20,000 men, aud poffeffed himfelf of their cannon and camp equipage. Belgrade immediately furrendered, and an advantageous peace was the refult of this important victory. Eugene now retired to Vienna covered with glory, and juftly confidered as the faviour of the empire, and the greateft benefactor to the houfe of Auftria. He was great in retirement, as he had been heroic and magnanimous in war. In the year 1733 he attempted new exploits, in confequence of the difputed election to the Polifh crown; but he was no longer the great, the enterprizing Eugene. He died in 1736 at Vienna, aged feventy-three. As a man he was cold and referved in his manner, and ferious in his afpect: as a friend he was liberal, free from pride, faithful to his promifes, and ever ready to do a kind action. As a general he was regarded by thofe under him in the character of a father and protector: in his military capacity he was enterprifing, full of refources, and though he fometimes committed faults, he rarely failed to redeem his credit by new and brilliant fucceffes. Moreri. Modern Univerfal Hift. Hift. of England. See alfo the article Churchill in this Dictionary.

EUGENIA, in *Botany*, fo named by Micheli in compliment to the heroic prince Eugene of Savoy, who fent him from Germany almoft all the plants defcribed by Clufius, and who had a celebrated botanic garden. Mich. Gen. 226. t. 108. Linn. Gen. 247. Sm. Tr. of Linn. Soc. v. 3. 280. Schreb. 333. Willd. Sp. Pl. v. 2. 959. Mart. Mill. Dict. v. 2. Juff. 324. (Syzygium; Gærtn. t. 33.). Clafs and order, *Icofandria Monogynia*. Nat. Ord. *Hefperideæ*, Linn. *Myrti*, Juff.

Gen. Ch. *Cal.* Perianth fuperior, in four deep, oblong, obtufe, concave, permanent fegments, the orbicular centre between them elevated, and fomewhat downy. *Cor.* Petals four, twice as large as the fegments of the calyx, oblong or roundifh, obtufe, concave. *Stam.* Filaments numerous, inferted into the elevated ring of the calyx, about as long as the corolla; anthers fmall, roundifh. *Pift.* Germen inferior, turbinate; ftyle fimple, the length of the ftamens;

ftigma

ftigma fimple. *Peric.* Berry roundifh or angular, crowned with the calyx, of one cell. *Seed* folitary, roundifh, fmooth and even.

Eff. Ch. Calyx fuperior, in four deep fegments. Petals four. Berry of one cell, with one feed.

Obf. The number of petals, and fegments of the calyx, is frequently five, in one inftance eight. The germen has, in fome fpecies at leaft, two cells, though one of them becomes obliterated as the fruit ripens.

This is an extenfive genus, chiefly from the Eaft and Weft Indies, whofe fpecies are as difficult to define as the rofes in our European gardens. Their habit is akin to the myrtle, but often more ftout and arborefcent. *Leaves* fimple, oppofite, ovate or elliptical, entire, without ftipulas, moft frequently fmooth, paler beneath, evergreen. *Flowers* either terminal or axillary, white or reddifh. *Fruit* not unwholefome, but fcarcely ever very grateful to the palate; in fome cafes highly fragrant. Willdenow has 30 fpecies, a number far fhort of what are known, and yet two of them (*acutangula* and *racemofa*), are fcarcely true *Eugeniæ.* There is alfo fome confufion between this genus and *Plinia*, the original *E. uniflora*, Linn. Sp. Pl. 673, being not only *Myrtus brafiliana*, ibid. 674, but alfo *Plinia rubra*, Linn. Mant. 243; as well as *P. pedunculata*, Linn. Suppl. 253; under which laft name it is figured in Curt. Mag. t. 473, with a wrong quotation of Linn. Mant. Whatever the *Plinia* of Plumier may be, this plant is the original *Eugenia* of Micheli's figure, and is well known in the Brafils and Weft Indies, its fruit refembling an indifferent cherry in fize, tafte, and colour, though different in being externally furrowed. This fruit fometimes ripens in ftoves in England, but the plant is no general favourite, being a meagre reprefentative of the common myrtle.

E. *Jambos.* Linn. Sp. Pl. 672. (Malacca Schambu; Rheede Hort. Mal. v. 1. t. 17.), is much celebrated for the fragrance of its fruit, which refembles that of a rofe, or rather rofe-water. It is alfo of an extremely fine yellowifh colour with a rofy tint, and though not pleafant to the tafte, is frequently brought to table in the Indies, for the fake of its perfume.

E. *malaccenfis.* Linn. Sp. Pl. 672. Sm. Exot. Bot. t. 61, a beautiful Eaft Indian fpecies, is efteemed for the elegance of its red cluttered flowers, as well as the flavour and cooling quality of its fruit.

EUGENIUS I. in *Biography*, pope, was born at Rome, and raifed to the higheft dignity in the church in the year 634, on the depofition of pope Martin. He owed his elevation to the choice of the Roman people and clergy, and their choice was confirmed by the emperor Conftans. At this period the weftern and eaftern churches were furioufly contending with each other upon the queftion whether Chrift poffeffed one will or two. Eugenius, after his promotion, took pains to quiet the minds of the difputants.. A compromife was entered into between the parties, but it was not of that nature to command general approbation: it was unfatisfactory to the Roman people and clergy, who oppofed the admiffion of the patriarch Peter's confeffion of faith. Peter had taken the other fide of the queftion, and in his confeffion he took no notice of the will and operations in Chrift. So vehement was this party that they refufed to permit the pope to perform divine fervice in the church of St. Mary, until he had publicly declared his condemnation of it. We have no other particulars relating to this pope, who died in the year 657, but he was commended by his contemporaries and fucceffors for piety, mildnefs, humanity, and generofity. Moreri. Bower.

EUGENIUS II. pope, was a Roman by birth, and from being archprieft of St. Sabina, was made bifhop of Rome in the year 824. This election was oppofed by the people, who made choice of a different perfon for pope. The double election excited confiderable difturbances at Rome, which occafioned the interference of Lewis the Debonnaire, who decided for Eugenius, and confirmed him in his high office. The monarch took this opportunity of reviving feveral ancient cuftoms and laws, declaratory of the dependence of the bifhops of Rome on the imperial power, and determining the limits of the fubmiffion and obedience which were paid to them. Eugenius, to fecure his own power, took the oath of fidelity to Lewis and his fon Lotharius, in which was included their folemn engagement that no future pope fhould be confecrated with their confent, but in the prefence of the emperor's deputy, and after the exaction of a fimilar oath to what was at that time adminiftered. During the pontificate of Eugenius, a council was affembled in France under the aufpices of Lewis and the Greek emperors Michael and his fon Theophilus, to examine the doctrine of the Greek church, in relation to images. This was in the year 825, and at the conclufion of the council the bifhops wrote a letter to Lewis, giving fentence againft both parties, *viz.* the churches of Conftantinople and Rome; the former for breaking images, whence they were denominated "Iconoclaftæ," and the latter for worfhipping them, whence they obtained the title of "Iconolatræ," declaring at the fame time that it was a far greater crime to worfhip than to break images. The emperor was alfo exhorted by the council to interfere with the pope, and to intreat him to abolifh the fuperftitious worfhip of images, which was the caufe of much offence to all good men. Lewis wrote to the pope, and deputed two bifhops to reafon with him on the fubject, but to little or no purpofe; he continued not only to promote, but to juftify the practice of image worfhip. In the following year Eugenius held a council at Rome, in which a number of decrees were paffed, intended to reform the ftate of ecclefiaftical difcipline and to encourage the progrefs of literature both facred and profane, but he died in the year 827, before he could carry his plans into effect. He was highly fpoken of by Catholic writers, and applauded for his humility, his beneficence, and the humane policy of his government. He is reprefented as excelling in mental and corporeal endowments. As a writer, two of his epiftles, and eleven of his decrees, are extant in the feventh volume of the "Collectio Conciliorum." It has been reported, and not greatly to the credit of Eugenius, that he was the inftitutor of the ordeal by cold water. See ORDEAL. Moreri. Bower.

EUGENIUS III. pope, fo called upon his elevation to the popedom, from his ufual name Bernard, was a native of Pifa, and a difciple of St. Bernard. On the death of Lucius II. in the year 1145, Bernard was unanimoufly fixed on by the cardinals as the new pope, and was enthroned with the ufual ceremony under the title of Eugenius III. The people, who had been long ftruggling to wreft from the popes the fovereignty which they had acquired over them in temporal matters, would not fuffer Eugenius to be confecrated, unlefs he refigned all pretenfions to dominion, otherwife than as connected with his fpiritual rank, and would be contented with the revenue to be derived from tithes, and the voluntary contributions of the faithful. Unwilling to make thefe conceffions, he privately withdrew to the Benedictine monaftery of Farfa in Sabina, whither he was followed by the cardinals, and confecrated. Not daring to return to Rome, he removed from Farfa to Viterbo, where he continued for fome months. During his abode there embaffadors arrived from the Crufaders in the Eaft, to implore

plore affiftance from the pope and the weftern princes againft the Turks, who had gained fome important advantages over them. Eugenius fupplicated the affiftance of Lewis VII. king of France, ftrongly urging him to march in perfon to the relief of the Chriftians in the Holy Land, and conferring on thofe who fhould attend him the privileges which his predeceffors had granted to fuch as engaged in the holy war. Lewis embarked, and Eugenius now took meafures to reduce the Romans to fubmiffion, which he effected in a fhort time, and forced them to acknowledge him as their temporal as well as fpiritual lord. His triumph was of no long duration, for an infurrection obliged him to feek for perfonal fafety in flight. He went to Treves, where he held a council in the year 1146. In the following year he was refpectfully entertained at Paris by the king; and here he was allowed to hold a council, in which William, archbifhop of York, was depofed from his dignity. From Paris he went to Rheims, where, in 1148, he held that council before which the fanatic Eon was examined. See Eon. He next returned to Italy, and, with the affiftance of the king of Sicily, once more fubdued the people of Rome, in the year 1149. Shortly after this he was obliged to retire into Campania, where he remained till the year 1152. During this period he was not inactive, but fent a legate into Ireland, by whom he eftablifhed the four archbifhoprics in that kingdom. He was now permitted to return to Rome, where he lived in peace till his death in 1153. His virtues have been highly commended by his contemporaries. By fome writers his chief merit arifes from his zeal and fufferings in promoting the interefts of the holy fee, and in combating the errors of heretics: by more modern hiftorians his memory has been held in abhorrence on account of the active part which he took in promoting the Crufades, by which great calamities overwhelmed Europe and the eaftern world. Moreri. Bower. See Croisade.

Eugenius IV. pope, was a native of Venice, and of plebeian rank, though defcended from an ancient family. His original name was Gabriel Condelmerio, and while he was very young he accompanied a nephew of pope Gregory XII. to Rome, where he took the Celeftine habit. He was afterwards made treafurer to the pope himfelf, and then bifhop of Sienna. In 1408 he was advanced to the office of cardinal prefbyter of St. Clement. While Martin V. was pope he was fent delegate into the Marche of Ancona, and afterwards to Bologna, and performed the duties repofed in him with great ability and reputation. On the death of Martin in 1431, he was elected to the papal fee, when he affumed the name of Eugenius IV. Immediately upon his elevation he involved himfelf, and the city of Rome, in the moft alarming difficulties, by attempting to feize upon treafures faid to have been left by his predeceffors; and no fooner was he extricated from the dangers refulting from this conduct, than he drew upon himfelf frefh troubles with the council of Bafil, which he determined to diffolve on account of their conciliating meafures with the Huffites of Bohemia. His legate, cardinal Cæfarini, whom he empowered to act on the occafion, a man of much difcretion, forewarned him of the troubles he was likely to bring on himfelf by the act. Eugenius had, however, made up his mind, and in 1431 iffued his bull, declaring the council of Bafil to be diffolved, and appointing another to be convened in eighteen months at Bologna. The emperor urged the pontiff to revoke his decree, fetting forth in ftrong and very preffing terms the evils into which he would otherwife plunge the Chriftian world; and he added that he was fure the affembled bifhops would not fubmit to be difappointed of the object of their meeting, and that he, as protector of the church, was bound to afford them his fupport. Eugenius was immoveable, and the council were alike determined to fet his power at defiance. After confirming the decrees of the council of Conftance, which declared the papal power to be fubordinate to that of a general council, and bound by its ftatutes and mandates they voted that no power on earth could diffolve them without their confent, and that none fhould withdraw from them without their leave; and they went fo far as to fummon the pope to appear in perfon before them within a limited time, or to fend legates with full authority to act in his name. The firmnefs of the council, after much altercation, brought the pope to fubmiffion, and in the year 1433 he iffued a bull, declaring null and void whatever had been done by him, or in his name, in derogation of the council general of Bafil. In the fame year Eugenius received the emperor Sigifmond at Rome with great magnificence, and crowned him there. Shortly after this he was attacked by Philip duke of Milan, who laid wafte the territory of Rome, and when the inhabitants laid their complaints before the pope, he referred them to the cardinal his nephew, who, regardlefs of every thing that did not contribute to his own eafe and pleafure, treated their fufferings with neglect and contempt. Enraged at this behaviour they took up arms, and produced a temporary revolution at Rome. It was with the utmoft difficulty that Eugenius efcaped from their fury, and took refuge at Florence; a reconciliation was effected, which was farther confirmed through the mediation of the council of Bafil, who difpatched fome of their body to offer friendly advice on the occafion. In 1437 frefh diffenfions arofe between the council and the pope, which terminated in their final rupture, and a new council was appointed to meet at Ferrara, whofe firft act was to declare the congregation of Bafil an unlawful affembly, and themfelves the only oecumenical council lawfully affembled, and they ordered all bifhops who ftill remained at Bafil to withdraw from that city within thirty days, on pain of excommunication, and the forfeiture of their dignities and benefices. The council of Bafil, on the other hand, paffed a decree or fentence of fufpenfion againft Eugenius from papal jurifdiction, forbidding all ecclefiaftics, on pain of excommunication, to obey him. Early in the year 1439, a contagious diforder breaking out at Ferrara, the pope tranflated the council to Florence, where a pretended union was effected between the Greek and Latin churches, which, being violently oppofed at Conftantinople, was rendered null and void. In the mean time the council of Bafil, after declaring the fuperiority of councils over the pope to be an article of the Catholic faith, proceeded to depofe Eugenius from the papacy, as difobedient to the commands of the church, a contemner of the canons, a difturber of the unity of the church, and an obftinate heretic; and they difpatched nuncios to the different courts of the Chriftian princes to acquaint them with the meafures which had been adopted. Eugenius thundered out his excommunications againft the fathers at Bafil, but they held his decrees in derifion, and raifed to the papal throne Amadeus, duke of Savoy, who affumed the name of Felix V. The rival popes and rival councils anathematized each other, laying claim to the true apoftolic powers. Eugenius was fupported by France, Italy, Spain, Portugal, Hungary, and England, but Felix was defended by the people of Savoy, by the Swifs, and by the dukes of Bavaria and Auftria. The German princes chofe to preferve a neutrality till the year 1447, when they declared for Eugenius, determining that he was the only true vicar of Chrift upon earth. In the midft of the public rejoicings on this occafion, he died in

his

his ſixty-fourth year. His character as a pope is eaſily gathered from what has been ſaid; he was ambitious, intriguing, and a decided enemy to reform. In his laſt illneſs he is ſaid to have been painfully affected with reflections on his paſt life; "Oh Gabriel," exclaimed the dying pontiff, "how much better had it been for thy ſoul's ſafety, hadſt thou never been promoted to the dignity of cardinal or pope!" He was a patron of literature and learned men, though he had no pretenſions to learning himſelf; his epiſtles and bulls are to be found in volumes xii. and xiii. of the "Collectio Conciliorum." He was a handſome man, of a venerable aſpect, and always looked downwards when he appeared in public. He was frugal and temperate in his own perſon, but was liberal and hoſpitable; and at his table there was a princely magnificence. In this reign the cardinals began to indulge in the ſports of the field, and to abandon themſelves to all kinds of luxury. Bayle. Moreri. Bower.

Eugenius, Catholic biſhop of Carthage, was raiſed to that ſituation in the year 481, at the requeſt of the emperor Zeno, who had entered into a treaty of peace with Hunneric, at that time the reigning monarch. In the year 483, he was ſummoned, with the other Catholic biſhops, by the king, to Carthage, to maintain a public debate in defence of their principles againſt the Arian biſhops, whom he patronized. Eugenius undertook to draw up a treatiſe, explanatory of the Catholic faith, which was approved by all the biſhops of his party, and preſented to Hunneric, and he offered to defend the principles contained in it by an appeal to the ſacred writings, as well as to the ſentiments of the fathers. He alſo delivered a petition to that prince, in the form of an apology, the deſign of which was, to obtain peace for the Catholics. It was, however, of no avail; the biſhops of that party were all ſentenced to baniſhment, and Eugenius was ſent into exile, amidſt the dreary deſerts of Tripoli. In the following year Hunneric died, and Eugenius was permitted to return to Carthage, but was again baniſhed, on the acceſſion of Thraſamund, and ſent into Gaul. He died at Albi, in the year 505. His principal works are, "Expoſitio fidei Catholicæ," "Apologeticus pro fide;" "Altercatio cum Arianis;" and a letter to his people, exhorting them to conſtancy in the orthodox faith. Moreri.

Eugenius, biſhop of Toledo, in the ſeventh century, was attached to the monaſtic life, but compelled, by order of the prince, to accept of the epiſcopal dignity in the year 646. He filled that ſee ſeveral years, and made a figure at the councils of Toledo, which were held in the years 653, 655, 656. He was author of a treatiſe "On the Trinity," and two books on miſcellaneous ſubjects. He reviſed and improved Dracontius's work on the creation of the world, which was publiſhed at Paris, together with his "Opuſcula," in the year 1619. Moreri.

EUGHTGUR, in *Geography*, a town of Hindooſtan, in the circar of Kitchwara; 15 miles E. of Ougein.

EUGIA, in *Ancient Geography*, a ſmall country of the Peloponneſus, in Arcadia.

EUGMO, in *Geography*, a ſmall iſland on the eaſt ſide of the gulf of Bothnia. N. lat. 63° 49′. W. long. 22° 42′.

EUGUBIO. See Gubbio.

EUHYDRIUM, in *Ancient Geography*, a town of Greece, in Theſſaly, according to Livy.

EVIAN, in *Geography*, a town of France, in the department of the Leman, on the coaſt of the lake of Geneva, containing two pariſhes and two convents. The place includes 1502, and the canton 12,911 inhabitants, on a territory of 280 kiliometres, and in 19 communes. Near Evian are ſome mineral waters, which render it in ſummer a place of reſort. It is ſituated 23 miles N. E. from Geneva. N. lat. 46° 25′. E. long. 6° 24′.

EVICTION, from *evinco*, *I overcome*, in *Law*, ſignifies a recovery of lands or tenements by law.

EVIDENCE, a quality in things whereby they become viſible and apparent to the eyes, either of the body or the mind.

The ſchoolmen diſtinguiſh evidence into *formal* and *objective*. The former is the act of the intellect, conſidered as clear and diſtinct; the latter conſiſts in the clearneſs and perſpicuity of the object; or it is the object itſelf ſo conſtituted as that it may be clearly and diſtinctly known.

Others divide evidence into *moral*, *phyſical*, and *metaphyſical*. A thing is ſaid to be *morally evident*, ſo far as we have a diſtinct notion or knowledge thereof, by unexceptionable witneſſes; *phyſically*, ſo far as natural ſenſe and reaſon, pointing out any thing, convince us thereof; *metaphyſically*, when we enter fully and clearly into the eſſence of any thing.

Evidence is the eſſential and infallible character or criterion of truth, and is that in effect which with us conſtitutes truth.

If evidence ſhould be found in propoſitions that are falſe, we ſhould be compelled into error, ſince the aſſent we give to evidence is neceſſary: whence would follow this impious poſition, that God who made us is the author of our errors, as he has conſtituted us ſo as to put us under a neceſſity of falling into them.

It may be added that as we neceſſarily love truth and hate error, it ſeems inconſiſtent with the nature of a beneficent being to form us with a love of what we could not obtain, or not know whether we did obtain it or not; beſides, that if we ſhould err in things that are evident, as well as in thoſe that are not ſo, we ſhould ſometimes find contradictions in evident propoſitions, as we commonly do in things that are obſcure.

Evidence, therefore, muſt be allowed the mark of truth; and thoſe things muſt be allowed true which carry with them ſuch a degree of evidence as obliges us to aſſent to them. Whatever we ſee evidently agreeable to things whereof we ſpeak, that we muſt acknowledge to be true.

The Epicureans allow of no other evidence but that of ſenſe, or that ariſing from ſenſe, it being a fundamental principle with them, that ſenſe is the firſt and primary criterion of all truth. By evidence of ſenſe, they mean that ſpecies or image exhibited by the ſenſe or phantaſy; which, when all impediments to a juſt judging, as diſtance, motion, medium, &c. are removed, cannot be contradicted or gainſaid; wherefore, the queſtion being put, whether or not a thing be ſuch as it appears; the anſwer is not to be given, till it has been tried and examined in all the ways, and by all the ſenſes, of which it can be an object. See Error.

There are certainly other ſuperior and leſs fallible ſources or grounds of evidence than ſenſe: ſuch is that inward conſciouſneſs by which we learn what belongs to the mind, or that which Mr. Locke calls reflection; of which ſuch are intelligence, intuition, and common ſenſe, principally relating to thoſe abſtracted, or other propoſitions that carry their own evidence with them, and admit no doubt about them; whence we derive our aſſent to propoſitions called axioms and maxims: ſuch is alſo reaſoning, whereby we infer one truth from others by natural and juſt methods of argument, whence reſults ſcience: ſuch is likewiſe the teſtimony of others, on which we found the evidence of Faith (ſee alſo Testimony): to which we may alſo add inſpiration, infpiration, or that impreffion made on the mind by God himfelf, which gives a convincing and indubitable evidence of the truth of any propofition, and attefted to others, either by prophecy or miracles. Watts's Logic, part ii. chap. ii. § 9.

By thus confidering the various fources whence our perception and belief of any truth are derived, we may be led to diftinguifh evidence into intuitive and deductive, and that founded on teftimony. Intuitive evidence comprehends that of pure intellection, of confcioufnefs, and of common fenfe, under the laft of which that of memory is included. (See Intuitive.) Deductive evidence is divided into fcientific and moral; the latter of which includes thofe kinds of evidence that are deduced from experience, analogy, and teftimony, to which may be added a mixed fpecies, derived from the calculation of chances. (See Deductive.) See alfo each of the above-mentioned fubjects. See Campbell's Phil. of Rhet. book i. chap. 5.

The evidences of the Chriftian religion are diftinguifhed into two kinds, the direct and collateral: the direct evidences are external and internal; the external are miracles and prophecy; the internal evidence is deduced from its excellence, confidered in reference to the main and principal end of Chriftianity. Whatever does not either belong to its excellence confidered in this light, or fall under the head of miracles wrought on purpofe to atteft it, or of prophecies fulfilled, and yet affords a proof or any real prefumption of its truth and divinity, is a collateral evidence for it. All the collateral evidences of the truth of Chriftianity are in one fenfe internal evidences, becaufe they all arife from fome particulars in the nature of this religion, from fome circumftances which have attended its reception, or fprung from it, or from fome remarkable facts connected with it, and related in the gofpel hiftory. Of this kind is the argument deduced from its great efficacy at its firft appearance, in banifhing polytheifm, idolatry, fuperftition, and the arts of magic; in foftening the rigour of defpotifm, introducing moderation into government, excluding many inconvenient civil laws once generally prevalent, giving rife to others of a very happy tendency, refifting the laws of war, humanizing the manners, and improving the cuftoms of nations, and reforming the temper and conduct of thofe who embraced it.

Another clafs of collateral arguments for the truth of the Chriftian religion, arifes from particulars in its nature or effects produced by it, or from facts in the Gofpel hiftory, which cannot be at all accounted for but on the fuppofition of a Divine original; or which are, at leaft, moft naturally explicable on that fuppofition. To this clafs may be referred thofe prefumptive arguments deduced from the character of Jefus, fo exalted, and yet fo uniformly fupported; the nature of his laft difcourfes with his difciples; the character of fome of his apoftles; that of Judas the traitor; the controverfies among Chriftians in the apoftolic age; and the method ufed by Chrift and his apoftles, of referring their claims to the impartial inquiries of men. Other collateral arguments have an affinity to the external evidences of Chriftianity: fuch are thofe derived from the miraculous converfion of the apoftle Paul and his fubfequent conduct; from the character of the man of fin foretold by Paul; from the quick and extenfive propagation of the Gofpel; from the continuance and prefent ftate of the nation of the Jews. Some of thefe arguments have an immediate relation to the proof of Chriftianity from prophecies; others are related to the proof from miracles. Other arguments have an equal relation to the internal and external evidence of Chriftianity; fuch is that deduced from the manner in which Chrift and his apoftles propofed the evidences of their miffion, and the advantage they have gained in confequence of the oppofition and fcrutiny of unbelievers. See on this fubject Lord Lyttelton's Obfervations on the Converfion and Apoftlefhip of St. Paul, Duchal's Prefumptive Arguments for the Truth of the Chriftian Religion, and Gerrard's Differtation on the genius and evidences of Chriftianity.

Evidence, in *Law*, is any proof, whether by teftimony of men on oath, or by writings and records; the former called *parol evidence*, that is, by word of mouth, and the latter *written evidence*.

It is thus called, becaufe the point in iffue is hereby made evident to the jury. Evidence in the trial by jury includes not only that which is given in proof, but that which the jury may receive by their own private knowledge; for an account of which fee the fequel of this article.

With regard to parol evidence, or witneffes, we may obferve in general, that all witneffes, whatever be their religion or country, that have the ufe of their reafon, are to be received and examined, except fuch as are *infamous*, or fuch as are *interefted* in the event of the caufe. All others are competent witneffes; though the jury from other circumftances will judge of their credibility. Infamous perfons are fuch as may be challenged as jurors, *propter delictum*; and, therefore, never fhall be admitted to give evidence to inform that jury, with whom they were too fcandalous to affociate. Interefted witneffes may be examined upon a *voir dire*, if fufpected to be fecretly concerned in the event; or their intereft may be proved in court. A party interefted in a fuit, or a wife for or againft her hufband, a hufband againft his wife, except in cafes of treafon, an alien infidel, perfons *non fanæ memoriæ*, thofe that are attainted of confpiracy, or in a præmunire upon ftat. 5 Eliz. cap. 1. popifh recufants convict on ftat. 3 Jac. I. cap. 5. (See contra 1 Hawk. P. C. c. 12. § 6.) perfons convicted of felony, perjury, &c. thofe who by judgment have ftood on the pillory, or been whipped, whilft the judgment is in force, are difabled from giving evidence: but kinfmen, though ever fo near, tenants, fervants, mafters, attornies for their clients, but not againft them, becaufe they are obliged to keep their fecrets, one of the jurors upon trial, and all others that are not infamous, who want not underftanding, or are no parties in intereft, may give evidence in a caufe, though the credit of fervants is left to the jury. (2 Rol. Abr. 685. 1 Vent. 243.) If after a man hath ftood in the pillory, &c. he be pardoned, he may be an evidence; and though judgment of the pillory infers infamy at common law, by the civil and canon law it imports no infamy, unlefs the caufe for which the perfon was convicted was infamous; and, therefore, fuch may be a good witnefs to a will, if not convicted of any infamous act. (3 Lev. 426, 427.) It has been held, that it is not ftanding in the pillory which difables a perfon for giving evidence; but ftanding there upon a judgment for an infamous crime, as forgery, &c. If for a libel, a man may be a witnefs. (5 Mod. 74. 3 Nelf. Abr. 557.) Perfons excommunicated cannot be witneffes; but perfons outlawed may be witneffes, becaufe the outlawry has no influence on their credibility. (Bull. N. P. 292, 3.) A man convicted of felony, and afterwards pardoned, may be a good evidence. (Raym. 369.) Burning in the hand is faid to reftore a perfon to his credit. (Ibid. 330.) A perfon condemned to be hanged for burglary, but having a pardon for tranfportation, hath been allowed to be a good evidence. (5 Mod. 108.) One outlawed for treafon and pardoned may be an evidence. (State Trials, vol. iii. 515.) Perfons acquitted, or guilty of the

fame

ſame crime, while they remain unconvicted, may be evidence againſt their fellows. (Kel. 17.) Although no evidence ought to be given of what an accomplice hath ſaid, who is not in the ſame indictment; (State Trials, vol. ii. 414.) an informer may be a witneſs, though he is to have part of the forfeiture, where no other witneſſes can be had. (Wood's Inſtit. 598.) If an action is brought againſt many perſons for taking of goods, one of them may be admitted as an evidence againſt the reſt. (Comberb. 367. 1 Mod. 282.) In criminal caſes, as of robbery on the high way, in action againſt the hundred; in rapes of women, or where a woman is married by force, &c. a man or a woman may be an evidence in their own cauſe. (1 Vent. 243.) And in private enormous cheats, a perſon may give evidence in his own cauſe, where nobody elſe can be a witneſs of the circumſtances of the fact but he that ſuffers. (1 Salk. 286.) Upon an information on the ſtatute againſt uſury, he that borrows the money, after he hath paid it, may be an evidence, but not before. (Raym. 190.) Although an alien infidel may not be an evidence, a Jew may, and be ſworn on the Old Teſtament. (1 Inſt. 6.) A quaker ſhall not be an evidence in any criminal cauſe unleſs he will take an oath: though on other occaſions his affirmation ſhall be accepted inſtead of an oath. Stat. 7 and 8 W. III. c. 34. See Quaker.

The oath of a Gentoo, ſworn according to the circumſtances of his religion, has been admitted in a civil matter. (1 Atk. 21.) And by Willes C. J. an infidel in general is an admiſſible witneſs, for the term does not imply that he is an atheiſt; but whenever it appears that a witneſs hath no idea of a God or religion, he ſhall not be permitted to give his teſtimony. (1 Atk. 40. 45.) When perſons that are competent witneſſes are ſerved with a writ of *ſubpœna ad teſtificandum*, they are bound to appear at the trial on pain of 100*l.* to be forfeited to the king, to which the ſtat. 5 Eliz. cap. 9. has added a penalty of 10*l.* to the party aggrieved, and damages equivalent to the loſs ſuſtained by want of their evidence: but no witneſs, unleſs his reaſonable expences be tendered him, is bound to appear at all; nor if he appears, is he bound to give evidence till ſuch charges are actually paid him, except he reſides within the bills of mortality, and is ſummoned to give evidence within the ſame. In a criminal cauſe, if a witneſs refuſe to appear, and give evidence, being ſerved with proceſs, the court will put off the trial, and grant attachment againſt him; and as refuſing to give evidence is a great contempt, the party may be committed and fined. (1 Salk. 278.) Preventing evidence to be given againſt a criminal is puniſhable by fine and impriſonment; and perſons diſſuading a witneſs from giving evidence, &c., and jurors or others, diſcloſing evidence given, are likewiſe offences puniſhed in the ſame manner. (2 Hawk. P. C. c. 22.) Members of either houſe of parliament may be witneſſes on impeachments. (State Trials, vol. ii. 612.) A perſon who hath a legacy in a will, is not a good witneſs to prove the will; but if he releaſe his legacy, he may be a good evidence. (Skin. 704.) Thus alſo, a perſon who claims any benefit by a deed, may not be an evidence to prove that deed; and a perſon concerned in the ſame title of land in queſtion will not be admitted as evidence. (Ibid. 705.) If a legatee is permitted to be ſworn and examined, the counſel cannot afterwards except againſt his evidence. (1 Lord Raym. 730.) To obviate all difficulties, it is enacted by ſtat. 25 Geo. II. c. 6. that any deviſe to a perſon being witneſs to any will or codicil ſhall be void, and ſuch perſon ſhall be admitted as a witneſs; and that any creditor atteſting a will or codicil, by which his debt is charged upon land, ſhall be admitted as a witneſs to the execution, notwithſtanding ſuch charge: the credit of every ſuch witneſs being left to the conſideration of the court and jury. The ſon of a legatee is no witneſs to a will in the ſpiritual court; but it is held he may be a good evidence to prove a nuncupative will, within the intent of the ſtatute of frauds. (1 Lord Raym. 85.) See Will.

One credible witneſs is ſufficient evidence to a jury of any ſingle fact in all civil actions, though the concurrence of two or more corroborates the proof; but in caſes of high-treaſon, petit-treaſon, and miſpriſion of treaſon, by ſtatutes 1 Edw. VI. cap. 12. 5 and 6 Edw. VI. cap. 11. and 1 and 2 Ph. and Mar. cap. 10. *two* lawful witneſſes are required to convict a priſoner, except in caſes of coining and counterfeiting the ſeals, or unleſs the party ſhall willingly and without violence confeſs the ſame: and by ſtat. 7 W. III. cap. 3. the confeſſion of the priſoner muſt be in open court; and both witneſſes muſt be to the ſame overt-act of treaſon, or one to one overt-act, and the other to another overt-act of the ſame ſpecies of treaſon. Baron Monteſquieu, indeed, lays it down for a rule, Spirit of Laws, book xii. chap. 3. that thoſe laws which condemn a man to death *in any caſe*, on the depoſition of a ſingle witneſs, are fatal to liberty.

All evidence is to be given in open court, in the preſence of the parties, their attornies, the counſel and all by-ſtanders, and before the judge and jury: many advantages attend this way of giving teſtimony, *ore tenus*, a method familiar among the ancient Romans, as may be collected from Quintilian, Inſt. Orat. lib. v. cap. 7. and it was continued as low as the time of Adrian; but the civil law, as it is now modelled, rejects all public examination of witneſſes.

No witneſs is bound to give any anſwer by which he confeſſes or accuſes himſelf of any crime. The court in criminal caſes is to examine the witneſſes, and not the priſoner or proſecutors. A witneſs ſhall not be permitted to read his evidence, but he may look at his notes to refreſh his memory. A witneſs may not recite his evidence to the jury, after having gone from the bar, and he hath given his evidence in court; if he does, the verdict may be ſet aſide. (Cro. Eliz. 159.) One that is to be an evidence at a trial, ought not to be examined before the trial, but by the conſent of both parties, and a rule of court for that purpoſe. No evidence ought to be produced againſt a man, in a trial for his life, but what is given in his preſence. State Trials.

Poſitive proof is always required whenever the nature of the caſe poſſibly admits of it.

Sometimes violent preſumption will be admitted for evidence without witneſſes; as where a perſon is run through the body in a houſe, and one is ſeen to come out of the houſe with a bloody ſword, &c. but on this the court ought not to judge haſtily, 1 Inſt. 6. 673; and though preſumptive and circumſtantial evidence may be ſufficient in felony, it is not ſo in treaſon. State Trials.

Though all preſumptive evidence of felony ſhould be admitted cautiouſly, for the law holds that it is better that ten guilty perſons eſcape, than that one innocent ſuffer. (See Presumption.) Sir Matthew Hale lays down two rules, moſt prudent and neceſſary to be obſerved. 1. Never to convict a man for ſtealing the goods of a perſon unknown, merely becauſe he will give no account how he came by them, unleſs an actual felony of ſuch goods be proved: and, 2. Never to convict any perſon of murder or manſlaughter, till at leaſt the body be found dead; on account of two inſtances, which he mentions, where perſons were executed for the murder of others, who were then alive, but miſſing. 2 Hal. P. C. 200.

Evidence by writings and records, is where acts of parliament, statutes, judgments, fines, and recoveries, proceedings of court, and deeds, &c. are admitted as evidence. The printed statute-book is good evidence upon a general act of parliament, which need not be pleaded; but in the case of a private act, it is otherwise; for there it must be pleaded and examined by the records of parliament before it can be admitted in evidence. Records and enrolments prove themselves; and a copy of a record or enrolment, sworn to, may be given as an evidence. (Co. Litt. 119. 262.) A record of an inferior court has been rejected in evidence; and the proceedings in county-courts, courts-baron, &c. may be denied, and then tried by a jury. But court-rolls of a court-baron, when shewn, are good evidence; and, in many cases, copies of the court-rolls are allowed as evidence. An ancient deed of thirty years standing proves itself; but modern deeds, and other writings, must be attested and verified by parol evidence of witnesses. The counterpart of a deed is no evidence, when the original is in being, and can be procured; though it may be, when the original cannot be procured. (Co. Litt. 225. 10 Rep. 92.) The counterpart of an ancient deed hath been admitted as evidence. (Mod. Caf. 225.) In case of a fine, a counterpart is good evidence of itself. (1 Salk. 287.) Although a witness swear to the hand and contents of a letter, if he never saw the party write, it will not be good evidence. If all the witnesses to a deed are dead, continual and quiet possession is presumptive evidence of the truth of it; yet it may receive farther credit by comparison of hands and seals. (Wood's Inst. 599.) When witnesses to deeds are dead, their hand-writing must be proved. (2 Inst. 118.) If one of several witnesses survive, a subpœna must be taken out against the living witness, and strict inquiry made after him, and affidavit made that he cannot be found, before the hand-writing of the deceased witnesses is to be proved. (1 Litt. 556.) And a shop-book may not be given in evidence for goods sold, &c. by 7 Jac. I. cap. 12. after one year, before the action brought, except there be a bill, &c. for the debt; unless between merchant and merchant in the usual intercourse of trade. In order to make books evidences, if the servant who was accustomed to make entries in it be dead, his hand must be proved; and this, when accompanied with other collateral proofs of fairness and regularity, is the best evidence that can then be produced. In debt, a release may be given in evidence; so may any matters of fact, tampering with witnesses, or fraud.

In order to prove a lease for years, nothing shall be admitted but the very deed of lease itself, if in being; but if that be positively proved to be burnt or destroyed, then an attested copy may be produced, or parol evidence given of its contents. No evidence of a discourse with another will be admitted, but the man himself must be produced: yet in some cases, as in proof of any general customs or matters of common tradition or repute, the courts admit of *hearsay* evidence, or an account of what deceased persons have declared in their life-time; but such evidence will not be received of any particular facts. The probate of a will, when it concerns merely personal estate, may be given in evidence; but where title of lands is claimed under a will, the original will must be shewn, not the probate, though if the will be proved in the Chancery, copies of the proceedings there will be evidence. (2 Rol. Abr. 687. Trials per pais, 234. 1 Salk. 286. Raym. 335.) In some cases the ledger-book of the ecclesiastical court in which the will is entered is sufficient evidence, being a roll or record of the court. (Bull. N. P. 245, 6.) Depositions of witnesses in Chancery between the same parties may be given as evidence at law, if the witnesses are dead, and the bill and answer proved. Depositions before a coroner are admitted as evidence, the witnesses being dead, or gone beyond sea. (1 Lev. 18). 2 Nelf. Abr. 760.) The confession of a prisoner before a magistrate, &c. may be given in evidence against him. (See 2 Hawk. P. C. c. 46.) See Baron Gilbert's Treatise of Evidence, or the Introduction to the Law of Nisi Prius, 4to. 1767.

From this treatise the following rules of evidence are extracted. 1. In general, the best evidence must be given that the nature of the thing will admit of. 2. No person interested in the question can be a witness. To this rule there are some exceptions; as, 1. A party interested may be admitted in a criminal prosecution in most instances. 2. He may be admitted for the sake of trade in the common usage of business, as porters, apprentices, &c. 3. Where no other evidence is reasonably to be expected. 4. Where he acquires his interest by his own act, after the party who calls him as a witness has a right to his evidence. 5. Where the possibility of interest is very remote. 3. The third general rule is that hearsay is no evidence. 4. In all cases where a general character or behaviour is put in issue, evidence of particular facts may be admitted; but not where it comes in collaterally. 5. In every issue the affirmative is to be proved. 6. No evidence need be given of what is agreed by the pleadings, &c. &c. See Pleading.

Sir Thomas Smith restrains evidence to authentic writings of contracts, written, sealed, and delivered. De Rep. Ang. lib. ii.

Evidence, *demurrer to*. See Demurrer.

Evidence, *exception to*. See Exception.

EVIL, Malum, in *Ethics*, a privation or absence of some proper or necessary good, or of some measure or degree thereof.

Evil is either *natural* or *moral*; between which there is this relation, that moral evil produces natural.

Evil, *moral*, is defined a deviation from right reason; a discernment of right from wrong, being given us as a guide of our actions; or it is the disagreement between the actions of a moral agent and the rule of those actions, whencesoever it is derived, and howsoever made known; and no action can be morally evil unless the agent be properly such, intelligent and free, and capable of distinguishing, choosing, and acting for himself. This the philosophers call *inhonestum*, and *turpe*, as staining the image of God, and sullying our original beauty; likewise *malum culpæ*.

Evil, *natural*, is a want of something necessary to the *bene esse*, or perfection of a thing, or to its answering all its purposes; such are defects of the body, blindness, lameness, hunger, diseases, death. This species is denominated *triste*, *injucundum*, *noxium*, and *malum pœnæ*.

Good and evil, says a learned writer, are opposites, and arise from the relations which things have to each other: for since there are some things which profit, and others which prejudice one another; and since some things agree, and others disagree; we call the former good and the latter evil. Whatever, therefore, is incommodious or inconvenient to itself or any thing else; whatever becomes troublesome or frustrates any appetite implanted by God; whatever forces any person to do or suffer what he would not, that is *evil*. These inconveniencies appear to be of three kinds: those of imperfection; those that are natural; and those that are moral. By the evil of imperfection we may understand the absence of those perfections or advantages which exist elsewhere, or in other beings; by natural evil, pains and uneasinesses, inconveniencies and disappointments of appetites arising from natural motions; and by moral evils, vicious elections, that is, such as are hurtful to ourselves,

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or others. This opinion is otherwife ftated in the following manner: all evil is inconveniency, but fome inconveniencies arife from the feries of natural caufes without our confent, and fometimes our knowledge; thefe we call natural evils: but others happen from the abufe of elections, when an undue choice occafions them; and in this cafe, befides the natural evil that arifes from them, there is likewife an obligation on the perfon that makes the choice to anfwer for the hurt he has done by it. Now thefe choices that bring inconveniencies are called moral evils; and the difference between natural and moral evil is not their both bringing inconveniencies and injury to ourfelves or others, for this conftitutes the nature of their evil, but that the ill effects of the one proceed from the choice, thofe of the other from natural caufes; and hence the author of that choice is anfwerable for the one, but nobody for the other. Moral evil, therefore, is natural evil, with choice fuperadded. See archbifhop King's "Effay on the origin of Evil," by Law, vol. i. and ii. Sherlock, alfo, in his "Treatife on Judgment," p. 20, &c. diftinguifhes in a fimilar manner between moral and natural good and evil; the only difference between them, he fays, is this, "that moral good and evil is in the will and choice, natural good and evil is in the nature of things; that which is good or hurtful to ourfelves or others is naturally good or evil; to love, to choofe, to do that which is good or hurtful to ourfelves or others, is morally good or evil, or is the good or evil of our choice or actions. If you will but recollect yourfelves, you will find that you have no other notion of good or evil but this; when you fay fuch a man has done a very good or very evil action, what do you mean by it? Do you not mean, that he has done fomething very good or very hurtful to himfelf or others? When you hear that any man has done good or evil, is not the next queftion, what good or what hurt has he done? And do not you mean by this, natural good or evil? which is a plain evidence that you judge of the moral good or evil of actions by the natural good or evil which they do."

The ingenious author of the "Enquiry into the Origin of our Ideas of Beauty and Virtue," gives the following ftatement of the nature of moral good and evil, and of the difference between thefe and natural good and evil. Moral evil, according to this philofopher, denotes our idea of a quality apprehended in actions which excites averfion and diflike towards the actor, even from perfons who receive no difadvantage thereby; as moral goodnefs denotes our idea of a contrary quality which procures approbation and love towards the actor, even in perfons unconcerned in its natural tendency. This notion fuppofes an univerfally acknowledged difference of moral good and evil from natural. Moral good, we all know, procures love towards thofe we apprehend poffeffed of it; whereas natural good does not. How differently, for inftance, are we affected towards thofe we fuppofe poffeffed of honefty, faith, generofity, &c. when we expect no benefit from thofe qualities, and thofe poffeffed of the natural goods, as houfes, lands, gardens, health, ftrength, &c. So whatever quality we apprehend morally evil, raifes our hatred towards the perfon in whom we obferve it; as treachery, cruelty, ingratitude, &c. whereas we love and pity many expofed to natural evils, as pain, hunger, ficknefs, &c.

The origin of thefe different ideas of actions has greatly puzzled the moralifts: fome make felf-intereft, or felf-love, the fource of them all; we approve the virtue of others as it has fome fmall tendency to our happinefs, either from its own nature, or from this general confideration, that a conformity to nature and reafon is in the general advantageous to the whole, and to us in particular; and on the contrary, difapprove the vice of others, as tending at the long run to our particular detriment.

Others fuppofe an immediate natural evil in the actions called *vicious*, that is, that we are determined to perceive fome deformity or difpleafure in fuch actions, without reflecting on any difadvantage that may any way redound to us from the action; and that we have a fecret fenfe of pleafure accompanying fuch of our own actions as are called *virtuous*, when we expect no farther advantage from them; but then they add, that we are excited to perform thofe actions, even as we purfue or purchafe pictures, ftatues, landfcapes, &c. from felf-intereft, to obtain the pleafure which accompanies the action.

But the author juft mentioned maintains that fome actions have to men an immediate goodnefs, and others an immediate evil, *i. e.* we perceive pleafure in fome and pain in others, and are determined to love or hate the doers, without any view of natural advantage, without any view to future rewards or punifhments, or even without any intention to obtain the fenfible pleafure of the good, but from a very different principle, *viz.* an internal moral fenfe, or a natural determination of the mind to receive amiable or difagreeable ideas of actions, when they fhall occur to our obfervation, antecedently to any opinion of advantage or lofs to redound to ourfelves from them, even as we are pleafed with a regular form or an harmonious compofition, without any knowledge of the mathematics, or feeing any advantage in that form or compofition different from the immediate pleafure. But according to this account of Dr. Hutchefon, however plaufible, moral good and evil fignify nothing in the objects themfelves, to which they are applied, any more than agreeable and harfh, fweet and bitter, &c. but only certain effects in us; and virtue is a mere affair of tafte; whereas it feems to be much more juft to conclude, that right and wrong, or good and evil, are real qualities of actions, and not merely of our minds; and that the power whereby we perceive thefe qualities is not any arbitrary fenfe but the underftanding: or to fuppofe with another excellent writer, that moral good, confidered as fynonymous with virtue, denotes the doing good to mankind, in obedience to the will of God, and for the fake of everlafting happinefs, and moral evil or vice, the contrary. Price's Original of our Ideas, &c. p. 13, and p. 59, &c. Paley's Principles of Moral and Political Philofophy, vol. i. p. 41. See farther under Deformity, Sense, Good, Virtue, and Vice.

The queftion concerning the origin of evil has very much perplexed philofophers and divines, both ancient and modern. Plato, for the folution of this queftion, maintained, that matter, from its nature, poffeffes a blind and refractory force, from which arifes in it a propenfity to diforder and deformity; and that this is the caufe of all the imperfection which appears in the works of God, and the origin of evil. Matter, he conceives, refifts the will of the fupreme artificer, fo that he cannot poffibly execute his defigns; and this is the caufe of the mixture of good and evil, which is found in the material world. "It cannot be," fays he, (Theæt. t. i. p. 176.) "that evil fhould be deftroyed, for there muft always be fomething contrary to good;" and again, "God wills, *as far as it is poffible*, every thing good, and nothing evil." What is that property of matter which oppofes the wife and benevolent intentions of the firft intelligence, Plato has not clearly explained, but he fpeaks of it as Σύμφυτος ἐπιθυμία, an innate propenfity to diforder, (Phileb.) and fays, "that before nature was adorned with its prefent beautiful forms, it was inclined to confufion and deformity, and that from this habitude

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bitude arises all the evil which happens in the world." Plutarch supposes the Platonic notion to be, that there is in matter an unconscious irrational soul; and this supposition has been adopted by several modern writers. But the writings of Plato afford no evidence, that he conceived the imperfection of matter to arise from any cause distinct from its nature. Such a notion is incongruous with Plato's general system, and it is contrary to the doctrine of the Pythagorean school, to which he was probably indebted for his notions on this subject; for the philosophers of that sect held, that motion is the effect of a power essential to matter. Some of the Stoics adopted the notion of the Platonists concerning the origin of evil, and ascribed it to the defective nature of matter, which it is not in the power of the great artificer to change; asserting, that imperfections appear in the world, not through any defect of skill in its author, but because matter will not admit of the accomplishment of his designs. But it was perceived by others, that this hypothesis was inconsistent with the fundamental doctrine of the Stoics concerning nature. For since, according to this system, matter itself receives all its qualities from God, if its defects be the cause of evil, these defects must be ultimately ascribed to him. No other way of relieving this difficulty remained, but to have recourse to fate, and say, that evil was the necessary consequence of that eternal necessity, to which the great whole, comprehending both God and matter, is subject. Thus, when Chrysippus was asked, whether diseases were to be ascribed to divine Providence, he replied, that it was not the intention of nature that these things should happen; nor were they conformable to the will of the author of nature and parent of all good things; but that, in framing the world, some inconveniences had adhered, by necessary consequence, to his wise and useful plan. To others the question concerning the origin of evil appeared so intricate and difficult, that finding themselves unequal to the solution of it, they denied either that there is any God at all, or, at least, any author or governor of the world. The Epicureans belonged to this class; nor does Lucretius allege any other reason for denying the system of the world to be the production of a deity besides its being so very faulty. Others again judged it to be more rational to assign a double cause of visible effects than to assign no cause at all; as nothing, indeed, can be more absurd than to admit actions and effects without any agent and cause. These persons, perceiving a mixture of good and evil, and being persuaded that so many inconsistencies and disorders could not proceed from a good being, supposed the existence of a malevolent principle, or God, directly contrary to the good one; hence they derived corruption and death, diseases, griefs, mischiefs, frauds and villanies, whilst from the good being they deduced nothing but good. This opinion was held by many of the ancients; by the Persian magi, Manichæans, Paulicians, &c. &c. See these articles, and also ZOROASTER. Absurd as this hypothesis was, it very long and generally prevailed, not only in the Heathen but in the Christian world; nor have the light and influence of Christianity yet availed to its total extermination, so that no trace or remnant of it remains. Those who wish to find a satisfactory refutation of it, may consult "King's Origin of Evil," vol. i. and the annexed notes of the editor.

The excellent Dr. Clarke, in his "Demonstration of the Being and Attributes of God," deduces from the possibility and real existence of human liberty an answer to the question, what is the cause and original of evil? "For liberty," he says, "implying a *natural* power of doing evil, as well as good; and the imperfect nature of finite beings, making it possible for them to abuse this their liberty to an actual commission of evil; and it being necessary to the order and beauty of the whole, and for displaying the infinite wisdom of the Creator, that there should be different and various degrees of creatures, whereof, consequently, some must be *less perfect* than others; hence there necessarily arises a possibility of evil, notwithstanding that the Creator is infinitely good. In short thus: all that we call *evil*, is either an *evil of imperfection*, as the *want of certain faculties and excellencies which other creatures have*; or *natural evil*, as *pain*, *death*, and the like; or *moral evil*, as all kinds of *vice*; the *first* of these is not properly an evil. For every power, faculty, or perfection, which any creature enjoys, being the free gift of God, which he was no more obliged to bestow, than he was to confer being or existence itself; 'tis plain the want of any certain faculty or perfection in any kind of creatures, which never belonged to their nature, is no more an evil to them, than their never having been created or brought into being at all, could properly have been called an evil. The *second* kind of evil, which we call *natural evil*, is either a necessary consequence of the former; as *death*, to a creature on whose nature immortality was never conferred; and then 'tis no more properly an evil than the former; or else 'tis counterpoised, in the whole, with as great or greater good; as the *afflictions and sufferings of good men*; and then also it is not properly an evil; or else, lastly, 'tis a *punishment*; and then 'tis a necessary consequent of the *third* and last sort of evil, *viz.* *moral evil*. And this arises wholly from the abuse of *liberty*, which God gave to his creatures for other purposes, and which 'twas reasonable and fit to give them for the perfection and order of the whole creation: only they, contrary to God's intention and command, have abused what was necessary for the perfection of the whole, to the corruption and depravation of themselves. And thus all sorts of evils have entered into the world, without any diminution to the infinite goodness of the Creator and Governor thereof.

EVIL, or *King's* EVIL, the appellation formerly given to *scrofula*, in consequence of the supposed power possessed by the kings of England and France of curing this disease by *touching* the sick.

The origin and first exercise of this royal faculty are not agreed upon by historians; those of France are disposed to maintain, that it was originally inherent in their kings, some asserting that St. Louis, others that king Robert, was the first who was thus gifted; but by most other writers it is assigned as an earlier prerogative of the English crown. Edward the Confessor is generally mentioned as the first possessor of this miraculous power: and it was disputed in the days of Malmsbury, who lived not long after his reign, whether this faculty were a peculiar reward from heaven for that king's sanctity, or hereditarily resident in the English crown. Polydore Virgil has noticed this gift to Saint Edward, and its continuance in the line of his successors; and Dr. Harpsfield, in his Ecclesiastical History of England, after describing the miracles of the Confessor, observes, "quam strumosos sanandi admirabilem dotem in posteros suos Anglorum reges, ad nostra usque tempora transfudisseet perpetuasse, merito creditur." The practice was long continued, and seems to have reached its greatest height in the reign of Charles II. to whom multitudes flocked to receive the benefits of the royal touch; insomuch, that after his restoration, he is said to have laid his hands upon more than six thousand persons in one year. His majesty was therefore obliged to make some restrictions with regard to the times of healing, and the number of patients. All persons were obliged to go to the king's surgeon, whose duty it was to examine

examine their certificates from the minifter and church-wardens of their parifh, to determine whether they were proper objects, to give them tickets of admiffion to the royal prefence, and to introduce every one to the king's facred hand to be touched. The king ufually gave public notice of the day of healing; in the winter the ceremony was always held at Whitehall; in the fummer fometimes at Whitehall, and fometimes at Windfor.

The following curious paragraphs were made public in 1660.

"The kingdom having been for a long time troubled with the evil, by reafon of his majefty's abfence, great numbers have lately flocked for cure. His facred majefty, on Monday laft, touched 250 in the Banqueting houfe; among whom, when his majefty was delivering the gold, one fhuffled himfelf in, out of an hope of profit, which had not been ftroked, but his majefty quickly difcovered him, faying, this man hath not yet been touched. His majefty hath for the future appointed every Friday for the cure, at which 200, and no more, are to be prefented to him, who are firft to repair to Mr. Knight, the king's furgeon, &c. Parliamentary Journal, July 2—9, 1660.

"Saturday being appointed by his majefty to touch fuch as were troubled with the evil, a great company of poor afflicted creatures were met together, many brought in chairs and flafkets; and being appointed by his majefty to repair to the Banqueting-houfe, his majefty fat in a chair of ftate, where he ftroked all that were brought to him, and then put about each of their necks a white ribbon, with an angel of gold on it. In this manner his majefty ftroked above fix hundred; and fuch was his princely patience and tendernefs to the poor afflicted creatures, that though it took up a very long time, his majefty, who is never weary of well-doing, was pleafed to make inquiry whether there were any more that had not yet been touched. After prayers were ended, the duke of Buckingham brought a towel, and the earl of Pembroke a bafon and ewer, who, after they had made obeifance to his majefty, kneeled down till his majefty had wafhed." Mercurius Politicus, June 21—28, 1660.

An exact regifter was at that time kept of the number of cafes that came for relief, and the whole amount is very great. From 1660 to 1664 inclufive, a period of five years, 23,601 perfons were touched by Charles II.: and from May 1667 to May 1684, the number of perfons touched amounted to 68,506; making all together 92,107. For the intervening years, 1665 and 1666, no regifter was made, the king having removed from the metropolis on account of the plague.

This fuperftitious practice was dropped by the prefent royal family, "who obferved (fays Hume) that it could no longer give amazement, even to the populace, and was attended with ridicule in the eyes of all men of underftanding." Rapin indeed remarks, that "the late king William III. of glorious memory, was fo perfuaded he fhould do no injury to perfons afflicted with this diftemper, by *not* touching them, that he refrained from it all his reign." The practice continued in vogue in the reign of queen Anne; it is recorded of Dr. Johnfon, that he was touched by that princefs, but without effect.

It is extraordinary that this belief in the efficacy of the royal touch in the cure of this fevere difeafe was by no means confined to the vulgar, nor to perfons unacquainted with the nature and cure of difeafes. Dr. Johnfon's mother is faid to have been inftigated by the advice of a celebrated phyfician, fir John Floyer, to bring her fon to London for the purpofe of receiving the remedy. And Wifeman and Browne, eminent furgeons of their day, and furgeons to the king (Charles II.) have given their ftrongeft teftimony in favour of the fuperiority of the royal remedy, over any which their art poffeffed. "I muft needs profefs," fays Wifeman, "that what I write will do little more than fhew the weaknefs of our ability, when compared with his majefty's, who cureth more in any one year, than all the chirurgeons of London have done in an age. However, that this attempt may not feem to want precedent, give me leave to tell you, that it is no more than the French kings' chirurgeons have done before me, or than old Mr. Clows did in queen Elizabeth's days, and all other general writers in chirurgery have done more or lefs." And he affirms that he had been "a frequent eye-witnefs of many cures performed by his majefty's touch alone, without any affiftance of chirurgery; and thofe many of them fuch as had tired out the endeavours of able chirurgeons before they came thither."

The other furgeon royal juft mentioned has left us the moft circumftantial account of this royal healing, in a publication, entitled "Adeno-choiradelogia; or, an Anatomick-Chirurgical Treatife of Glandules and Strumæs, or King's-evil-fwellings, together with the Royal Gift of Healing, or Cure thereof, by Contact or Impofition of Hands, performed for above 640 years by our kings of England; continued with their admirable effects and miraculous events; and concluded with many wonderful examples of Cures by their facred touch. All of which are fuccinctly defcribed by John Browne, one of his Majefty's Chirurgeons in Ordinary, and Chirurgeon of his Majefty's Hofpital, London, 1684." His offices evince that the author was a man of character, and his book is approved, as was the cuftom of his time, by the prefident and feveral fellows of the College of Phyficians. Like Wifeman, he feems to have been a ftaunch loyalift, and a vehement defender of the divine right of kings; he detefted all diffenters, and confidently afferts that the ufurper, Cromwell, tried in vain to exercife this royal prerogative, "he having no more right to the healing power, than he had to the regal jurifdiction." The third part of the treatife of Browne, which is devoted to the hiftory and nature of the royal gift, is entitled *Charifma Bafilicon*. Befides an hiftorical view of this prerogative, it contains rules for the meaneft capacity to find out the difeafe, which were deemed expedient to prevent poor people from unneceffary journeys; and fixty admirable cures, performed with or without gold, are circumftantially detailed, as well as feveral cafes of fcrofulous tumours and fores, which difappeared on being touched with handkerchiefs dipped in the blood of Charles I.

Some fhrewd fufpicions had, indeed, been thrown out, that the piece of gold, given by the king on the occafion, was the moft efficacious remedy employed; and the above mentioned writers are anxious to refute fuch a flander on the royal qualifications. The author of a late treatife tells the following ftory, which may, in fome degree, account for the numbers regiftered at Whitehall. "An old man, who was witnefs in a caufe, had by his evidence fixed the time of a fact, by queen Anne having been at Oxford, and touched him while a child, for the cure of the *evil*. When he had finifhed his evidence, the relator had an opportunity of afking him whether he was really cured. Upon which he anfwered, with a fignificant fmile, that he believed himfelf never to have had a complaint, that deferved to be confidered as the *evil*; but that his parents were poor, *and had no objection to the bit of gold*." See Wifeman's Chirurgical Treatifes, book iv. chap. 1. Browne above cited. Edin. Med. and Surg. Journal, vol. iii. p. 185.

With

With refpect to the nature of the difeafe, vulgarly called *King's Evil*, and the practice now adopted for its cure, fee SCROFULA.

EVIL, *falling*, in *Horfes*. See FALLING-*evil*.

EVIL, *hungry*. See HUNGRY and BULIMY.

EVIRATUA, in *Geography*, a town of Brafil, on the river of the Amazons, 36 miles W. of Fort Rio Negro. S. lat. 2° 50'.

EVIT'S CREEK, a river of America, in Maryland, which runs into the Potomack. N. lat. 39° 38'. W. long. 78° 44'.

EUKSINEH, a town of Afiatic Turkey, in Natolia; 10 miles N. E. of Eregri.

EULÆUS, in *Ancient Geography*. See CHOASPES.

EULBACH, or EULENBACH, in *Geography*, a town of Germany, in the county of Erbach; 3 miles N. E. of Erbach.

EULE, a town of Bohemia, in the circle of Kaurzim; 12 miles S. of Prague. N. lat. 49° 55'. E. long. 14° 31'.

EULENBERG, a town of Moravia, in the circle of Olmutz; 14 miles N. of Olmutz.

EULENBURG, a town of Saxony, in the circle of Leipfic, fituated on an ifland in the Mulda, and containing three churches. Beer is the principal article of trade. It is 12 miles N. E. of Leipfic. N. lat. 51° 27'. E. long. 12° 38'.

EULEPA, in *Ancient Geography*, a town of Cappadocia. Itin. Anton.

EULER, LEONARD, in *Biography*, a great mathematician, was born at Bafil in the year 1707, where he was educated. He performed his academical tafks with fo much rapidity, that he had a good portion of time left at his own command, which he confecrated to the ftudy of the mathematics. In the purfuit of this kind of knowledge, he was affifted by John Bernouilli, who was regarded as one of the chief mathematicians of Europe, and whofe diftinguifhed attention and efteem he obtained, by his early proficiency and unwearied application. In 1723, M. Euler was admitted to the degree of M. A. on which occafion he obtained great applaufe by delivering a Latin difcourfe, wherein he drew a comparifon between the philofophy of Newton and the Cartefian fyftem. In compliance with his father's defire, he applied himfelf to theology and oriental literature, in which he made no inconfiderable progrefs, but his predominant bias ftill leading him to the mathematics, his father allowed him to follow the bent of his inclination. In the courfe of his ftudies under Bernouilli, he contracted an intimate friendfhip with his two fons, Nicholas and Daniel, which proved to be of the higheft advantage to him in after life. Thofe two celebrated mathematicians having been invited to Peterfburgh, in the year 1725, by Catharine I. for carrying into execution the project of Peter the Great, for the eftablifhment of an academy of fcience, promifed Euler to ufe their endeavour to find him a fituation in that city. By their advice he applied himfelf diligently to the ftudy of natural knowledge, and attended the lectures of all the eminent profeffors of Bafil. While engaged in thefe purfuits he compofed a differtation "On the nature and propagation of Sound;" and alfo an anfwer to a prize queftion, "Concerning the mafting of Ships," which obtained the fecond prize. By this circumftance his attention was early drawn to the curious and important ftudies of naval architecture and navigation, which he contributed greatly to enrich in the fubfequent periods of his life. He now joined his friends the Bernouillis at Peterfburgh, and was appointed with them a joint profeffor in the univerfity of that city. In this fituation his talents and genius were fo far called into exercife as to entitle him to rank among the moft eminent mathematicians. He contributed many memoirs to the academical collection, which excited a noble fpirit of emulation between him and his two friends, unalloyed by the leaft mixture of envy or jealoufy, and fuch as produced no alteration in their friendfhip. The integral calculus he carried to new degrees of perfection; invented the calculation of fines; fimplified analytical operations, and in this way threw new light on all the branches of mathematical fcience. In 1730, M. Euler was appointed profeffor of natural philofophy; and, in 1733, he fucceeded his friend Daniel Bernouilli, in the mathematical chair. In 1735, the academy propofed an intricate and important problem for folution, which Euler completed in three days, though it was fuppofed to be the labour of many months. The exertion on this occafion was fo violent that it produced a fever which endangered his life, and deprived him of the ufe of one of his eyes. In the year 1740, the Academy of Sciences at Paris propofed for folution the important fubject of "The flux and re-flux of the fea." To this Euler applied the force of his genius, and produced a memoir, which was allowed to be a mafter piece of analyfis and geometry. He had, however, as competitors, Daniel Bernouilli, and our countryman, Colin Maclaurin, with whom he fhared the prize. In 1741, Euler, at the exprefs invitation of the king of Pruffia, repaired to Berlin, where his induftry and talents appeared to great advantage. He furnifhed many effays for the memoirs of the Pruffian academy, without withholding his contributions from the academy of Peterfburgh, which was now encouraged by the patronage and munificence of the emprefs Elizabeth. In 1742, he obtained a penfion from the academy at Peterfburgh, and in 1766, by permiffion of the king of Pruffia, he returned to that city, to fpend the remainder of his days; when the munificence of Catharine II. liberally rewarded him for the preference which he exhibited towards his Peterfburgh connections. Shortly after his return he loft the fight of the other eye, yet in this deplorable fituation he dictated to his fervant, an unlettered youth, and who was entirely unacquainted with mathematical knowledge, his "Elements of Algebra," a work of high merit, and which has been tranflated into the Englifh language. At this period he was elected one of the very few foreign members of the Academy of Sciences at Paris. After this he received from them the prize for his differtations "Concerning the inequalities in the motions of the planets:" alfo two prizes for queftions propofed relative to "A more perfect theory of the moon." He next reviewed his whole theory with the affiftance of his fon, and Meffrs. Krafft and Lexell; and purfued his refearches till he had conftructed the new tables which appeared with the great work in 1772. "This work alone," fays his biographer, "would be fufficient to render his name immortal, and when it is confidered that it was completed after he was totally blind, and at a time in which he was embarraffed in his domeftic circumftances by a dreadful fire, that had confumed great part of his fubftance, and forced him to quit the ruined houfe; it is impoffible not to be ftruck with admiration and aftonifhment at the powers of his genius and memory, and the perfeverance, fortitude, and tranquillity of mind which he muft have poffeffed." Some time after this he underwent the operation of couching, which reftored to him his fight; but either too eager to benefit by the organ, or by the negligence of his furgeon, he was a fecond time deprived of his fight, and the relapfe was attended with much tormenting pain. Still he he was active in the purfuit of fcience, and in the courfe of feven years tranfmitted to the academy of Peterfburgh feventy diftinct memoirs, and left behind him two hundred more, which were afterwards revifed and completed. In the beginning of September, 1783, he was feized with feveral attacks of a vertigo; thefe, however, did not prevent his calculating the motion of air-balloons, which then began to engage the attention of the philofophical world; but on the 7th of the fame month, while he was amufing himfelf with his grand-children, an apoplectic fit terminated his illuftrious career, at the age of 76. Befides being foreign member of the Royal Academy of Sciences at Paris, M. Euler was member of the Imperial Academy of Peterfburgh, ancient director of the Royal Academy of Berlin, and fellow of the Royal Society of London. His works were very numerous; his knowledge was not confined to his favourite ftudies of the mathematics and aftronomy, of which he has fecured to himfelf an imperifhable fame. He had made much progrefs in medical, botanical, and chemical fcience. He alfo poffeffed, in a high degree, what is generally called erudition. He had read with attention and tafte the moft eminent Latin claffics, and was familiarly acquainted with the civil and literary hiftory of all ancient and modern nations. His uncommon memory feemed to retain every idea that was conveyed to it either from reading or from meditation. The Æneid of Virgil he could repeat from the beginning to the end, and point out to his hearers the firft and laft line of every page in the edition which he ufed. He enjoyed a vigorous conftitution, and a furprifing fhare of health, confidering the intenfity and ardour of his application. His manners were unaffected and pleafing, his temper lively and cheerful, and his converfation both inftructive and entertaining. The evening of his days was calm and ferene, fweetened in no fmall degree by the fame that follows genius, the univerfal efteem and refpect that were due to his exemplary virtues, and the fatisfaction which he received from the kind offices of friendfhip, and the endearments of domeftic felicity.

This great geometrician had beftowed much meditation, early in life, on harmonics, or the philofophy of found; for in 1739, at the age of 32, he publifhed at Peterfburgh, in Latin, a work in 4to. under the title of "Tentamen novæ Theoriæ Muficæ ex certiffimis harmoniæ principiis dilucidé expofitæ, auctore Leonardo Eulero." This work, being written in Latin, and requiring in the reader, befides that language, a knowledge in geometry, algebra, and fluxions, was little noticed by the public at large on its firft appearance, and ftill lefs underftood by muficians, for whofe ufe it muft have been chiefly intended. It, however, fet mathematicians and men of fcience to work, and ftarted many curious fubjects of meditation to fuch as interefted themfelves in the ftudy of harmonics.

But we do not very well fee how the author could with propriety call his treatife an attempt at a *new* theory of mufic. The ratios were all known ever fince the time of Euclid. Indeed he has followed the proportions which Zarlino tried to eftablifh in his "Inftitutioni," which had been adopted by Des Cartes, Rameau, Tartini, &c.; and Des Cartes, and others after him, had accounted for the pleafure which we receive from concords, by the fimplicity of the ratios between the founds which form them. There is a plate, p. 35, reprefenting, we thought, in a new and ingenious manner to the eye, the pulfations of two ftrings; the one fixed to a given tone, and the other tuned progreffively to all the confonant intervals, which clearly fhews the coincidences of vibration, upon the frequency of which the degree of fweetnefs and perfection in concords depends. We believe, however, that this was done in the 17th century, but in a lefs elegant manner, by our countryman lord keeper North, in a quarto pamphlet of only twenty-five pages, intitled, "A Philofophical Effay of Mufick directed to a Friend;" London, 1677.

In this little tract the vibrations of each confonance are reprefented to the eye, and the coincidences with the fixed tone, its bafe or principal, in the fame manner as in the work of the great geometrician Euler, who has pufhed ratios as far as our perception and appreciation can go, extending the whole compafs of our mufical fyftem to eight octaves. See COMPASS.

The degrees of fuavity in confonance from the fimplicity of ratios and frequency of coincidence, had, we believe, been fettled before the year 1739, when this treatife was publifhed.

The following is a tranflation of the titles of the feveral chapters of this work. After a preface of twenty pages,

Chap. I. treats of found, and the auditory fenfe.
II. Of the fweetnefs and principles of harmony.
III. Of mufic in general.
IV. Of concords.
V. Of concords in fucceffion.
VI. Of a feries of concords.
VII. Of intervals, and their names.
VIII. Of the genera of mufic.
IX. Of the diatonico-chromatico genus.
X. Of other more compounded genera.
XI. Of the concords in the diatonico-chromatico genus.
XII. Of the modes or keys and fyftems in the diatonico-chromatico genus.
XIII. Of the ratio of compofition in a given mode and fyftem.
XIV. Of the modes and fyftems in tranfpofed keys.

In the 13th chap. on the laws of compofition, and the poffible combinations in any given mode, key, or fyftem, fome of thefe combinations employ every note in the fcale, feemingly at once, which would be extremely offenfive if heard together. The author probably means, that all thefe founds may be heard fucceffively in melody, provided they are in tune, and have a fundamental bafe.

Upon the whole, Euler feems not to have invented much in this treatife; and to have done little more than arrange and methodize former difcoveries in a fcientific and geometric manner. He may, indeed, not have known what antecedent writers had difcovered before; and though not the firft, yet to have imagined himfelf an inventor.

EULER's *Logarithms*, or *Binary Logarithms*, are a fpecies of artificial numbers contrived by M. Euler to facilitate the calculation and comparifon of mufical intervals, which they do, by reprefenting each interval in *decimal parts* of the octave, which is 1 in this notation, the fucceffive octaves or powers of 2 being reprefented by 2, 3, 4, &c. as in the following table, for the firft 10 numbers, *viz.*

1 = 0.000000	6 = 2.584963
2 = 1.000000	7 = 2.807356
3 = 1.584963	8 = 3.000000
4 = 2.000000	9 = 3.169925
5 = 2.321928	10 = 3.321928

By help of the primes which compofe mufical ratios, and their binary logarithms in this table, the Euler's logarithm may be found, which anfwers to any interval: as the names of the feveral intervals occur, we fhall give their binary logarithms.

EULISIA, in *Ancient Geography*, a country of Scythia, towards the Palus Mæotis.

EULOGIUS, in *Biography*, patriarch of Alexandria, was, at firft, prefbyter of the church of Antioch, and diftinguifhed himfelf by his zeal for the Catholic doctrines in a letter which he wrote to Eutychius, patriarch of Conftantinople, containing an expofition of the true faith. He was elevated to the fee of Alexandria in the year 581, and became very active in rooting out herefy, not only by the allowable and fair weapons of reafon and argument, but by expelling from their fituation all ecclefiaftics who were advocates for the doctrine of one nature in Chrift. He lived in habits of intimacy with Gregory the Great, whofe fentiments and difpofition were congenial to his own. He died in 608. Of his works only fragments are remaining. Moreri.

Eulogius, elected archbifhop of Toledo in the ninth century, was born at Cordova about the year 800. He was educated for the priefthood, and difcharged the duties of that office with zeal and activity till the year 844, when he was driven into exile by the Saracens for his boldnefs in maintaining the principles of the Catholic faith. After much fuffering he ventured to return to Cordova, where, in the year 850, he was thrown into prifon on account of his religion. In the dungeon he employed himfelf in writing animating exhortations to the Chriftians, to fupport and confole them under their perfecution, for confcience fake, and to encourage them to undergo the fevereft trials rather than difgrace themfelves by apoftacy. He was afterwards liberated, and by his perfonal labours, as well as writings, perfevered in fortifying his fellow Catholics againft the arts and terrors of their enemies. As a reward for his exertions in this hazardous employment, he was chofen to fill the vacant fee of Toledo; but he was put to death before he could receive the epifcopal confecration. The accufation againft him was the having converted a young Mahometan female to the Chriftian faith: he was beheaded in 859. He was author of "Memoriale Sanctorum, five Libri III. de Martyris Cordubenfibus;" "Apologeticus pro Martyribus, &c.;" "Exhortatio ad Martyrium;" and fome moral epiftles. Thefe were collected and printed with notes by Ambrofius Moralis in 1554, and again in a more correct form by Poncius Leo in 1574. Moreri.

EULOGY, Eulogia, in *Church Hiftory*. When the Greeks have cut a loaf, or piece of bread, to confecrate it, they break the reft into little bits, and diftribute it among the perfons who have not yet communicated, or fend it to perfons that are abfent; and thefe pieces of bread are what they call eulogies.

The word is Greek, ευλογια, formed of ευ, *bene*, *well*, and λεγω, *dico*, *I fay*, *fpeak*; q. d. *benedictum*, *bleffed*.

The Latin church has had fomething like eulogies for a great many ages; and thence arofe the ufe of their holy bread.

The name eulogy was likewife given to loaves or cakes brought to church by the faithful to have them bleffed.

Laftly, the ufe of the term paffed hence to mere prefents made a perfon, without any benediction. See the Jefuit Gretfer, in his Treatife de Benedictionibus & Maledictionibus, lib. ii. cap. 22. 24, &c. where he treats of eulogies thoroughly.

From a paffage in Bollandus, on the Life of S. Melaine, cap. 4. it appears, that eulogies were not only of bread, but any kind of meat bleffed and hallowed for that purpofe. And that almoft every body bleffed and diftributed eulogies; not only bifhops and priefts, but even hermits, though laymen, made a practice of it. Women alfo would fometimes fend eulogies.

The wine fent as a prefent was alfo held an eulogy. Bollandus remarks farther, that the eucharift itfelf was alfo called eulogy.

Eulogy, likewife, means an encomium on any perfon, on account of fome virtue or good quality.

EUMARIDES, of ευμαρης, *eafy*, among the *Ancients*, a kind of fhoes common to men and women.

The eumarides were ufed for pomp and delicacy, being neat, and painted with various colours.

EUME, in *Geography*, a river of Spain, which runs into the fea near Corunna.

EUMECES, in the *Writings of the Ancient Naturalifts*, the name of a ftone which Pliny tells us refembled a flint, and was found in Bactria; the ancients had an idle opinion, that, if laid under the head, it occafioned true and prophetic dreams, foretelling to the perfon the more remarkable future events of his life. Hift. Nat. lib. xxxvii. cap. 10.

EUMENES, in *Biography*, a captain under Alexander the Great, was a native of Cardiopolis, in the Thracian Cherfonefe. His father was of a low ftation, but one in a condition to have entertained at his houfe Philip king of Macedon, who became the patron of his fon. So well did the youth approve himfelf as fecretary to the monarch, that his fon Alexander continued him in the fame office, and gave him a command in the cavalry. According to Plutarch, Eumenes took every advantage that his ftation afforded him of accumulating money, for his tent being fet on fire by the private orders of his fovereign, to whom he had refufed the loan of three hundred talents; there was found to the value of more than one thoufand talents in melted gold and filver. After the death of Alexander, when the provinces were divided among the principal commanders, the government of Cappadocia, Paphlagonia, and the country bordering on the Euxine fea, as far as Trapezius, which as yet were unconquered, were affigned to Eumenes. Eumenes attached himfelf to Perdiccas, who made him his chief minifter, and gave directions to Antigonus and Leonatus to put him in poffeffion of his government. Antigonus paid no attention to the order, but Leonatus, pretending to comply, marched an army feemingly for the purpofe, which Eumenes joined. His defign was, however, to feize the kingdom of Macedon for himfelf; but upon making it known, Eumenes deferted him by night, after feizing his treafures, and repaired to Perdiccas. In reward for his fidelity, Perdiccas himfelf made an expedition in Cappadocia, and after defeating and killing the king Ariathes, left Eumenes mafter of the country. He was next appointed prefect of Afia, between mount Taurus and the Hellefpont, and was entrufted with the care of oppofing the army expected to march againft him out of Greece under Antipater and Craterus. On the approach of thefe great commanders, Eumenes concealed from his army that they were about to contend with Craterus, for whom they entertained the moft profound refpect and veneration, and giving battle to him and Neoptolemus, he flew the latter with his own hand, while Craterus was mortally wounded, fighting at the head of his phalanx. Eumenes, who felt for him emotions of the fincereft friendfhip, grafped his hand as he was expiring, wept over his remains, and honoured him with a magnificent funeral. After the murder of Perdiccas by his own army, Eumenes was declared a public enemy, and Antigonus was fent to conduct the war againft him. Eumenes was routed, but able to retire to the impregnable caftle of Nora, which he defended with great ability. He was abundantly fupplied with corn, and though without

out any other kind of provifions, he kept his men in good humour, by his affable and cheerful demeanour. Another fcene opened itfelf for the ambition of Antigonus, and Eumenes was fet at liberty. He inftantly began to levy troops, and in a fhort time was declared royal general of Afia, and there was affigned to him a guard of Argyrafpidæ, or filver fhields. To infpire his troops with a fort of religious enthufiafm in the caufe, he pretended to have feen Alexander in a vifion, by whofe direction he erected a royal tent, containing a throne of gold, with all the enfigns of majefty, where the captains were to offer incenfe, and then deliver their orders in a common council. After this there were difputes about the chief command, but when Antigonus approached all agreed that Eumenes was the only general, under whom they would fight. His fituation was difficult and precarious, he was aware that many of the other commanders were defirous of getting rid of him, as the chief obftruction to their ambitious defigns. From thofe whom he moft fufpected he borrowed large fums of money, that by fuch a pledge he might give them an intereft in his fecurity. The war was protracted with various fuccefs to a fecond campaign, when a battle enfued, in which Eumenes routed the enemies' infantry, but in the mean time his cavalry took poffeffion of the camp of Eumenes. This circumftance occafioned fo much difcontent in the army, that when Antigonus fent an offer to reftore the foldiers, their wives and property, on condition of their delivering Eumenes into his hands, the Argyrafpidæ furrounded him, feized his fword, tied his arms behind him, and gave him up prifoner. Antigonus being afked how he fhould be kept? As you would keep a lion or a wild elephant, he replied. All the Afiatic chiefs fubmitted upon this event, and it remained only to determine the fate of the illuftrious captive. This was fo long kept in fufpence, that Eumenes expreffed his furprife that Antigonus had neither the courage to put him to death, nor the generofity to make him his friend by fetting him at liberty. A party in the army, headed by Demetrius, favoured the laft meafure, but the majority urged Antigonus to remove fo formidable a rival. This counfel prevailed, and orders were given to deprive him of food. He had fuffered the pains of hunger two or three days, and was faft approaching his end, when the army being fuddenly obliged to decamp, an executioner was fent to difpatch him. His remains were treated with funeral honours, and his afhes were enclofed in a filver urn, and fent to his family. This was in the year 315 B. C. Eumenes had a fine perfon, was highly accomplifhed, and poffeffed the manners and fentiments fuited to an elevated ftation; he was faithful to the caufe of his deceafed mafter, and it was not till after his death that the captains who divided the Macedonian empire among them openly affumed the ftyle of independent fovereigns. Eumenes perifhed in his forty-fifth year. Univer. Hift. Plutarch.

Eumenes II. king of Pergamus, fucceeded his father Attalus in the year B. C. 197. He cultivated the friendfhip of the Romans, who were now beginning to extend their influence into Afia, urging them to check the ambitious projects of Antiochus the Great, of which he feared he fhould be the victim. Eumenes joined his fleet to that of the Romans, and by his perfonal bravery greatly contributed to a naval victory, which was gained over that king; nor was he lefs ufeful at the decifive battle of Magnefia. On account of his important fervices he was rewarded by an acceffion to his dominions, of all the countries weft of mount Taurus, which had belonged to Antiochus, and alfo of all the provinces lying between that mountain and the river Meander, except Lycia and Caria, which were given to the people of Rhodes. Eumenes, now one of the moft potent princes in Leffer Afia, was involved in a war with Prufias, king of Bithynia, in which he was defeated both by land and fea. Peace was made, and another conteft took place between Eumenes and Pharnaces; in this the latter was obliged to fue for peace. Eumenes now made an alliance with Antiochus, fon of his old enemy Antiochus the Great, and in conjunction with his brother Attalus placed that prince on the throne of Syria, from which he had been driven by an ufurper. Perfes, king of Macedon, by increafing his military force, excited the jealoufy of his neighbours, and Eumenes took a journey to Rome, for the purpofe of acquainting the fenate with all he had difcovered of his dangerous projects. On his return, Eumenes, going to offer facrifice at the temple of Delphi, had nearly loft his life by affaffins hired by Perfes to deftroy him. He received fo much injury that he was carried almoft lifelefs on board his fhip, and it was generally believed that he was actually dead. Attalus his brother, giving credit to the news, affumed the royal enfigns, and even married the queen Stratonice. Eumenes, after his recovery, gave his brother a friendly reception, advifing him not to marry his wife again till it was certain he was dead. From this period he was engaged in contefts with the Romans, who began to regard him with fufpicion, and it is thought they encouraged Attalus to feize upon his brother's kingdom for himfelf. Eumenes died in the year 159 B.C. leaving an infant fon to the protection of his brother and fucceffor Attalus. Eumenes was liberal, and even magnificent towards his friends. He was a patron of letters, and made confiderable additions to the celebrated library of Pergamus. Univer. Hift.

Eumenes, an orator, was an Athenian by defcent, but was born at Autun in Gaul, where he was for a confiderable time profeffor of rhetoric, and acquired great reputation. He was fecretary to the emperors Maximian and Conftantius, and was much efteemed by Conftantine the Great, whom he harangued in favour of the inhabitants of Autun in 311. He delivered an oration before the prefect of Lyonefe Gaul, in favour of the reftoration of the public fchools in the province, towards which he nobly offered to contribute his own falary, as fecretary, probably, as well as profeffor. He died about the middle of the fourth century. Fragments of his orations are printed in the "Panegyrici Veteres." Moreri.

EUMENIA, in *Ancient Geography*, a town of Afia, in the Greater Phrygia, feated on the Cludrus.—Alfo, a town of Afia Minor, in Caria.—Alfo, a town of Thrace, on the confines of Lower Mœfia.

EUMENIDEIA, Ευμενιδεια, an annual feftival obferved in honour of the Furies. It was otherwife called σεμνων εορτη, becaufe the Athenians called the Furies σεμναι θεαι, *i. e. venerable goddeffes.*

EUMENIDES, in *Antiquity*. See Furies.

EUMETRES Beli, in *Natural Hiftory*, the name given by the ancients to a gem which the Affyrians held facred to their god, and which many other nations learned from them to fuppofe very powerful againft magic. Many have fuppofed this to be the one we now call oculus Beli: but this is an error, fince Pliny, in his account of the eumetres, fays, that it was of a very fine green. It was probably a gem of the emerald kind, that ftone having ever been in very high efteem in the Eaftern part of the world, as it is alfo to this day.

EUMINACUM, in *Ancient Geography*, a town of Mœfia, Mœsia, marked in the Itinerary of Antonine; 24 miles from Viminiacum.

EUMME' Faregge', or *Omm Faredje*, a canal of Egypt, joining lake Manzaleh with the Mediterranean; supposed to be the mouth of that ancient canal, called the Tanitic or Saitic branch of the Nile.

EUMOLPIDES, in *Antiquity*, priests of Ceres, who had the power among the Athenians of initiating into the mysteries of this goddess, or excluding from them.

EUMOLPUS, in *Biography*, a disciple of Orpheus, who, tracing the footsteps of his father Musæus, wrote concerning the mysteries of Ceres.

EUNAPIUS, a native of Sardis, in Lydia, flourished in the fourth century, and was a kinsman of the celebrated sophist Chrysanthius, at whose request he wrote the lives of the philosophers of his time. This work has been characterized by Brucker "as a mass of extravagant tales, discovering a feeble understanding, and an imagination prone to superstition;" besides being a sophist, he was an historian, and practised physic. In his writings he seems to have entertained a great prejudice against Christianity, the martyrs to which he treats with a contempt that has given just offence to contemporary ecclesiastical writers. He wrote a history of the Cæsars from Claudius II. to Arcadius and Honorius, of which only a fragment, "De Legationibus," is remaining. The "Vitæ Philosophorum" was published with a Latin translation by Junius in 1596. Moreri.

EUNILAK, in *Geography*, a place of East Greenland. N. lat. 61° 4'. W. long. 46°.

EUNOFIUS, a name given by some authors to the ætites, or eagle-stone.

EUNOMIANS, in *Ecclesiastical History*, a sect denominated from Eunomius, bishop of Cyzicus, who, in the fourth century, maintained most of the errors of Arius, and added others to them. He was a native of Dacora, a town of Cappadocia; and removing to Constantinople, gained his subsistence first as a notary, and afterwards as a schoolmaster. At Alexandria he became a disciple of Aetius, whose opinions he adopted and strenuously defended. Having been ordained a deacon by Eudoxius, bishop of Antioch, he was deputed to the court of the emperor Constantius for the purpose of defending Eudoxius against the accusations of Basil, bishop of Ancyra; but in his way thither he was seized by the partizans of Basil, and banished to Myda, a city in Phrygia. In the year 360 he was ordained bishop of Cyzicus; but boldly avowing his opinions, he became obnoxious to the orthodox party, and underwent various and severe persecutions. At the command of the emperor Constantius, he was at length condemned and deposed by Eudoxius. At Chalcedon, whither he retired, his enemies pursued him, and he was afterwards banished by the emperor Valens to Mauritania. At the close of the reign of this emperor, after he had been allowed to return to Constantinople, he was charged with disturbing the peace of the church, and again banished to the island of Naxos. When Valens died, he returned to Chalcedon, but was soon sent into exile by the emperor Theodosius. Wearied by incessant and grievous persecution he obtained leave from the court to retire to the place of his nativity, where he died at an advanced age, about the year 394. He was the author of various works, most of which are now lost. Those that are extant are "Eunomius's Creed," presented to the emperor Theodosius in the year 383, and his "Apologeticus," or Defence of his Doctrine, in which, according to Dr. Cave, the sly arch-heretic reasons shrewdly. Fabricius has published this piece entire, and an English version of it may be seen in the 1st volume of Whiston's "Primitive Christianity revived." Socrates Hist. Eccles. Cave's H. L. Fabr. Bib. Græc. vol. viii. Lardner.

EUNOMIŒUPSYCHIANS, a sect of heretics of the fourth century, mentioned by Nicephorus, lib. xii. cap. 30. being the same with those called Eutychians by Sozomen, lib. vii. cap. 17. See Eutychians.

EUNUCH, Ευνουχος, a term applied in the general to all who have not the faculty of generating, either through imbecility or frigidity; but more particularly to such as have been castrated, or have lost some of the parts necessary for that purpose.

The word is formed of ευνην εχει, q. d. *lecti curam habet, guardian*, or *keeper of the bed.*

In England, France, &c. eunuchs are never made but on occasion of some disease which renders such an operation necessary; but in Italy they make eunuchs for the sake of preserving the voice; and in the East they make eunuchs to be guards or attendants on their women.

Great numbers of children, from one to three years of age, are yearly castrated in Italy to supply the operas and theatres, not only of Italy but other parts of Europe, with singers; though it is not one in three, that, after having lost their virility, have a good voice for a recompence. See Conservatorios.

Tavernier assures us, that in the kingdom of Boutan, in the East Indies, there are every year made twenty thousand eunuchs, and sold thence into other countries.

The seraglios of the Eastern emperors are chiefly served and guarded by eunuchs; and yet we have very good testimonies, that the rich eunuchs in Persia and other countries keep seraglios for their own use. This is a punishment of crimes in some countries. See Adultery.

By an arret of the grand chamber of Paris in 1665, it is adjudged that an eunuch could not marry, not even with the consent of the woman, and all the parties on both sides.

Claudian has a very severe satire against the eunuch Eutropius, who had been elected consul of Rome. He represents him as an old woman, dressed up in the honours of the consulate.

In the council of Nice those were condemned who, out of an indiscreet zeal, and to guard themselves from sensual pleasures, should make themselves eunuchs. Such as thus mutilated their bodies were excluded from holy orders; witness Leontius, bishop of Antioch, who was deposed for having practised this cruelty on himself; and the bishop of Alexandria excommunicated two monks who had followed his example, on pretence of securing themselves from the impetuous motions of concupiscence.

Several of the emperors made very severe prohibitions against the making of eunuchs, or people's castrating themselves. See Castration.

Eunuchs, *Eunuchi*, in *Ecclesiastical History*, is also the denomination of a sect of heretics in the third century, who had the folly or madness to castrate not only those of their own persuasion, but even all they could lay hands on.

They took their rise from the example of Origen, who, upon a misunderstanding of our Saviour's words in St. Matthew, chap. xix. ver. 12. made himself an eunuch, by cutting off the offending part, as some say; or as others (particularly St. Epiphanius), by the use of certain medicines. These heretics were also called *Valesians.*

EVOCATI, among the Romans, soldiers, who having served their time in the army, went afterwards volunteers at the request of some favourite general.

EVOCATION, Evocatio, among the Romans, a religious ceremony always observed by them at undertaking the

the siege of a town, wherein they solemnly called upon the gods and goddesses of the place to forsake it and come over to them. Without the performance of this ceremony, they either thought that the place could not be taken, or that it would be a sacrilege to take the gods prisoners.

The form of evocation used at taking the city of Carthage is related by Macrobius, Sat. III. 9.

They always took it for granted that their prayer was heard, and that the gods had deserted the place and came over to them, provided they were able to make themselves masters of it. The ancients had also two other sorts of evocation; one was a magical operation, which they used in order to call up departed souls. This custom of raising the manes, or conjuring up souls departed, was so ancient, that its origin is traced as high as the earliest periods of time; and all the anathemas denounced by the sacred authors against those who consulted familiar spirits are proofs of the antiquity of this practice. Among the different sorts of magic prohibited by Moses, that of calling up the dead is expressly specified. (See Witch *of Endor.*) Prophane authors look upon Orpheus as the inventor of this art, in evidence of which it is alleged, that the hymns which are ascribed to him are mostly real pieces of conjuration, but it is probable that this practice was derived from the people of the East, and was carried into Greece with other religious ceremonies, by colonies which came and settled here. It is certain, however, that in the time of Homer, this sort of conjuration was practised, as it is mentioned in some passages of the Iliad. At that time it was not reckoned odious or criminal, since there were persons who made public profession of conjuring up ghosts, and there were temples where the ceremony of conjuration was to be performed. Pausanias (in Bœot.) speaks of that which was in Thesprotia, where Orpheus came to call up the soul of his wife Eurydice. Ulysses's travels into the country of the Cimmerians, whither he went to consult the ghost of Tiresias, described by Homer in the Odyssey (l. xi.) seems to indicate a kind of conjuration. Historians, as well as poets, have mentioned this species of conjuration. Another sort of evocation was that which was used in calling up the gods. In order to understand this practice, it should be recollected, that it was a doctrine of the Pagan theology, that the gods presided in a peculiar manner over certain places, and that several of these places were under the protection of the same god; and as it was impossible for him to be in them all at the same time, it was necessary to use the ceremony of evocation, when his presence was thought needful. They had hymns proper to this operation, which they called κλετικοι, such as were most of those ascribed to Orpheus, and those of the poet Proclus. When they thought the patron god was arrived, they celebrated the festival named επιδημιαι. As soon as the danger, which made them invoke the gods was passed, they gave them liberty to go any where else; and they had other hymns for celebrating their departure, which hymns were called αποπεμπτικοι.

EVOCATORIÆ Epistolæ, among the Romans, letters sent by the emperors to command the attendance of any person; or letters granting licence to any one to wait on the emperor; every person not being allowed this privilege till they had desired and obtained the evocatoriæ epistolæ.

EUODIA, in *Botany*, from ευωδια, *a sweet smell*, Forst. Gen. 7. t. 7. See Fagara.

EVOLI, in *Geography*, a town of Naples, in Principato Citra; 15 miles E.S.E. of Salerno.

EVOLVENT, in *Geometry*, a term which some writers use for the curve resulting from the evolution of a curve; in contradistinction to the evolute, which is the curve supposed to be opened or evolved.

The evolute always both touches and cuts the evolvent at the same time: the reason is, that it has two of its infinitely small sides in common with the evolvent; or, rather exactly placed on two equal sides thereof; one of them within-side that of the evolvent, *i. e.* on the concave side thereof; and the other on the convex side of its correspondent side; so that the evolute touches the evolvent in two points; whence, instead of being a tangent, it is said to osculate the evolvent; and, hence, it is also called *osculator*, and *circulus osculator.*

There is one, and but one osculator, to each point of the evolvent; but to the same point there is an infinity of other circles which only touch, and do not osculate. The osculator, and the evolute, make no angle in the place where they touch and cut; nor can any curve line be drawn between, as there may between a tangent and a curve.

EVOLUTE, Evoluta, in the *Higher Geometry*, a curve first proposed by Mr. Huygens, and since much studied by the latter mathematicians. See Curvature.

The evolute is a curve, supposed to be evolved, or opened; and which, in opening, describes other curves.

To conceive its origin and formation, suppose a flexible thread, wound exactly over the convexity of any curve, as A B C G (*Plate* VI. *Analysis*, *fig.* 1.) and suppose the thread fixed in G, and every where else at liberty, to A. Now, beginning to unwind the thread from the point, and continuing it to D, and, throughout, keeping it tight on the curve surface A B C G, when the thread is become quite straight, and is only a tangent, F G, to the curve in the point G, it is evident the extremity A, in its progress to F, has described another curve line A D E F.

Here, the first curve A B C G is called the evolute; each of its tangents B D, C E, &c. comprehended between it and the curve A D E F, called the *involute*, is called a *radius of the evolute*, or *radius osculi*, *radius osculator*, or radius of curvature, of the curve A D E F, in the respective points D, E, &c. And the circles, whereof the osculators B D, C E, &c. are radii, are called *circuli osculatores* of the curve A D E F, in D, E, &c. And, lastly, the new curve resulting from the evolution of the first curve begun in A, is called the *curve of evolution*, or *curve described by evolution.*

Evolute, *the radius of the*, then, is the part of the thread comprized between any point where it is a tangent to the evolute, and the correspondent point where it terminates in the new curve. Which appellation, *radius*, is the more proper, as one may actually consider this part of the thread in every step it takes, as if it described an arc of an infinitely small circle, making a part of the new curve, which thus consists of an infinite number of such arcs, all described from different centres, and with different radii.

Every curve, therefore, may be conceived as formed by the evolution of another. And we are to find that, whose evolution formed it; which amounts to the finding of the radius of the evolute in any point; for, as it is always a tangent to the generating curve, it is, properly, no more than one of its infinitely small parts, or sides, prolonged; and all its sides, whose positions are determined of course, are no other than the generating curve itself.

The same thread is also called *radius curvedinis*, or *radius osculi*, because a circle described hereby, from the centre G, is said to osculate, or kiss it, as both touching and cutting at the same time, *i. e.* touching both the inside and the out.

Hence, 1. The evolute B C F (*fig.* 35.) is the place of all

all the centres of the circles that ofculate the curve A M, defcribed by evolution. 2. When the point B fall on A, the radius of curvature, or radius of the evolute, M C, is equal to the arc B C; or to the aggregate of A B, and the arc B C. 3. Since the element of the arc M m, in the curve defcribed by evolution, is an arc of a circle defcribed by the radius C M; the radius of the evolute C M is perpendicular to the curve A M, or to a tangent at the point M. 4. Since the radius of the evolute M C is always a tangent to the evolute B C F, curves by evolution may be defcribed through innumerable points, if only tangents be produced in the feveral points of the evolute, till they become equal to their correfpondent arcs.

The finding of the radii of evolutes is a thing of great importance in the higher fpeculations of geometry; and even, fometimes, is of ufe in practice as the inventor of the whole theory, Huygens, has fhewn, in applying it to the pendulum. (Horol. Ofcill. part 3.) The doctrine of the ofcula of evolutes is owing to M. Leibnitz, who firft fhewed the ufe of evolutes in the meafuring of curves.

We fhall here fubjoin a brief account of the method of finding the radius of the evolute in different kinds of curves and equations expreffing the nature of evolutes.

1. To form a general expreffion for (B E) the radius of the evolute, or of curvature at any point B in the involute curve A B Y, whofe axis is A X, and evolute D E, *fig.* 3.

With the radius E B defcribe the circular arc B K, which will have the fame curvature with the involute curve A B at the point B. Draw the radius E K parallel to the axis A X, and produce the ordinate B C to L, to which draw A N parallel: let the abfcifs A C be $= x$, the ordinate C B $= y$, radius E B or E K $= r$, K N $= a$, and N A $= b$; then L E $= r - a - x$. If the abfcifs x be fuppofed to increafe uniformly, and B m to be a tangent at the point B; and $m\,n$ be drawn parallel to B C, and B N parallel to A X; B n, $n\,m$, and m B, which are the contemporary increments of the abfcifs, ordinate, and curve, will be as their fluxions refpectively; or B n will be as $\dot{x}$, $n\,m$ as $\dot{y}$, and B m $(= \overline{Bn^2 + nm^2}|^{\frac{1}{2}})$ as $\overline{\dot{x}^2 + \dot{y}^2}|^{\frac{1}{2}}$.

Farther, the triangles B $n\,m$ and B L E are fimilar; therefore B n : $n\,m$ :: B L : L E, *i. e.* $\dot{x} : \dot{y} :: y + b : r - a - x$; confequently, $r\dot{x} - a\dot{x} - x\dot{x} = y\dot{y} + b\dot{y}$: the fluxion of which equation (fuppofing $\dot{x}$ invariable, and therefore, the direction of the curve A B continually approaching towards a parallelifm with its axis, the fluxion of $\dot{y}$ as negative) is $-\dot{x}^2 = \dot{y}^2 - y\ddot{y} - b\ddot{y}$; and $\dot{x}^2 + \dot{y}^2 = \overline{b + y} \times \ddot{y}$.

Again, L B : B E :: n B : B m, *i. e.* $b + y : r :: \dot{x} : \overline{\dot{x}^2 + \dot{y}^2}|^{\frac{1}{2}}$; therefore $b + y = \dfrac{r\dot{x}}{\overline{\dot{x}^2 + \dot{y}^2}|^{\frac{1}{2}}}$, and fubftituting this expreffion for $b + y$, the above equation will become $\dot{x}^2 + \dot{y}^2 = \dfrac{r\dot{x}\ddot{y}}{\overline{\dot{x}^2 + \dot{y}^2}|^{\frac{1}{2}}}$; confequently, $\overline{\dot{x}^2 + \dot{y}^2} \times \overline{\dot{x}^2 + \dot{y}^2}|^{\frac{1}{2}} = r\dot{x}\ddot{y}$, *i. e.* $\overline{\dot{x}^2 + \dot{y}^2}|^{\frac{3}{2}} = r\dot{x}\ddot{y}$, and $\dfrac{\overline{\dot{x}^2 + \dot{y}^2}|^{\frac{3}{2}}}{\dot{x}\ddot{y}} = r =$ B E. In deducing this expreffion, the increment of the ordinate y, or the velocity or fluxion with which it flows, is fuppofed continually to decreafe, therefore its fecond fluxion is negative: but when y increafes with an accelerated motion, its fecond fluxion will be affirmative; and the above expreffion will be $\dfrac{\overline{\dot{x} + \dot{y}^2}|^{\frac{3}{2}}}{-\dot{x}\ddot{y}}$. By fubftituting 1 for $\dot{x}$, which is invariable in thefe expreffions, they will become $\dfrac{\overline{1 + \dot{y}^2}|^{\frac{3}{2}}}{\ddot{y}}$ and $\dfrac{\overline{1 + \dot{y}^2}|^{\frac{3}{2}}}{-\ddot{y}}$ refpectively; the former taking place when the curve is concave, and the latter when it is convex towards the axis, and the fign of $\ddot{y}$ fhewing the pofition of the evolute and radius of curvature with refpect to the curve and axis. By reducing thefe expreffions from the nature and properties of the curve, and always fubftituting 1 for $\dot{x}$, we fhall obtain the value of B E, or the radius required. The vertical diftance or radius A D may be eafily obtained by fubftituting for $\dot{x}$, 1, and for $\dot{y}$ its proper value in the expreffion for the fubnormal C H, which is evidently $\dfrac{y\dot{y}}{\dot{x}}$. *E. gr.*

1. To find the radius of curvature at any point B in the parabola A Y, *fig.* 4.

Let the parameter be $= a$, abfcifs A C $= x$, and ordinate C B $= y$: then, by the nature of the curve $ax = y^2$, and therefore $a\dot{x} = 2y\dot{y}$ (fee Fluxion), and making $\dot{x} = 1$, $a = 2y\dot{y}$, and $\dot{y} = \dfrac{a}{2y} = \dfrac{a}{2 \times \overline{ax}|^{\frac{1}{2}}}$. But the fluxion of this equation will be $-\ddot{y} = \dfrac{-a^2}{4 \times \overline{ax}|^{\frac{3}{2}}}$, or $\ddot{y} = \dfrac{a^2}{4 \times \overline{ax}|^{\frac{3}{2}}}$, and $\dot{y}^2$ being equal to $\dfrac{a^2}{4ax} = \dfrac{a}{4x}$, we fhall have, by fubftituting thefe values in the expreffion $\dfrac{\overline{1 + \dot{y}^2}|^{\frac{3}{2}}}{\ddot{y}}$ for $\dot{y}^2$ and $\ddot{y}$,

$$\frac{\overline{1 + \frac{a}{4x}}|^{\frac{3}{2}} \times \overline{4 \cdot ax}|^{\frac{3}{2}}}{a^2} = \frac{4}{a^2} \times \overline{\frac{4x + a}{4x}}|^{\frac{3}{2}} \times \overline{ax}|^{\frac{3}{2}} = \frac{4}{a^2} \times \overline{\frac{4ax^2 + a^2x}{4x}}|^{\frac{3}{2}} = \frac{4}{a^2} \times \overline{\frac{1}{4}}|^{\frac{3}{2}} \times \overline{4ax + a^2}|^{\frac{3}{2}} = \frac{4}{a^2} \times \frac{1}{8} \times \overline{4ax + a}|^{\frac{3}{2}} = \frac{\overline{4ax + a^2}|^{\frac{3}{2}}}{2a^2}.$$

Then if a femicircle be defcribed through the point B, C n be bifected in H, and H r be made equal 2 A C, and r E be a perpendicular at r, produced till it meets a line B E, drawn from B through H, this line B E will be the radius of curvature required: for B C^2 = A C $\times$ C n, 35 E. 3. or $\dfrac{\text{B C}^2}{\text{A C}}$ = C n, *i. e.* $\dfrac{ax}{x} = a =$ C n, and C H $= \frac{1}{2}a$, and C $r = \frac{1}{2}a + 2x$; and by 47 E. 1. $\overline{\text{C H}^2 + \text{C B}^2}|^{\frac{1}{2}}$ = B H, *i. e.* $\overline{\frac{1}{4}a^2 + ax}|^{\frac{1}{2}}$ = B H; and by 4 E. 6. C H : H B :: C r : B E; *i. e.* $\frac{1}{2}a : \overline{\frac{1}{4}a^2 + ax}|^{\frac{1}{2}} :: \frac{1}{2}a + 2x : \dfrac{a + 4x}{a} \times \overline{\frac{1}{4}a^2 + ax}|^{\frac{1}{2}} = \dfrac{\overline{a^2 + 4ax}|^{\frac{3}{2}}}{2a^2}$ = B E as before. A D the vertical diftance, or, $\dfrac{y\dot{y}}{\dot{x}}$, is in this cafe, putting $\dfrac{a}{2y}$ for $\dot{y}$, and 1 for $\dot{x}$, equal to $\dfrac{a}{2}$; and this likewife appears, by confidering, that in the expreffion for the radius when the radius becomes equal to the vertical diftance, the abfcifs x vanifhes, and it becomes $\dfrac{\overline{a^2}|^{\frac{3}{2}}}{2a^2} = \dfrac{a^3}{2a^2} = \dfrac{a}{2}$.

E. gr. 2. To find the radius of curvature at any point B in the cycloid A B D, *fig.* 5.

Put the radius O F or O D $= a$, abfcifs A C $= x$, ordinate

nate C B $= y$, sine I G $= s$, and arc F G $= z$. Now by 35 E. 3. I G $= \overline{DI \times IF}^{\frac{1}{2}}$, that is, $s = \overline{2ay - y^2}^{\frac{1}{2}}$; the fluxion of which equation is $\dot s = \frac{a\dot y - y\dot y}{\overline{2ay-y^2}^{\frac{1}{2}}}$; and by the nature of the cycloid, arc D G = G B; and therefore, arc F G = G I + A C, or A C = arc F G − G I, that is, $x = z - s =$ (by substituting for s its above value) $z - \overline{2ay - y^2}^{\frac{1}{2}}$; and the fluxion of this equation, making $\dot x = 1$, is $1 = \dot z + \frac{y\dot y - a\dot y}{\overline{2ay - y^2}^{\frac{1}{2}}}$.

But $\dot z = \overline{\dot s^2 + \dot y^2}^{\frac{1}{2}}$ = (by writing for $\dot s$ its above value); $\overline{\frac{\overline{a\dot y - y\dot y}^2}{2ay - y^2} + \dot y^2}^{\frac{1}{2}} = \frac{a\dot y}{\overline{2ay - y^2}^{\frac{1}{2}}}$; which, substituted for $\dot z$, makes the above equation $1 = \frac{a\dot y}{\overline{2ay - y^2}^{\frac{1}{2}}} + \frac{y\dot y - a\dot y}{\overline{2ay - y^2}^{\frac{1}{2}}}$; that is, $1 = \frac{y\dot y}{\overline{2ay - y^2}^{\frac{1}{2}}}$; therefore, $\dot y = \frac{\overline{2ay - y^2}^{\frac{1}{2}}}{y}$; and the fluxion of this equation (the fluxion of $\dot y$ being negative), is $-\ddot y = \frac{\frac{ay\ddot y - y^2\ddot y}{\overline{2ay - y^2}^{\frac{1}{2}}} - \dot y \cdot \overline{2ay - y^2}^{\frac{1}{2}}}{y^2} = \frac{-a\dot y}{y \cdot \overline{2ay - y^2}^{\frac{1}{2}}} =$ (by writing for $\dot y$ its equal), $-\frac{a}{y^2}$; that is, $\ddot y = \frac{a}{y^2}$.

Now, by substituting $\frac{2ay - y^2}{y^2}$ for $\dot y^2$, and $\frac{a}{y^2}$ for $\ddot y$, we have $\frac{\overline{1 + \dot y^2}^{\frac{3}{2}}}{\ddot y} = \frac{\overline{1 + \frac{2ay - y^2}{y^2}}^{\frac{3}{2}} \times y^2}{a} = \frac{\overline{2ay}^{\frac{3}{2}}}{ay} = \frac{2ay \times \overline{2ay}^{\frac{1}{2}}}{ay} = 2 \cdot \overline{2ay}^{\frac{1}{2}}$ = B E, the radius of curvature required.

Construction.—Make F H = G B; and through the point H draw the right line B E, making B H = H E = chord F G; then will B E be the radius of curvature at the point B; for a tangent to the point B is parallel to the chord D G, and the radius of curvature is always perpendicular to the tangent; therefore, because by 31 E. 3. the ∠ D G F is right, B E must be parallel to the chord F G. Now, by 4 and 8 E. 6. D F : F G :: G F : F I, or C B, ∴ G F $= \overline{DF \times CB}^{\frac{1}{2}} = \overline{2ay}^{\frac{1}{2}}$, and $2\,GF = 2 \cdot \overline{2ay}^{\frac{1}{2}}$ = B E.

2. To form a general expression for the radius of curvature in spirals, or curves whose ordinates are referred to a fixed or central point:

Let C B Y, (*fig.* 6.) be the curve, C the central point, or that from which all the ordinates issue; and B E the radius of the curvature at the point B, that is, let the point E be supposed in the evolute curve: conceive C b and E b indefinitely near to C B and E B, that is, let the points B and b be supposed indefinitely near to each other; and let C F and C f be perpendicular to E B and E b respectively, then will the points F and r be indefinitely near to a coincidence; and therefore B r and C r may be taken as equal to B F and C F. Now, if with the ordinate C B as a radius, the little circular arc B n be described and considered as a little right line perpendicular to C b, and the increment B b be considered as coinciding with the tangent to the point B, then the little right-angled triangle B n b will be similar to the right-angled triangle B F C; (for ∠ C B n = ∠ E B b; and therefore ∠ E B n being common, the ∠ C B F = ∠ n B b; and, consequently, the angles at F and n being right, ∠ B C F = ∠ B b n); therefore by 4 E. 6. b B : B n :: C B : B F; that is, (if we put the ordinate C B $= y$, B $n = x'$, and $n\,b = y'$, when, by 47 E. 1 B b will be $= \overline{x'^2 + y'^2}^{\frac{1}{2}}$,) $\overline{x'^2 + y'^2}^{\frac{1}{2}} : x' :: y : \frac{x'y}{\overline{x'^2 + y'^2}^{\frac{1}{2}}}$ = B F or B r; and B b : b n :: B C : C F, that is, $\overline{x'^2 + y'^2}^{\frac{1}{2}} : y' :: y : \frac{yy'}{\overline{x'^2 + y'^2}^{\frac{1}{2}}}$ = C F or C r; the increment of which is $r\,f$; that is, supposing x' to be invariable) $\frac{\frac{\overline{y'^2 + yy''} \times \overline{x'^2 + y'^2}^{\frac{1}{2}} - y'y'' \times yy'}{\overline{x'^2 + y'^2}^{\frac{1}{2}}}}{x'^2 + y'^2} = \frac{x'^2y'^2 + y'^4 + yx'^2y''}{\overline{x'^2 + y'^2}^{\frac{3}{2}}} = rf$. Again, the triangles E B b and E r f being similar, B b − rf : B b :: (B E − r E, or) r B : B E; that is, $\left(\overline{x'^2 + y'^2}^{\frac{1}{2}} - \frac{x'^2y'^2 + y'^4 + yx'^2y''}{\overline{x'^2 + y'^2}^{\frac{3}{2}}} =\right) \frac{x'^4 + x'^2y'^2 - yx'^2y''}{\overline{x'^2 + y'^2}^{\frac{3}{2}}} : \overline{x'^2 + y'^2}^{\frac{1}{2}} :: \frac{x'y}{\overline{x'^2 + y'^2}^{\frac{1}{2}}} : \frac{y \times \overline{x'^2 + y'^2}^{\frac{3}{2}}}{x'^3 + x'y'^2 - yx'y''}$ = B E, or B E $= \frac{y \times \overline{\dot x^2 + \dot y^2}^{3}}{\dot x^3 + \dot x\dot y^2 - y\dot x\ddot y}$; which is a general expression for the radius of curvature of all curves referred to a fixed or central point, when x' or $\dot x$ is invariable.

Hence, if $\dot x$ be made = 1, the general expression for the radius of curvature will be $= \frac{\dot y \times \overline{1 + \dot y^2}^{\frac{1}{2}}}{1 + \dot y^2 - y\ddot y}$. Wherefore, if we put the equation of the given spiral into fluxions, making $\dot x = 1$, and put this fluxional equation into fluxions again; and from thence, or from the nature of the curve, find the values of $\dot y^2$ and $\ddot y$: then, if for $\dot y^2$ and $\ddot y$ we substitute these their values in this general expression, we shall have B E the radius of curvature required.

Otherwise. Let A R B be the proposed curve, (*fig.* 7.) P the point, or centre, to which its ordinates are referred. N O L the evolute, and R O the ray of curvature at R. Moreover, let P H be perpendicular to R O; and supposing the ordinate P R (y) to become variable by the motion of the point R along the curve, let the fluxions of A R and P H (p), expressing the celerities of the points R and H in directions perpendicular to R O, be denoted by $\dot z$ and $\dot p$ respectively: the fluxions of quantities being always as the celerities by which the quantities themselves increase in magnitude. (See FLUXION).

Therefore the celerities of any two points, in a right line revolving about a centre, being as the distances from that centre, it follows that $\dot p : \dot z$ :: O H : O R; whence by division (putting R H $= v$) we have $\dot z - \dot p : \dot z :: v$ (R H) : R O $= \frac{v\dot z}{\dot z - \dot p} = \frac{vp\dot z}{p\dot z - p\dot p}$, But $p\,\dot z = y\,\dot y$.

and

and therefore $RO = \frac{vy\dot y}{y\dot y - p\dot p}$; which, because $y^2 - p^2$ is $= v^2$ (and therefore $y\dot y - p\dot p = v\dot v$) will also be $= \frac{vy\dot y}{v\dot v} = \frac{y\dot y}{\dot v}$.

E. G. 1. Let the given curve A R (*fig.* 7.) be the logarithmic ſpiral, whoſe nature is ſuch, that the angle P R Q (or R P H) which the ordinate makes with the curve, is every where the ſame.

Then (denoting the ſine of that angle by b, and the radius of the tables by a) we have $RH\ (v) = \frac{by}{a}$, and therefore $RO\ \left(\frac{y\dot y}{\dot v}\right) = \frac{ay\dot y}{b\dot y} = \frac{ay}{b}$; which being to P R ($y$) in the conſtant ratio of a to b, or of P R to R H, the triangles R O P and R P H muſt therefore be ſimilar, and ſo the angle P O H, which the ordinate P O makes with the evolute, being every where equal to P R Q, will likewiſe be invariable. Whence it appears that the evolute is alſo a logarithmic ſpiral, ſimilar to the involute; and that a right line drawn from the centre, perpendicular to the ordinate of any logarithmic ſpiral, will paſs through the centre of curvature.

E. G. 2. To find the radius of curvature at any point B the ſpiral of Archimedes, C B, &c *fig.* 8.

Put the circumference of the generating circle A F, &c. $= a$, and its radius $CA = b$; ordinate $CB = y$, arc $AF = z$. Let Cf be ſuppoſed indefinitely near to C F, that is, let the ∠ F C f be ſuppoſed indefinitely ſmall; and with the ordinate C B as a radius deſcribe the little circular arc B n, which put $= x'$; alſo put $Ff = z'$. Now, by the nature of the curve, $a : b :: z : y$, or $z = \frac{ay}{b}$, the fluxion of which equation is $\dot z = \frac{a\dot y}{b}$; and by the ſimilar ſectors C B n and C F f, $y : x' :: b : z' = \frac{bx'}{y}$, or, $\dot z = \frac{b\dot x}{y}$. Hence, $\frac{a\dot y}{b} = \frac{b\dot x}{y}$; that is, (making $\dot x = 1$) $\frac{a\dot y}{b} = \frac{b}{y}$; from which equation we have $\dot y = \frac{b^2}{ay}$; therefore $\dot y^2 = \frac{b^4}{a^2y^2}$, and $\ddot y = \frac{-ab^2\dot y}{a^2y^2} =$ (by writing for $\dot y^2$ its value), $\frac{-b^4}{a^3y^3}$; and if we ſubſtitute for $\dot y^2$ and $\ddot y$ theſe their values, we ſhall have $\frac{y\times\overline{1+\dot y}\big|^{\frac12}}{1+\dot y^2 - y\dot y}$

$$= \frac{y\times\overline{1+\frac{b^4}{a^2y^2}}\Big|^{\frac32}}{1+\frac{b^2}{a^2y^2}+\frac{b^4}{a^2y^4}} = \frac{\overline{a^2y^2+b^4}\big|^{\frac32}}{a^2y^2+2ab^2} = BE,$$

the radius of curvature ſought.

Conſtruction.—Through the centre C draw the indefinite right line H v perpendicular to the ordinate C B; draw the tangent T B, perpendicular to which draw B H; produce B C to V, making $BR = TH$ and $RV = CH$; with B V and B R as radii, deſcribe the arcs V v and R r; draw the right line v B; and from the interſecting point r draw r E parallel to v H; then will B E be the radius of curvature at the point B: for, $CT = \frac{yz}{b}$, that is, by ſubſtituting $\frac{ay}{b}$ for z, $CT = \frac{ay^2}{b^2}$; and by 8 and 4 E. 6. T C : C B :: C B : C H, that is, $\frac{ay^2}{b^2} : y :: y : \frac{b^2}{a} = CH$; therefore $TH = BR = Br = \frac{ay^2}{b^2} + \frac{b^2}{a}$, and $BV = Bv = \frac{ay^2}{b^2} + \frac{2b^2}{a}$; and by 47 E. 1. $HB = \overline{BC^2 + CH^2}\big|^{\frac12} = \overline{y^2 + \frac{b^4}{a^2}}\big|^{\frac12} = \frac{\overline{a^2y^2+b^4}\big|^{\frac12}}{a}$: again, by 4 E. 6. $Bv : BH :: Br : BE$, that is, $\frac{ay^2}{b^2} + \frac{2b^2}{a} : \frac{\overline{a^2y^2+b^4}\big|^{\frac12}}{a} :: \frac{ay^2}{b^2} + \frac{b^2}{a} : \frac{\overline{a^2y^2+b^4}\big|^{\frac12}}{a} \times \frac{a^2y^2+b^4}{a^2y^2+2b^4} = \frac{\overline{a^2y^2+b^4}\big|^{\frac32}}{a^3y^2+2ab^4} = BE$.

3. To find an equation that ſhall expreſs the nature of the evolute of a given involute curve.

Let B E be the radius of evolution or curvature at any point B in the involute curve A B, *fig.* 9. whoſe abſciſs is $AC = x$, and ordinate $CB = y$. Parallel to H A draw E N; produce B C to L; and equal and parallel to C L, draw D N from the vertex of the evolute D E; then will the triangles B H C and B E L be ſimilar: and therefore, by 4 E. 6. B H : H C :: B E : E L, that is, $\frac{\dot y}{\dot x}\times\overline{\dot x^2+\dot y^2}\big|^{\frac12} : \frac{y\dot y}{\dot x} :: \frac{\overline{\dot x^2+\dot y^2}\big|^{\frac32}}{\dot x\ddot y} : \dot y \times \frac{\dot x^2+\dot y^2}{\dot x\ddot y} = EL$; and H C : C B :: E L : L B, that is, $\frac{y\dot y}{\dot x} : y :: \dot y\times\frac{\dot x^2+\dot y^2}{\dot x\ddot y} : \frac{\dot x^2+\dot y^2}{\ddot y} = LB$. Now, theſe are general expreſſions for E L and L B, when $\dot x$ is conſidered as invariable, and the fluxion of $\dot y$ as negative. Hence, therefore,

If $\dot x = 1$, and the fluxion of $\dot y$ be negative, the general expreſſion for B L will be $= \frac{1+\dot y^2}{\ddot y}$, and this multiplied by $\dot y$ is $\dot y \times \frac{1+\dot y^2}{\ddot y} =$ the general expreſſion for L E. Now, by help of the equation of the given involute curve, exterminate $\dot y$, $\dot y^2$, and $\ddot y$, out of theſe expreſſions, and find the vertical diſtance A D. Then, if we put the abſciſs of the evolute $DN = u$, and its ordinate $NE = v$; by help of theſe two equations, $u = BL - BC$, and $v = AC - AD + LE$, we may get the nature of the evolute curve D E required.

Note.—If the given involute be convex towards its axis, and x and y increaſe together, or the fluxions of x and $\dot y$ be both affirmative, then the general expreſſions for B L and L E will be $\frac{1+\dot y^2}{-\ddot y}$; and $\dot y \times \frac{1+\dot y^2}{-\ddot y}$ reſpectively; wherein the negative ſign ſhews, that the points L and E muſt be taken on the concave ſide of the involute curve, that is, on the other ſide of it with regard to x and y.

E. gr. To find the nature of the curve A E P (*fig.* 10.) by whoſe evolution the cycloid A B D is deſcribed.

Put $AC = x$, $CB = y$, arc $FG = z$, and O D or $OF = a$; then by Ex. 2. art. 1. above, $\dot y = \frac{\overline{2ay-y^2}\big|^{\frac12}}{y}$, $\dot y^2 = \frac{2ay-y^2}{y^2}$, and $\ddot y = \frac{a}{y^2}$; wherefore, $BL =$

1 +

$$\frac{1+\dot{y}^2}{\dot{y}} = \frac{\overline{1+\frac{2ay-y^2}{y^2}} \times y^2}{a} = 2y, \text{ and } LE = \dot{y} \times$$

$BL = \frac{\overline{2ay-y^2}|^{\frac{1}{2}}}{y} \times 2y = 2 . \overline{2ay-y^2}|^{\frac{1}{2}}$. Hence, if we put the abſciſs $AN = u$, and ordinate $NE = v$, we have $u\ (= BL - CB =)\ 2y - y = y$, and $v = (AC + LE =)\ x + 2 . \overline{2ay-y^2}|^{\frac{1}{2}}$ that is, (becauſe $x = z - \overline{2ay-y^2}|^{\frac{1}{2}}$) $v = z + \overline{2ay-y^2}|^{\frac{1}{2}}$, or, (writing u for y its equal,) $v = z + \overline{2au-u^2}|^{\frac{1}{2}}$. Wherefore, the evolute curve A E P is a cycloid, and equal to the given cycloid A B D; for, let $AS = SV = a$, then (A N being $= FI$,) $AT = FG = z$, and $NT = \overline{2au-u^2}|^{\frac{1}{2}} = IG$; and therefore, $AT + TN = z + \overline{2au-u^2}|^{\frac{1}{2}}$, that is, $AT + TN = NE$, which is the property of the cycloid; therefore, the evolute A E P is a cycloid; and becauſe $AV = FD$, therefore the cycloids A E P and A B D are equal. See Cycloid.

The evolute of a ſpiral, or indeed of any other curve, may be deſcribed by finding the radii of curvature at ſeveral points in the involute; for then we ſhall have as many points in the evolute, through which if a curve line be drawn, it will be the evolute ſought.

Wolf. Elem. Math. tom. i. p. 524, ſeq. or the Infinim. Petites of M. le Marquis de l'Hopital. Simpſon's Fluxions, vol. i. p. 71, &c. And Rowe's Fluxions, edit. 3. 1767, chap. vi. and vii. p. 103—132.

Since the radius of an evolute is either equal to an arc of an evolute, or exceeds it by ſome given quantity, all the arcs of evolutes may be rectified geometrically, whoſe radii may be exhibited by geometrical conſtructions; whence we ſee why an arc of a cycloid is double its chord; the radius of the evolute being double the ſame, and the evolute of a cycloid being itſelf a cycloid, equal and ſimilar to the involute.

M. Varignon has applied the doctrine of the radius of the evolute to that of central forces; ſo that having the radius of the evolute of any curve, one may find the value of the central force of a body; which, moving in that curve, is found in the ſame point where that radius terminates; or reciprocally, having the central force given, the radius of evolute may be determined. Hiſt. de l'Acad. Roy. des Sciences, an. 1706.

The variation of curvature of the line deſcribed by the evolution of a curve, is meaſured by the ratio of the radius of curvature of the evolute, to the radius of curvature of the line deſcribed by the evolution. See Maclaurin's Flux. art. 402. prop. 36.

Evolute, *imperfect*. M. Reaumur has given a new kind of evolute, under this denomination. Hitherto the mathematicians had only conſidered the perpendiculars let fall on the points of the convex ſide of the curve; if other lines not perpendicular were drawn upon the ſame points, provided they were all drawn under the ſame angle, the effect would be the ſame; that is, the oblique lines would all interſect within the curve; and by their interſections, form the infinitely ſmall ſide of a new curve, whereof they would be ſo many tangents.

This curve would be a ſort of evolute, and would have its radii; but an imperfect evolute, ſince the radii are not perpendicular to the firſt curve. Hiſt. de l'Acad. &c. an. 1709.

EVOLUTION, in *Geometry*, the unfolding or opening of a curve, and making it deſcribe an evolvent.

EVO

The word *evolutio* is formed of the prepoſition *e*, *out*, and *volvo*, *I roll*, or *wind*; q. d. an *unwinding*, or *unrolling*.

The equable evolution of the periphery of a circle, or other curve, is ſuch a gradual approach of the circumference to rectitude, as that its parts do all concur, and equally evolve, or unbend; ſo that the ſame line becomes ſucceſſively a leſs arc of a reciprocally greater circle, till at laſt they change into a ſtraight line. In the Philoſophical Tranſactions, N° 260, a new quadratrix to the circle is found by this means, being the curve deſcribed by the equable evolution of its periphery.

Evolution, in *Algebra*, is alſo uſed for the extraction of roots out of powers. In which ſenſe it ſtands oppoſed to involution. See Extraction *of roots*.

Evolution, as relating to *Military* operations, muſt be underſtood to be founded on the principles of Tactics (which ſee), and be conſidered indiſpenſably neceſſary to the ſafety, the progreſs, and the ſucceſs of all bodies of men, whether large or ſmall. The term is generally uſed as ſynonymous with manœuvre, but in ſtrictneſs they are by no means to be ſo accounted; for an evolution rather relates to an open, candid, and undiſguiſed movement, made either for a change of poſition, or for the general purpoſes of attack and defence; while a manœuvre applies abſtractedly to deceptious movements, to feints, and to that kind of trick which gives riſe to the ſaying ſo common among us, "I have out-manœuvred him." Thus the French, from whom we have directly borrowed the term, ſay, "un ruſé manœuvre," *i. e.* a cunning fellow; and among them a ſkilful ſeaman is deſignated "un manœuvrier."

In every ſervice, both in the military and naval departments, certain regulations exiſt which direct, that all candidates for promotion ſhould be acquainted, not ſimply with the ſeveral motions of the firelock, and the ordinary duties of individuals, but with a variety of movements to be made by entire battalions, or armies, and by either ſingle ſhips, ſquadrons, diviſions, or fleets reſpectively. It being our intention to amplify under the head of Tactics, *military* and *naval*, we ſhall in this place confine ourſelves to thoſe evolutions which, forming a part of the Britiſh diſcipline, ought to be thoroughly underſtood by every perſon whoſe purſuits tend towards the goal of martial celebrity; and ſhould be thoroughly underſtood by every officer, of whatever rank.

The following nineteen changes will be ſufficient for the purpoſe, under the remark, that we pre-ſuppoſe a battalion to be arranged at cloſe order, and all in readineſs for performing the required evolutions.

Evolution 1.

On a rear diviſion.	Form cloſe column of companies behind grenadiers. Form cloſe column of two companies. Face and march to the right. Deploy on the rear diviſion.	*Explanation.*—The column marches *quick*, 20 or 30 paces to the right, and, without halting, begins to deploy into line on the rear diviſion. The commanding officer of the battalion gives the word, for each diviſion to halt, front.

Evolution 2.

On a front diviſion.	Form cloſe column of companies in front of the left. Form cloſe column of two companies. Face and march to the left. Deploy on the front diviſion.	The column marches *quick*, 30 or 40 paces to the left, and, without halting, begins to deploy on the front diviſion. The commanding officer of the battalion gives the word for each diviſion to halt, front.

Evolution

Evolution 3.

On a central divifion.

Form clofe column of companies on a central company, either flank in front, and facing to the rear.
Countermarch of each divifion in clofe column.
Deploy on any central named company.

The clofe column is formed facing to the rear. It then countermarches each divifion, fo as to return to the proper front. In the central deployment by companies, the company officers give the words refpectively to halt, front.

Evolution 4.

Change of pofition in open column.

Wheel back into open column of companies, the right in front.
March forward 30 or 40 paces.
Enter an oblique line (the three or four leading companies), by wheeling fucceffively to the left, a half-wheel.
Halt.
The rear companies file into column.
Wheel up into line.

The battalion, thus, at an intermediate point, enters an alignment, on which it is to form.

Evolution 5.

Wing thrown back.

The left company is wheeled back till parallel with the original pofition. The reft of the companies wheel into echellon.
March to the rear.
Form on the left company.

The whole companies wheel back at the fame time; the left company twice the number of paces that the others do. Should it be neceffary for the fubfequent movements, the line may retire 50 or 60 paces, and then front.

Evolution 6.

Countermarch, and change of pofition.

Wheel back into open column, the right in front.
Countermarch companies by files.
March in column 30 or 40 paces.
Head divifion halts clofe to the head of column.
Form fquare, and prepare for firing.
Re-form in clofe column.
Open out to open column from the rear, and halt.
Change head of column, by the countermarch of companies, from the rear to the front.
Column moves on and halts.
Wheel up into line.

After the countermarch by files, the column ftands with its left in front. The column clofes in quick time. The fquare is formed, and clofe column re-formed. The column opens out in quick time from its rear divifion, and halts. The countermarch by companies, from the rear to the front, is in ordinary time. When the line is formed, it is then confiderably to the reviewing general's right, and with its rear to him.

Evolution 7.

Countermarch by files on the centre of the battalion.

This brings back the battalion to its original front.

Evolution 8.

March in open column.

Form open column behind the left company, which is put in march when the third company has taken its place in column.
The right fub-divifions double.
The column halts, and pivots are corrected.
Wheel up into line.

The companies that are filing incline towards the head of the column; fucceffively front at their wheeling diftances, afcertained as ufual by their ferjeants; take up the ordinary ftep, and follow in open column. When the column is marching fteadily, the whole fub-divifions double at once, at one command, and again move up at another.

Evolution 9.

Echellon change of pofition.

Wheel back into open column, the left in front.
The third company is wheeled back, the 8th of a circle, and each of the others 3-16ths of the circle.
Form line on the third company by the echellon-march.

The line is thus formed oblique, from open column, on a central company, by the echellon-march.

Evolution 10.

Change of pofition.

The left company is wheeled up the 8th of a circle, and each of the others 1-16th.
Form line by the echellon-march.

The line thus changes pofition to the front, on the left company, by the echellon-march.

Evolution 11.

Change of pofition.

The battalion faces to the right.
March in file 50 or 60 paces.
Halts.
Wheels up into line, except the light company, which files quickly to the right, and forms behind the colours.

The column of companies is formed by the rear men of each moving up quickly to the left of their leaders, and of each other: the officers move to pivot flanks, and pivots are inftantly corrected. The column halts when the colours are oppofite to the general.

Evolution 12.

Retreat in line.

The battalion retires (50 paces).
Halts; fronts.
Fire twice by companies from centre to flanks.
Retire by alternate companies in two lines (250 paces, each retreat about 50 paces.)
Form line.
Retire in line (50 paces).
Halt; front.

The light company, being previoufly fubdivided and prepared, acts in the retreat by alternate companies, filling up, or at leaft occupying the intervals in the firft line, and retiring with it to the fecond, in which it continues to fet in like manner, and thus alternately. When the line halts, and fronts, it refumes its place on the left.

Evolution 13.

March to flank in echellon.

Companies make a half wheel to the right.
March in echellon, (250 paces.)
Wheel back on the march into parallel line.
Forward (100 paces.)
Halt.
Fire thrice by companies, from flanks to centre.

At the word "wheel back into line," the pivot flanks mark time, and the divisions wheel back in ordinary time. At the proper instant, when the battalion is formed, the commander gives the word "Forward," for the whole to advance by the colours, and to correct any irregularity there may be in the battalion.

[Hitherto the battalion may have been *two* deep, but if its companies can muster ten files each, the corps may now be formed *three* deep.]

Evolution 14.

Movements in the square.

Form square.
March the square by the left.
Angle of the front face (50 paces.)
Halt; form square.
March square by the left face.
Halt; form square.
March square by the rear face.
Halt; form square.
Fire in square by companies.
Form the line.

The square is formed by the echellon march of companies. After the march by the left face, the square is formed when opposite the general. The line is formed by the echellon wheel-up, and march of companies. When the order is given to form line, the light company marches quickly, and places itself two deep, and in two divisions, ten or twelve paces behind the two centre companies.

Evolution 15.

Retiring, and filing to the rear.

Retire in line (100 paces.)
File by companies from the proper right.
Halt in open column, the right in front.
Wheel up into line.

When the line has passed the light company twenty paces, that company extends to cover the centre of the battalion, and follows at 50 or 60 paces distance; and when the column halts to form, the light company passes quickly through and beyond it. The companies file quickly to the rear.

The battalion forms line at the extremity of its ground; the light company 30 paces in its rear.

Evolution 16.

Filing, advancing, and charging to the front.

Advance in line (50 paces.)
File from the right of companies to the front (50 paces.)
Halt in open column, the left in front.
Wheel up into line.
Advance in line (50 paces.)
Advance by alternate half battalions, and fire four times.

Before the line advances, the light company quickly forms, extended 30 paces before the centre, and preserves that distance in advancing. When the column halts to form, the light company passes quickly to the rear, and assembles half of it behind each flank, then moves relatively with the flank-companies, till after the charge of bayonets. The alternate half-battalions fire, the two first ranks standing.

Evolution 17.

Charge and pursuit.

Form line. Advance (50 paces.)
Fire volley. Advance (50 paces.)
Fire volley. Charge bayonets (50 paces.)
Halt. Load.

After the volley, bayonets are ported; the battalion advances firm by the centre at the quick step, and at the word "Halt," the front rank comes down to the charging position. The word "Prime and Load" is then given, and the light company, issuing from behind the flanks, pursue, return, and assemble, and join on the left of the battalion.

Evolution 18.

Retiring in line.

Retire in line (100 paces.)
Retire by alternate half battalions.
Fire four times.
Retire in line (100 paces, or more.)
Halt. Front.

The whole battalion being assembled, the alternate half-battalions fire, the two front ranks standing.

Evolution 19.

Advance in line and salute.

Advance in line (100 paces.)
Halt.
Fire two vollies.
Port arms at the last one, and half cock.
Open ranks.
Advance within 50 paces of reviewing general.
Halt.
General salute.

In the vollies the front rank kneels.

The music may occasionally play, and the drums roll, as the line advances.

The music will play while advancing at open ranks.

We have selected this portion of the discipline ordered for the British army, because it comprizes sufficient changes to give our readers a correct idea of what are termed *evolutions*. These are so contrived as to be performed on a very moderate extent of ground; each evolution serving to correct any obliquity, or lateral change of position, and confining the regiment within certain limits.

It may be proper to remark, that though the foregoing relate in this instance to a single regiment under review, the whole of the charges may be considered as representing those made by a large army; the several companies being the representatives of regiments, or of larger bodies. See BATTALION.

Fa. Hoste, a Jesuit, in 1697, printed a Treatise on Naval Evolutions, in folio. By naval evolutions he means the motions made by a fleet, squadron, or naval armament, in order to put themselves in a proper disposition for attacking the enemy, or defending themselves with the most advantage. See TACTICS.

EVOLVULUS, in *Botany*, from *evolvo*, *to roll out or unfold*, in opposition to *Convolvulus*, with which the present genus agrees in habit, except in not having a convoluted stem. Linn. Gen. 152. Schreb. 204. Willd. Sp. Pl. v. 1. 1516. Juss. 134. Class and order, *Pentandria Tetragynia*. Nat. Ord. *Campanaceæ*, Linn. *Convolvuli*, Juss.

Gen. Ch. *Cal.* Perianth inferior, of five lanceolate, acute, permanent segments. *Cor.* of one petal, regular, wheel-shaped, plaited, slightly five-cleft. *Stam.* Filaments five, capillary, spreading, almost as long as the corolla; anthers rather oblong. *Pist.* Germen superior, nearly globular; styles four, capillary, spreading, the length of the stamens; stigmas simple fimple. *Peric.* Capfule nearly globular, of four cells and four valves. *Seeds* folitary, roundifh, angular on the inner fide.

Eff. Ch. Calyx of five leaves. Corolla five-cleft, wheel-fhaped. Capfule fuperior, of four cells. Seeds folitary.

Willdenow has feven fpecies, five of which were known to Linnæus. Among the latter is *E. linifolius*, Linn. Sp. Pl. 392. (Convolvulus linifolius; Am. Acad. v. 4. 306. Syft. Nat. ed. 10. v. 2. 923. Brown. Jam. t. 10. f. 2.) whence he informs us he derived the above generic character, having the plant alive under his own infpection. It is a fmall inconfpicuous annual, with flender, ftraight, fpreading ftems; narrow, lanceolate, hairy leaves; and little, blue, axillary flowers; native of low ground in Jamaica.

The other fpecies have rounder leaves, but otherwife agree very much with the above. They grow in the Eaft or Weft Indies, and are annuals of humble growth, and no confpicuous attractions, being inferior in beauty to the meaneft fpecies of *Convolvulus*.

E. *tridendatus*, Linn. Sp. Pl. 392, is now returned to *Convolvulus*, fee that genus, fp. 19.

EUONYMUS, ευωνυμον of Theophraftus, fo called by antiphrafis, from ευωνυμος, *having a good name*, becaufe the plant was *infamous* for its ftrong fœtid fmell, and its poifonous quality to cattle. Spindle-tree. Linn. Gen. 107. Schreb. 148. Willd. Sp. Pl. v. 1. 1130. Juff. 377. Gærtn. t. 113. Clafs and order, *Pentandria Monogynia*. Nat. Ord. *Dumofæ*, Linn. *Rhamni*, Juff.

Gen. Ch. *Cal.* Perianth inferior, flat, in four or five deep, equal, roundifh, concave fegments. *Cor.* Petals four or five, ovate-oblong, flat, fpreading, longer than the calyx. *Stam.* Filaments four or five, awl-fhaped, erect, fhorter than the petals, inferted, alternately with them, into a glandular receptacle; anthers two-lobed. *Pift.* Germen fuperior, pointed; ftyle fhort, fimple; ftigma obtufe. *Peric. Capfule* fucculent, coloured, depreffed, with four or five angles, and as many cells and valves. *Seeds* folitary, ovate, each wrapped up in a pulpy arillus.

Eff. Ch. Calyx flat. Petals five. Capfule fuperior, five-fided, coloured, of five cells and five valves. Seeds in a pulpy covering.

A genus of extra-tropical fhrubs, the produce of Europe, North America and Japan. Willdenow has feven fpecies. They are deftitute of hairinefs, and have oppofite branches and leaves; the latter fimple, deciduous, more or lefs elliptical, entire or toothed, with fcarcely any ftipulas. Flowers of a dull or greenifh hue, in axillary forked panicles, not ornamental. Fruit much more confpicuous and often very beautiful, on account of the pink, waxy hue of the capfule, varying occafionally to white, and orange coverings of the feeds.

E. Tobira. Thunb. Jap. 99. (Tobira; Kæmpf. Am. Exot. 796, cum ic.), a native of Japan, has terminal flowers, and in many other refpects feems not perfectly to accord with this genus.

E. europæus. Sm. Fl. Brit. 262. Engl. Bot. t. 362; and *E. verrucofus*, Jacq. Auftr. t. 49; alfo *E. latifolius*, Jacq. Auftr. t. 289; are good examples of it. Linnæus confounded them together as varieties, but Scopoli, and afterwards Jacquin, have well diftinguifhed them. The laft fpecies in particular is very remarkable for its warty branches, flender habit, reddifh flowers, and fmall pale capfules, out of which the black feeds, partially clothed with their fcarlet arillus, hang by flender threads. The wood of all of them is tough, and ufed for fkewers and fpindles. It fhould be cut in the fummer. The fruit ferves in many places to decorate churches and ruftic kitchens at Chriftmas-time. It is reported to be dangeroufly emetic and purgative.

Euonymus, in *Gardening*, comprehends plants of the hardy flowering fhrubby kind, of which the fpecies cultivated are, the common fpindle-tree (*E. europæus*); the warted fpindle-tree (*E. verrucofus*); the purple-flowered fpindle-tree (*E. atropurpureus*); the ever-green fpindle-tree (*E. americanus*); and the broad-leaved fpindle-tree (*E. latifolius.*)

The evergreen fort of fpindle tree has a variety with variegated leaves.

Method of Culture.—All the four more common forts may be propagated either by feeds, layers, or cuttings of the young fhoots; but the evergreen kind requires a different method.

In the firft mode, the feeds fhould be fown in the clumps or borders in the early autumn, covering them well in. In the following autumn the plants fhould be removed, and fet out in nurfery rows, being kept well cleared from weeds during the fummer. After two or three years growth in this fituation, they will be fit to plant out for good, in proper fituations.

With refpect to the young fhoots, they may be laid down in the autumn, a flit being made at the joint placed the deepeft in the ground. In the following autumn they will be well rooted, and may be taken off and planted out in the manner of the feedling plants.

The cuttings fhould be made eight or ten inches in length, and planted in a fhady border in the autumn. When they have ftruck full root, they fhould be carefully removed, and managed as thofe raifed from the feed.

But the two laft methods, and thofe of budding and grafting, are the only ones by which the green variety can be continued with certainty and fuccefs.

With regard to the laft fpecies, it is beft increafed by laying down the young branches after being tongued in the autumn, managing them afterwards in the fame manner as the others.

Thefe plants are fufficiently hardy to bear the open air, when planted in warm fheltered fituations.

They are all very ornamental plants; the four common forts producing a fine effect by their berry-like feeds, and the laft fort but one by its evergreen leaves; the chief objection to the former kinds being their great aptitude to have their leaves compleatly eaten up by the caterpillars foon after they are fully expanded.

EVORA, or Elvora, anciently *Ebora*, in *Geography*, an ancient, walled and fortified, large but not populous, city of Portugal, the capital of the province of Alentejo, and an archbifhop's fee, fituated on a gentle eminence in a fruitful plain, furrounded by hills, near the centre of the province; 65 miles E. Lifbon. The ftreets are narrow, crooked, and full of angles. It has no trade or manufactures; but contains five parifh churches, twenty-three religious houfes, and about twelve thoufand inhabitants. The cathedral and other buildings are high and in the Gothic ftyle. This city is faid to have been founded by the Phœnicians, and walled round by Sertorius, who fupplied the town with water by means of a beautiful aqueduct, (fince entirely rebuilt by John III.,) and who, after having refided there for a confiderable time, was buried, as tradition reports, in this place. Julius Cæfar conftituted it a municipium, and named it Liberalitas Julia. It was taken by the Moors in the year 715, and retaken by the Chriftians under Giraldo, whofe heroic conduct is celebrated by Camoens in his Lufiad, in 1166, and then reduced under the dominion of Alphonfo Henriques. In 1540 it was erected into

into an archiepiscopal see by pope Paul III.; and the first prelate founded an university, now fallen into decay. In this city are the remains of a temple of Diana, 7 pillars of which are standing, of the Corinthian order, connected by a plaster-wall. This edifice, at first a pagan place of worship, was converted into a Moorish mosque, and is now the butchers shambles. There are many other Roman vestiges, inscriptions, &c. particularly in the great square, which indicate the antiquity of this place. Its fortifications are 12 bastions, and two demi-bastions, and a castle in ruins. On the north side of Evora the hills rise, being round the town adorned with gardens, and on their summits with evergreen oaks. The road from hence to Montemor o novo, which lies at the distance of five leagues, passes over granite hills, partly covered with corn fields, and partly with fine woody or evergreen oaks and pastures. N. lat. 38° 30'. W. long. 7° 42'.

EVORAMONTE, a town of Portugal, in the province of Alentejo, seated on a rock, and containing about 800 inhabitants; 15 miles N.E. of Evora. N. lat. 38° 42'. W. long. 7° 31'.

EVORIA, a town of European Turkey in Livadia; 24 miles N. of Lepanto.

EUOSMA, in *Botany*, from ευοσμος, *sweet-smelling*, because the flowers have the scent of hawthorn-blossoms. Jackson in Andr. Repos. t. 520. Class and Order, *Pentandria Monogynia*. Nat. Ord. *Rotaceæ*, Linn. *Gentianæ*, Juss.

Gen. Ch. *Cal.* Perianth inferior, in five deep, obovate, concave, equal, permanent segments. *Cor.* of one petal, bell-shaped; tube dilated, as long as the calyx, pervious; limb in five broad, short, obtuse, spreading lobes. *Stam.* Filaments five, awl-shaped, shorter than the tube, inserted into its lower part, alternate with the lobes of the limb; anthers incumbent, roundish, compressed. *Pist.* Germen superior, oval, two lobed; style very short and thick; stigma capitate, four-lobed, on a level with the anthers. *Peric.* Capsule ovate, pointed, with a longitudinal furrow on each side, swelling irregularly from the projection of the seeds, of two valves, whose inflexed edges divide it into two cells; receptacles one in each cell, linear, triangular, parallel to the valves and close to the partitions. *Seeds* five or six in each cell, in two rows, oval, flattened on the inner side, all over rough with minute tubercles.

Eff. Ch. Calyx deeply five-cleft. Corolla bell-shaped, with a five-cleft border. Stigma four-lobed. Capsule superior, with two furrows and two cells, bursting at the top. *Seeds* several, oval, rough, affixed to a triangular receptacle.

1. *E. albiflora*. Andr. Repos. t. 520. Native of New South Wales, in the country near Port Jackson, from whence specimens and seeds were long ago sent by Dr. White. It is said to bear our winters in the open ground, flowering in April. *Stem* shrubby, with numerous, opposite, slender, square, leafy, slightly downy branches. *Leaves* opposite, on short stalks, lanceolate, acute, entire, smooth; shining and deep green above; paler, opaque, and somewhat glaucous beneath. *Stipulas* small, bristle-shaped, in pairs at the base of each footstalk, somewhat hairy. *Flowers* in dense, axillary, bracteated panicles, much shorter than the leaves; snow-white, small, but copious, and very fragrant. *Capsules* about a quarter of an inch long, obtuse, rugged, tipped with the short permanent style.

The characters above given will, we believe, distinguish this genus from *Exacum*, to which it is most allied of any in the same natural order. See EXACUM.

EVOVÆ, a barbarous word, says Rousseau, formed of the six vowels, which begin the syllables of the words *seculorum amen*, and which is only used in canto fermo. It is from the letters of this word that the tone is found in the psalms and antiphonaria of the Roman catholic church, and the notes by which the verses of the psalms and canticles must be terminated.

The evovæ always begins by the dominant of the mode and ends upon the final.

EVOUTS, in *Geography*, a small island in the Southern Pacific ocean; 15 miles S. from Terra del Fuego. S. lat. 55° 33'. W. long. 67° 36'.

EUPAREA, in *Botany*, ευπαρεια, *having beautiful cheeks*, in allusion probably to the scarlet colour of the flowers, said to resemble *Anagallis arvensis*. Gærtn. v. 1. 230. t. 50. Schreb. 156. Willd. Sp. Pl. v. 1. 1183. Mart. Mill. Dict. v. 2. Class and order, *Pentandria Monogynia*. Nat. Ord. *Lysimachiæ*, Juss.

Gen. Ch. *Cal.* Perianth inferior, of five lanceolate, acute leaves. *Cor.* Petals from five to twelve, lanceolate, spreading, longer than the calyx. *Stam.* Filaments five; anthers. *Pist.* Germen roundish, superior; style bristle-shaped, long; stigma simple. *Peric.* Berry dry, globose, crowned with the permanent style, of one cell. *Seeds* numerous, roundish, small, affixed to a globose, fungous, central receptacle.

Eff. Ch. Calyx of five leaves. Petals from five to twelve. Berry superior, dry, of one cell, with many seeds. Receptacle globose.

E. *amœna* is the only known species, gathered in New Holland by sir Joseph Banks and Dr. Solander. Gærtner describes it as a procumbent plant, resembling *Lysimachia nummularia*, but about one-fourth its size. Flowers of the colour of the Scarlet Pimpernel. He adds that "the seed-vessel, which-ever way pressed, would not open by regular valves, so that it is very nearly allied to *Trientalis*." Indeed his figures betray the very close affinity, even the identity of these two genera, except that one is described as polypetalous, the other monopetalous, and that the stamens of *Euparea* are not said to equal the petals in number, when the latter are more than five.

EUPATORIA, formerly KOSLOF, or *Gosleve*, in *Geography*, a town and district of Russia, in the province of Taurida or Crim Tartary, near the Black sea. N. lat. 45° 40'. E. long. 33° 14'.

EUPATORIA, or *Pompeiopolis*, in *Ancient Geography*, *Akmetschid*, a town in the N.W. part of the Tauris Chersonesus.

EUPATORIA, *Amid*, a town of the kingdom of Pontus, situated in the gulf of Amisa, and contiguous to a town of the same name. Mithridates Eupator is said to have built it, and to have given it his name.

EUPATORIUM, in *Botany*, ευπατωριον of Dioscorides, from Mithridates, surnamed Eupator, who is reported to have brought this plant into use as a counter-poison. Linn. Gen. 413. Schreb. 546. Willd. Sp. Pl. v. 3. 1748. Sm. Fl. Brit. 859. Mart. Mill. Dict. v. 2. Juss. 178. Gærtn. t. 166. Class and order, *Syngenesia Polygamia-æqualis*. Nat. Ord. *Compositæ discoideæ*, Linn. *Corymbiferæ*, Juss.

Gen. Ch. *Common Calyx* oblong, imbricated; scales linear-lanceolate, erect, unequal, unarmed. *Cor.* compound, uniform, discoid; florets all uniform, perfect, fertile, monopetalous, funnel-shaped, with a regular, five cleft, spreading border. *Stam.* Filaments five, capillary, very short; anthers united into a cylindrical tube. *Pist.* Germen minute; style thread-shaped, very long, cloven down as far as the top of the anthers, straight; stigmas slender, bluntish,

 straight.

ſtraight. *Peric.* none, except the permanent calyx. *Seeds* ſolitary, oblong, angular; down long, rough, or feathery. *Recept.* naked.

Eff. Ch. Receptacle naked. Down rough or feathery. Calyx imbricated, oblong. Style prominent, cloven half way down, divaricated.

A large genus, chiefly, though not entirely, American. The *roots* are perennial. *Stem* ſometimes ſhrubby. *Leaves* oppoſite, moſtly ſimple, and ſtrongly ſerrated. *Flowers* corymboſe, terminal, numerous, white, bluciſh, or reddiſh. Whole plant, roughiſh, bitter, or aromatic. Willdenow has 71 ſpecies.

E. *cannabinum*, Engl. Bot. t. 428, ſingular for having fingered leaves, which indeed are ſometimes found undivided, is the only Britiſh ſpecies. It grows in watery places about the banks of rivers, or in mountainous boggy thickets, where it with us ſupplies the place of the Swiſs *Cacalia alpina*, which its pink flowers ſomewhat reſemble.

Several of the American ſpecies are eſteemed in that country, on account of their aromatic and tonic qualities, and known by the name of Fever root, or Fever weed. Among theſe, we believe, are E. *ſeſſilifolium*, *perfoliatum*, and *aromaticum*, but we want further information on this ſubject.

E. *Aya-pana*, Venten. Jard. de la Malmaiſon, t. 3. a native of the banks of the river of the Amazons, is ſaid to be "an excellent ſudorific and alexipharmic;" partaking therefore, no doubt, of the virtues of the above-mentioned ſpecies. Its *leaves* are lanceolate, nearly entire, and not accurately oppoſite. The *flowers* are purpliſh.

E. *zeylanicum*, Linn. Sp. Pl. 1172, has decidedly alternate leaves, ſo as to have raiſed a doubt in the mind of Linnæus whether it could belong to this genus; yet its fructification ſeems altogether like the generality of the ſpecies.

EUPEGIUM, in *Ancient Geography*, a town of Greece, in the Peloponneſus.

EUPEN, or Oepen, in *Geography*, a town of France, in the department of the Ourthe, and chief place of a canton in the diſtrict of Malmedy; 4 miles E.N.E. of Limburg. The place contains 6,749, and the canton 12,616 inhabitants, on a territorial extent of 102½ kiliometres and ſeven communes. Here is a conſiderable manufacture of cloth.

EUPETALOS, in *Natural Hiſtory*, the name of a gem deſcribed by the ancients as famous for its variety of colours. Pliny, lib. xxxii. cap. 10. tells us, that it ſhewed at once blue, fire-colour, red-lead colour, and yellow. It ſeems to have been the opal, and that Pliny's deſcription of it in this place was taken from ſome author he did not perfectly underſtand, as is the caſe in many of his accounts from the Greeks.

EUPHASEE, in *Geography*, the ancient name of Hiwaſſee river in Teneſſee, N. America; alſo the name of an Indian town on its S.W. bank, 28 miles from its mouth. See Hiwassee.

EUPHEMISMUS, Ευφημισμος, of ευ, *well*, and φημι, *I ſpeak*, in *Rhetoric*, a figure which expreſſes things in themſelves diſagreeable and ſhocking, by terms implying the contrary quality; that is, the Pontus, or Black ſea, having the epithet of αξενος, (i. e. *inhoſpitable*) given it on account of the ſavage cruelty of thoſe who inhabited the neighbouring countries; this name, by euphemiſm, was changed into that of Euxinus. Thus Ovid. Triſt. lib. iii. eleg. 13.

"Dum me terrarum pars pene noviſſima Ponti
Euxinus falſo nomine dictus habet."

In which ſenſe it only makes a ſpecies of irony. But every euphemiſm is not irony; for we ſometimes uſe improper and ſoft terms in the ſame ſenſe with the proper and harſh. See Voſſ. Rhet. lib. iv. cap. 186, ſeq.

EUPHEMIUS, in *Biography*, ſucceeded to the high dignity of patriarch of Conſtantinople in the year 490. He was zealouſly attached to the doctrines of the Catholic church, of which he gave proof by ſtriking out from the liſts of perſons in communion with the church, the name of Peter Mongus, patriarch of Alexandria, becauſe that prelate had pronounced an anathema againſt the council of Chalcedon. This circumſtance produced a violent ſchiſm between the two patriarchs, who convened their reſpective ſynods, in which they mutually procured excommunications of each other to be iſſued. In the year 491, on the death of Zeno, when Anaſtaſius was taking meaſures to ſecure the imperial throne, Euphemius warmly oppoſed him, on account of his known Arian principles, and when he found his oppoſition fruitleſs, he refuſed to crown the new emperor till he had delivered to him a written confeſſion of orthodox faith, and engaged under his hand, and by the ſanctity of an oath, to maintain the principles of the Catholic doctrine, as eſtabliſhed by the council of Chalcedon. In the year 493, Theodoric, having become maſter of Italy, ſent ambaſſadors to Anaſtaſius to treat for peace, to which Euphemius was thought to be the chief obſtacle. In a ſhort time afterwards Anaſtaſius having confidentially informed the patriarch of his deſire to terminate in an honourable manner the war in which he was engaged with the Iſaurians, Euphemius betrayed his ſecret to the patrician John, the father-in-law of Athenodorus, one of the chiefs of the Iſaurians. The emperor was made acquainted with the patriarch's conduct, and laid the caſe before an aſſembly of biſhops, who were convened at Conſtantinople in the year 495, and by his influence with them, obtained a decree that Euphemius ſhould be depoſed, and cut off from the communion of the church. He afterwards obtained a ſentence of baniſhment againſt Euphemius, who died at Ancyra in the year 515. Moreri.

EUPHON, in *Acouſtics*, a muſical inſtrument lately contrived by Dr. Chladni of Wittemberg, who, in conſequence of a variety of experiments on the longitudinal vibrations of claſtic bodies, conſtructed this inſtrument, ſo called from its pleaſant ſound, which conſiſts of glaſs tubes diſpoſed in a proper frame, and expreſſing their ſounds by being rubbed longitudinally. The euphon has ſome reſemblance to a ſmall writing deſk. When opened, the glaſs tubes, of the thickneſs of the barrel of a quill, and about 16 inches long, are ſeen in an horizontal poſition. They are wetted with water by a ſponge, and ſtroked with the wet fingers in the direction of their length, ſo that the increaſe of the tone depends merely on the ſtronger or weaker preſſure, and the ſlower or quicker movement of the fingers. The number of tubes is 42. In the back part there is a perpendicular ſounding-board divided in the middle, through which the tubes paſs. From this conſtruction it appears, that the euphon ſhould not be conſidered as an altered or improved harmonica, (See Armonica), but as a totally new and different inſtrument. In regard to ſweetneſs of ſound, it approaches very near to the harmonica; but it poſſeſſes ſeveral advantages, peculiar to itſelf. It is ſimpler, with regard both to its conſtruction and the movement neceſſary for producing the ſound, as neither tuning nor ſtamping is required, but merely the movement of the finger. It produces its ſound more ſpeedily; ſo that as ſoon as it is touched you may have the tone as full as the inſtrument is capable of rendering it; whereas in the harmonica, the tones, particularly the lower ones, muſt be made to increaſe gradually.

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It has alſo greater diſtinctneſs in quick paſſages, becauſe the tones do not reſound ſo long as in the harmonica, where the ſound of one low tone is often heard when you wiſh only to hear the following tone. The uniſon is purer than is generally the caſe in the harmonica, where it is difficult to have perfect glaſſes, which in every part give like tones with mathematical exactneſs. It is however as difficult to be tuned as the harmonica. It does not affect the nerves of the performer; for a perſon ſcarcely feels a weak agitation in the fingers; whereas in the harmonica, particularly in concords of the lower notes, the agitation extends to the arms and even through the whole body of the performer. This inſtrument is leſs expenſive than the harmonica; when one of the tubes breaks, or any other part is deranged, it can ſoon be repaired, and at very little expence: whereas, when one of the glaſſes of the harmonica breaks, it requires much time and is very difficult to procure another capable of giving the ſame tone as the former, and which will correſpond ſufficiently with the ſeries of the reſt. For an account of the experiments that led the author to the conſtruction of this inſtrument, and of the various ſtages of his progreſs in the improvement of it, we refer to the Philoſophical Magazine, vol. ii. p. 391, &c.

EUPHONIC Accent. See Accent.

EUPHONY, in *Elocution* and *Compoſition*, that ſweet or pleaſing quality in the ſucceſſive ſounds of language, which reſults from happy combinations of the enunciative elements, ſuch eſpecially as, though eſſentially different in their characteriſtic powers, melt eaſily into each other ſo as to preſerve an uninterrupted flow of utterance through the reſpective members of a ſentence, without labour to the ſpeaker, or offence to the hearer. The word is formed of ευ, *bene*, *well*, and φωνη, *vox*, *voice*. Quintilian calls *euphonia*, *vocalitas*; Scaliger, *facilis pronunciatio*. The moſt obvious rule with reſpect to euphonic compoſition is that a due mixture ſhould be made of conſonants and vowels; and the principle of this rule may be at once explained and illuſtrated by the following parody on a famous but ſophiſtical couplet in Pope's Eſſay on Criticiſm,

> "Your conſonants with vowels well combine,
> And twelve ſmall words may flow in one ſmooth line."

But this is not all that is requiſite for perfect euphony: every vowel does not blend with equal grace and facility with every conſonant; nor is every ſucceſſion of mere vowels, or every ſucceſſion of conſonants, equally offenſive or cacophonous. Words or ſyllables, for example, terminating with thin vowels, may be followed by other words or ſyllables, commencing with broad or open vowels, or the reverſe, with very happy effect; and ſome conſonants may be brought together, in immediate ſucceſſion, even as terminative and initial elements of following ſyllables or words, in ſuch way as rather (while they increaſe the ſonorous energy of ſuch compoſition,) to diverſify the time and expreſſion, than to diſturb the euphony of the ſentence. All the liquids eſpecially (thoſe that properly ought to be, as well as thoſe that commonly are ſo called) combine with almoſt equal facility with other liquids, and with vowels or with the conſonants, whether ſemi-liquids, ſibilants, or mutes. (See Liquid, Mute, &c.) Which of theſe, and under what circumſtances, may be thus brought together, with the happieſt effect of euphony and expreſſion, it would require a much longer diſcuſſion than we have ſpace for, to aſcertain; and, after all, much muſt be left to the taſte, the ear, and the experimental diſcrimination of the writer. But it is not upon the writer alone, that the effect of euphony depends. The reader or reciter muſt alſo do his part, for though it is very poſſible ſo to write, that no organs, and no management of thoſe organs, can elicit in the delivery, any thing but the diſſonance of cacophony; there are ſome pedants who contrive to render even the ſmootheſt compoſitions harſh and cacophonous, and then aſcribe to their native language, (of the very elements and genius of whoſe oral compoſition they are utterly ignorant,) the diſguſting diſſonance which does, in reality, belong to their own jargonized utterance. Euphony in the reader or ſpeaker depends principally upon his ſkill and management in the articulation and implication of the ſucceſſive elements, ſyllables, and words as explained under the term Enunciation; and upon his giving full tune, and ſufficient quantity to the liquids and liquifiable conſonants. Cacophony (the antagoniſt of Euphony) on the contrary, reſults in the reader, from the laboured ſeparation of terminatives and initials, that might eaſily have been implicated; from giving unneceſſary impulſe and force to the mutes, from hurrying over the liquids, and partially tuneable elements, as if they were mere mutes, and from perpetual unneceſſary interruptions in the ſtream of enunciative delivery.

EUPHORBIA, in *Botany*, ευφορβιον of Dioſcorides, ſo named after Euphorbus, phyſician to Juba king of Lybia. Spurge. Linn. Gen. 243. Schreb. 326. Willd. Sp. Pl. v. 2. 881. Sm. Fl. Brit. 513. Mart. Mill. Dict. v. 2. Juſſ. 385. Claſs and order, *Dodecandria Trigynia*. Nat. Ord. *Tricoccæ*, Linn. *Euphorbiæ*, Juſſ.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, inflated, ſomewhat coloured, with four, in ſome few inſtances five, marginal teeth, permanent. *Cor.* Petals, or Nectaries, four, ſometimes five, turbinate, gibbous, thick, abrupt, unequal in ſituation, alternate with the teeth of the calyx, inſerted into its margin by their claws, permanent, bearing plenty of honey. *Stam.* Filaments numerous, 12 or more, thread-ſhaped, jointed, longer than the corolla, inſerted into the receptacle, coming to maturity at different periods, ſeparated by briſtly ſcales; anthers roundiſh, of two diſtinct lobes. *Piſt.* Germen ſuperior, roundiſh, three-ſided, elevated on a ſtalk above the margin of the calyx; ſtyles three, cloven; ſtigmas obtuſe. *Peric.* Capſule ſtalked, roundiſh, three-lobed, of three cells, and three valves which ſeparate elaſtically. *Seeds* ſolitary, roundiſh.

Obſ. The petals or nectaries are for the moſt part four, in ſome flowers five, which often happens on the ſame plant, ſuch flowers being furniſhed with ſtamens only, without a piſtil, and coming forth earlier than the reſt. In many the petals are glandular, in others creſcent-ſhaped, or toothed; in ſome few thin and membranous; they are commonly ſituated as it were on the outſide of the calyx. The capſule is either ſmooth, or hairy, or warty.

Eſſ. Ch. Calyx of one leaf, inflated, inferior. Nectaries four or five, inſerted into the calyx. Capſule ſtalked, three-lobed.

A vaſt, but very natural, genus, whoſe ſpecies amount in Willdenow's work to 124. They are divided into ſeveral ſections. All abound with an acrid milk.

Thoſe of the firſt ſection have a very peculiar thick, ſhrubby, fleſhy, angular ſtem, armed with ſpines, and bearing few or no leaves. To this belongs *E. officinarum*, probably the original ſpecies. See its figure in Commelin's Hort. Amſt. v. 1. t. 11. Alſo *E. antiquorum*, ib. t. 12, an Eaſt Indian plant, which ſeems very improperly named, as neither agreeing with the deſcriptions of the ancients, nor growing in the country whence they procured their ευφορβιον.

The ſecond ſection has ſhrubby ſtems without thorns, neither forked nor umbelliferous. As *E. Caput Meduſæ*, Comm. Hort. t. 17, common in Green-houfes; and *E. petiolaris*, Curt. Mag. t. 883.

The third has forked ftems, not umbelliferous, and the plants are moftly herbaceous and annual, as *E. picta*, Jacq. Ic. Rar. t. 477, and *pilulifera*, t. 478; alfo *E. Peplis*, Engl. Bot. t. 2002, common on the fea fhores of the fouth of Europe.

The fourth has the flowers in an umbel, three-branched in the firft inftance, and the branches fubfequently forked repeatedly, each fubdivifion of the inflorefcence accompanied by a pair of heart-fhaped, unequal-fided, fomewhat coloured bracteas, as our common weed *E. Peplus*, Curt. Lond. fafc. 1. t. 35. Engl. Bot. t. 959.

The fifth has a four-branched umbel, as the great *E. Lathyris* of the gardens, commonly called the Caper tree, remarkable for its long, dark, four-rowed leaves. There are but few fpecies in this fection.

The fixth, a numerous fection, has a five-branched umbel, like the common *E. heliofcopia*, Curt. Lond. fafc. 1. t. 36. Engl. Bot. t. 883; and the rare and fplendid *E. punicea*, Sm. Ic. Pict. t. 3, a fhrubby Jamaica plant, of which a moft miferable fpecimen is drawn in Jacq. Ic. Rar. t. 484.

The feventh and laft fection confifts of fuch fpecies as have numerous rays to the common umbel, like *E. Cypariffias*, Engl. Bot. t. 840, frequent in gardens, and *amygdaloides*, t. 256, very common in woods.

EUPHORBIA, in *Gardening*, comprehends plants of the herbaceous, fhrubby, fucculent kinds, the principal cultivated fpecies of which are; the triangular fpurge (E. antiquorum); the Canary fpurge (E. canarienfis); the officinal fpurge (E. officinarum); the Medufa's head fpurge (E. caput Medufæ); the myrtle-leaved fpurge (E. tithymaloides); the feven-angled fpurge (E. heptagona); the warty-angled fpurge (E. mammilaris); and the Cape fpurge (E. lathyris): the firft fpecies is a large plant, of which there is a variety with a naked three-cornered compreffed ftalk, fending out a great number of erect branches, which are likewife generally three-cornered, but fometimes four-cornered; armed with fhort crooked fpines, having no leaves. The plants have not, we believe, yet produced flowers in this climate. This variety, like the fpecies from which it is produced, is a native of the Eaft Indies.

The fourth fpecies has alfo a variety frequently denominated the "Little Medufa's head," which has a thick fhort ftalk, feldom more than eight or ten inches in height, from which come out a great number of flender trailing branches, about a foot in length, intermixing, and having the fame appearance with the other, but fmaller and much fhorter; the ends are befet with narrow leaves, between which the white flowers come out and appear. Its native fituation is the fame as that of the fpecies from which it is derived. According to fome there are likewife a double branching, a dwarf trailing, and other varieties.

The fifth fort has alfo laurel leaved and variegated leaved varieties.

Method of Culture.—Thefe different forts of plants may be raifed by planting cuttings, which have been made at a joint, five or fix inches in length, after having been rolled in fand, and laid upon a fhelf for fome days to have the wounds healed over, in the fummer feafon about the middle, choofing fmall pots for the purpofe filled with light, dry, fandy mould, with fome rubbifh at the bottoms, fuch as that formed of one fourth part of lime-rubbifh which has been well fcreened, the fame quantity of fea fand, and one half of the whole of light frefh vegetable earth, which fhould be very well mixed and incorporated together, by being often turned over; then plunging the pots in the bark hot bed, giving due fhade when the weather is hot and funny, with a little water occafionally once or twice a week. As foon as the plants have ftricken root, air fhould be admitted to them pretty freely in the fituation in which they may be; or they may, in order to be hardened, be removed into the ftove.

In the after management they fhould be allowed larger pots annually as they advance in growth, and be often refrefhed with water during the fummer months, but very fparingly in the winter feafon.

It may be remarked that moft of thefe forts of plants are capable of being kept in the hot-houfe, on the fhelves, and fome of them, as the fifth, fixth, and feventh forts, in a dry airy green-houfe, or glafs cafe, during the winter months, great care being taken to protect them well from the frofts; being fet out in the fummer in the open air: but the fourth fpecies requires fome fort of fupport in order to prevent the branches, by their weight, forcing it upon the pots; as by this fort of treatment the plants will rife to the height of four or five feet, throwing out a great number of fide branches. The eighth kind, however, requires little or no particular care after it has been once introduced, except merely that of keeping the young plants clean, as it will be continued by its fcattering the feeds.

All thefe plants, with the exception of the laft, afford great variety in collections of the hot and green-houfe kinds; and that alfo in the clumps and borders of the pleafure grounds, among others of the lefs hardy forts.

EUPHORBIÆ, in *Botany*, the 96th natural order in Juffieu's fyftem, or the 1ft of his 15th clafs. The definition of this clafs is,—Cotyledons two. Petals none. Stamens in a feparate flower from the piftils. Its characters are thus more fully explained. Flowers either monoecious, that is, males and females together on the fame plant, or dioecious, on feparate ones; very rarely hermaphrodite. Calyx in all of one leaf, or a fcale fupplying its place. Corolla none, except occafionally fome fcales, or internal divifions of the calyx, refembling petals. In the male flowers the ftamens are inferted either into the upper or lower part of the calyx, or fcale which fupplies its place, definite, or rarely indefinite, in number; their filaments diftinct, or rarely united into a central ftalk, originating from the middle of the calyx. Germen in the females fimple, or fometimes more than one, fuperior, or rarely inferior; ftyle one, or feveral, rarely wanting; ftigma either folitary or more than one. Fruit either fuperior or inferior, various in the ftructure and number of its cells.

The learned author, by his fubfequent remarks and explanations, is evidently aware of the difficulties attending this clafs, which indeed is in no fenfe really a natural one, its orders having little or no affinity to each other, except the two laft *Amentaceæ* and *Coniferæ*.

The characters of the order of *Euphorbiæ* are, *Flowers* monoecious or dioecious, or rarely hermaphrodite. *Calyx* of each tubular, or deeply divided, fimple or double, the internal fegments occafionally refembling petals. *Petals* none, except the fegments juft mentioned. *Stamens*, in the male flowers, definite or indefinite in number, their filaments inferted either into the receptacle, or the centre of the calyx, diftinct or united, fometimes branched, fometimes jointed. In fome there are chaffy fcales between the filaments. *Germen*, in the female flowers, folitary, fuperior, feffile or ftalked; ftyles in fome cafes feveral, often three, with an equal number of cells to the capfule, each containing one or two feeds; in others the ftyle is fimple, with three or more ftigmas, the fruit of feveral

veral cells, equalling the ſtigmas in number, with one or two ſeeds in each. In all the cells are furniſhed with two internally elaſtic valves; the ſeeds have a partial covering, and are attached at the upper part to the permanent central axis of the fruit. Corculum flat, enveloped in a fleſhy albumen. The plants are either herbaceous, or ſhrubby, or arboreſcent; ſome of them milky. Leaves alternate or oppoſite, (in ſome few inſtances wanting,) either with or without ſtipulas. The firſt ſection conſiſts of ſuch genera as have ſeveral ſtyles, moſtly three. Theſe are *Mercurialis*, *Euphorbia*, *Argythamnia* of Browne's Jam. 338. Sw. Prod. 39, *Cicca*, *Phyllanthus*, *Xylophylla*, *Kirganelia*, *Kiggellaria*, *Clutia*, *Andrachne*, *Agyneia*, *Buxus*, *Securinega* of Commerſon, *Adelia*, *Mabea*, Schreb. 641, *Ricinus*, *Jatropha*, *Dryandra*, *Aleurites*, *Croton*, *Acalypha*, *Caturus* and *Excœcaria*. The ſecond ſection, with a ſolitary ſtyle, contains *Tragia*, *Stillingia*, *Sapium of* Browne, *Hippomane*, *Ægopricon*, *Sechium* of Browne, *Hura*, *Omphalea*, *Plukenetia* and *Dalechampia*.

The ſeeds of theſe plants are mild and eatable in many inſtances, if freed from their integuments and corculum, the latter being very dangerouſly purgative, as in *Euphorbia* and even *Ricinus*, proving mild in the latter only from the copious oil of the cotyledons. *Euphorbia*, which gives its name to this natural order, can only by a very bold analogy, or rather hypotheſis, be ſaid to have no corolla, and is very imperfectly polygamous, not monoeecious; indeed Juſſieu allows it to be hermaphrodite. See EUPHORBIA.

EUPHORBIUM, is a moſt acrid gum reſin, which exudes from the *Euphorbia officinarum* and other ſhrubs of the ſame genus, and was formerly uſed in pharmacy, but is now nearly, if not, entirely rejected.

This gum is brought from Barbary and other parts of the Mediterranean in tears or drops of an irregular form, generally entangling much impurity; of a pale yellow colour without, and white within. Euphorbium has no ſmell: when taken into the mouth it gives at firſt no taſte, but after a little time a moſt acrid biting ſenſation is felt, which increaſes to an intolerable degree, and if not immediately rejected it proceeds to corrode the ſkin of the tongue and fauces. The ſame acrimony is ſhewn when applied to the body in any other manner. In reducing it to powder the duſt that flies off will excite the moſt violent ſneezing, and often bleeding from the noſtrils and throat, ſo that particular precautions muſt be taken. When laid for ſome time on the ſkin it bliſters.

The ſpirituous tincture of euphorbium is ſtill more acrid.

This gum reſin, on account of its extreme acrimony, can hardly be uſed with ſafety as an internal medicine, as it is liable to produce violent diarrhœa and bloody ſtools, and much inflammation. The only purpoſe for which it has been employed in the later diſpenſatories has been in mixture with cantharides to increaſe the veſicating and irritating property, but euphorbium is now altogether diſuſed.

EUPHORIA, in *Botany*, ſo named by Commerſon from ευφορος, *fertile*, a genus comprehending the two Chineſe fruits Lit-chi and Longan, to which Juſſieu ſuſpects Forſter's *Pometia* may alſo belong. See SCYTALIA.

EUPHORY, ſignifies the ſame as *Eucracy*.

EUPHRASIA, in *Botany*, from ευφραινω, *to exhilarate*, or *delight*, alluding to the brightneſs or gaiety of the bloſſoms. Eye-bright. Linn. Gen. 304. Schreb. 401. Willd. Sp. Pl. v. 3. 192. Tournef. t. 78. Sm. Fl. Brit. 650. Mart. Mill. Dict. v. 2. Juſſ. 100. Gærtn. t. 54. Claſs and order, *Didynamia Angioſpermia*. Nat. Ord. *Perſonatæ*, Linn. *Pediculares*, Juſſ.

Gen. Ch. *Cal.* perianth of one leaf, inferior, cylindrical, four-cleft, equal, permanent. *Cor.* of one petal, ringent; tube as long as the calyx; upper lip concave, notched; lower ſpreading, deeply three-lobed, its lobes equal, obtuſe, notched. *Stam.* Filaments four, thread-ſhaped, ſituated cloſe under the upper lip; anthers of two lobes, the lobes unequally ſpinous at their lower extremities. *Piſt.* Germen ſuperior, ovate; ſtyle thread-ſhaped, agreeing in form and ſituation with the ſtamens; ſtigma obtuſe, undivided. *Peric.* Capſule ovate-oblong, compreſſed, of two cells and two valves; the partition contrary to the valves. *Seeds* numerous, minute, roundiſh, longitudinally ſtriated.

Eſſ. Ch. Calyx cylindrical, four-toothed, equal. Upper lip of the corolla cloven; lower three-lobed, the lobes cloven. Anthers bearded with unequal ſpines. Capſule ovate-oblong. Seeds ſtriated.

Botaniſts are not perfectly agreed about the limits of this genus, and its near allies *Bartſia* and *Rhinanthus*. The firſt of Willdenow's twelve ſpecies, E. *latifolia*, Linn Sp. Pl. 841, is *Bartſia latifolia*, Sm. Prod. Fl. Græc. Sib. 428, a beautiful native of the ſouth of Europe. His ſixth, E. *odontites*, is *Bartſia odontites* of Hudſ. Fl. Angl. 268, and Sm. Fl. Brit. 648. Engl. Bot. t. 1415.

E. *officinalis*, Linn. Sp. Pl. 841. Engl. Bot. t. 1416. Curt. Lond. faſc. 5. t. 42. common in heathy and mountainous paſtures, which its gay bloſſoms greatly enliven in autumn, is a genuine and original example of the genus. This is a ſmall, upright, annual plant, with ovate ſharply ſerrated *leaves*. The *flowers* are white, ſtrongly ſtreaked with purple, having a yellow ſpot on the lip. On the Alps they are often larger, light purple, and ſtill more beautiful.

The dazzling brilliancy of theſe little bloſſoms ſeems to have given riſe to the vulgar opinion, that the plant was good for the eyes; whence its Engliſh name Eye-bright.

EUPHRATENSIA, in *Ancient Geography*. See COMMAGENE.

EUPHRATES of Alexandria, in *Biography*, a Stoic philoſopher, who flouriſhed in the ſecond century, was a friend of Dio and of Apollonius Tyanæus, who introduced him to Veſpaſian. Although a violent quarrel aroſe between the latter philoſopher and Euphrates, in conſequence of which Philoſtratus, the panegyriſt of the former, inveighs with great ſeverity againſt the latter, it appears from the teſtimony of Epictetus, Pliny the younger, and Euſebius, that Euphrates was univerſally eſteemed for his talents and virtues, and that the cenſures of Philoſtratus deſerve only contempt. Pliny's character of him is highly intereſting. "If ever," ſays he (Ep. l. i. ep. 10.), "polite learning flouriſhed at Rome, it certainly does at preſent. Of this I could give you many inſtances; but I will content myſelf with naming only Euphrates the philoſopher. When, in my youth, I ſerved in the army in Syria, I had an opportunity of converſing familiarly with this excellent man, and took ſome pains to gain his affection, though that indeed was not difficult; for he is exceedingly open to acceſs, and full of that gentleneſs of manner which he teaches. Euphrates is poſſeſſed of ſhining talents, which cannot fail to intereſt even the unlearned. He diſcourſes with great accuracy, dignity, and elegance; and frequently riſes into the ſublimity and luxuriance of Plato himſelf. His ſtyle is copious and diverſified, and ſo wonderfully ſweet, as to captivate even the moſt reluctant auditor. Add to all this, his graceful form, comely aſpect, long hair, and large white beard; circumſtances which, though they may probably be thought trifling and accidental, contribute, however, to procure him much reverence. There is no diſguſting negligence in his dreſs; his countenance is grave, but not auſtere; his approach commands reſpect, without exciting awe. With

With the ſtricteſt ſanctity, he unites the moſt perfect politeneſs of manner. He inveighs againſt vice, not againſt men; and, without chaſtiſing, reclaims the offender. You liſten with fixed attention to his exhortations, and even when convinced, ſtill hang with eagerneſs upon his lips."

In conformity to the principles of the Stoic philoſophy, Euphrates, when he found his ſtrength worn out by diſeaſe and old age, voluntarily put a period to his life by drinking hemlock, having firſt, for ſome unknown reaſon, obtained permiſſion from the emperor Adrian. Brucker's Hiſt. Phil. by Enfield, vol. ii.

Euphrates, the reputed founder of a religious ſect in the ſecond century, ſometimes called "Ophians," or "Ophites," and ſometimes "Serpentinians," names derived from the peculiar tenet which he held, that the ſerpent, by which our firſt parent was deceived, was either Chriſt himſelf, or "Wiſdom" concealed under the form of that animal, and that he was the occaſion of all the knowledge which men had received. Hence he is ſaid to have inculcated a particular veneration for the ſerpent, preſerving a living one, offering to it a ſubordinate kind of divine honour, and bringing it out to partake of or to conſecrate the euchariſt. Origen and others contend that the followers of Euphrates were not Chriſtians, but calumniators of Jeſus Chriſt, and oppoſers of his doctrine: but Dr. Lardner, who has taken ſome pains in inveſtigating the ſubject, conſiders them as believers in Chriſtianity, and maintaining that Jeſus, who was born of a virgin, was a moſt excellent man, and that, having by his miracles and inſtructions manifeſted himſelf to be the true Meſſiah, was crucified, and afterwards raiſed from the dead, received into heaven, where he ſits on the right hand of God. He conceives that what ſome have ſaid of them, reſpecting the ſerpent being Chriſt, muſt be a miſtake, founded on an opinion that the brazen ſerpent in the wilderneſs was a type or figure of Chriſt. The other accounts of worſhipping the ſerpent, &c. this judicious and learned writer rejects without heſitation. Moreri. Lardner.

Euphrates, in *Ancient Geography*, one of the moſt conſiderable and beſt known rivers of Aſia, the ſource of which was in the mountains of Armenia north of Abus, which after receiving ſeveral ſtreams in this part of Armenia, at the towns of Elegia, Gymnias, and Brapus, purſued its courſe towards the ſouth-weſt, ſeparating Armenia Major, on the eaſt, from Armenia Minor on the weſt. It then proceeded ſouth-eaſtward, waſhing the ſkirts of Syria, and dividing Arabia from Meſopotamia; and afterwards directing its courſe towards the north-eaſt, it ſeparated Chaldæa and Babylonia from Meſopotamia, till at length mixing its waters with thoſe of the Tigris, with which it previouſly communicated by ſeveral canals, it emptied itſelf into the Perſian gulf. The Euphrates, according to Ptolemy, above Babylon, near a town in Meſopotamia, called Sipphara, divided itſelf into two branches, one running to Babylon, and the other to Seleucia, where it fell into the Tigris. Pliny ſays the latter was partly artificial; for he places Seleucia at the confluence of the Tigris and Euphrates, adding that the Euphrates was conveyed to it by a canal. Prideaux, on the authority of Pliny, ranks this artificial branch among the ſtupendous works of Nebuchadnezzar. Between theſe two branches a canal was cut from the Euphrates, above Babylon, to the Tigris at Apamea, 60 miles below Seleucia. This canal was denominated *Naarmalcha*, and was dug by Nebuchadnezzar, as Abydenus informs us, to convey the waters of the Euphrates, when it overflowed, into the Tigris, before they reached Babylon. At the diſtance of 800 furlongs from Babylon to the ſouth was another canal, called by Arrian Pallacopes, and by Appian Pallacotta, derived from the branch of the Euphrates that paſſed through Babylon, and continued to certain lakes or marſhes in Chaldæa. On this canal, or river, as Arrian calls it, Alexander ſailed from the Euphrates to the above-mentioned lakes. But it is impoſſible, at this diſtance of time, and after the changes that have occurred, to trace out the numerous branches and canals which watered the ancient country of Babylon. This great river moved ſlowly through a great part of its courſe, and was ill adapted for navigation, as ſome parts of it were ſhoal and others rocky. Thevenot, however, is of opinion, that the Euphrates might, with little trouble, be made navigable, even by great barks, quite to the Tigris, only by clearing the channel of the ſtones with which it is choked in ſome places. The ancient mode of navigating this river was very extraordinary. The veſſels were round, without diſtinction of head or ſtern, and no better than great wicker baſkets, covered over with hides, guided by two oars or paddles. They were capable of carrying a very conſiderable weight; and when they had unloaded their cargo at Babylon, they were ſold, but the hides were kept: and loading their aſſes with them, the navigators returned home by land, the rapidity of the ſtream not allowing them to return by water.

Euphrates, in *Modern Geography*, a river of Aſiatic Turkey, which riſes from the mountains of Armenia, as ſome have ſaid, in two ſtreams, a few miles to the N.E. of Erzeron, the ſtreams uniting to the S.W. near that city; and chiefly purſuing a S.W. direction to Semiſat, where it would fall into the Mediterranean, if not prevented by a high range of mountains. In this part of its courſe the Euphrates is joined by the Morad, a ſtream almoſt doubling in length that of Euphrates, ſo that the latter river might more juſtly be ſaid to ſpring from mount Ararat, about 160 Britiſh miles to the eaſt of the imputed ſource. At Semiſat, the ancient Samoſata, this noble river aſſumes a ſoutherly direction; then runs an extenſive courſe to the S.E., and after receiving the Tigris, falls by two or three mouths into the gulf of Perſia, about 50 miles S.E. of Baſſora. N. lat. 29° 50'. E. long. 66° 55'. The comparative courſe of the Euphrates may be eſtimated at about 1400 Britiſh miles. This river is navigable for a conſiderable diſtance from the ſea. This river in its courſe ſeparates Aladulia from Armenia, Syria from Diarbekir, and Diarbekir from Arabia, and paſſing through the Arabian Irak, there joins the Tigris.

Euphrates, a river of Africa, in the country of Whidah, on the Slave coaſt.

EUPHROSYNE, in *Mythology*, one of the three Graces. See Graces.

EUPHROSYNUM, in *Botany*, a name uſed by Pliny and ſome others for the common borrage. See Borrage.

EUPILIS, in *Ancient Geography*, *Puſſiano*, a lake of Italy, in Gallia Ciſalpina, whence, according to Pliny, iſſued the river Lambrus.

EUPNŒA, of ευ, *well*, and πνεω, *I breathe*, in *Medicine*, is a right and natural reſpiration.

EUPOLIS, in *Biography*, an Athenian who flouriſhed B.C. 440, was known as a comic writer, and one of that claſs who marked out by name the objects of their ſatire, which rendered him extremely popular with the many, as he was dreaded by the great. He is mentioned by Horace and Quintilian, who put him in the ſame claſs with Cratinus and Ariſtophanes. His comedies were of a political caſt, in one of which Alcibiades was ſo ſeverely attacked, that he is ſaid to have hired aſſaſſins to throw him into the ſea. The plot did not ſucceed, for Eupolis wrote ſeveral comedies after the period aſſigned to this fact, and Ælian relates that

that he died at Ægina. Fragments of his works have come down to us, and titles of twenty of his plays. Gen. Biog.

EUPORIA, in *Ancient Geography*, a town of Macedonia, placed by Ptolemy in Bisaltia.

Euporia, of ευ and πορος, *passage*, in *Medicine*, is an easy preparation of medicines, or the easiness of their operation.

EUPSYCHIANS. See Eunomioeupsychians.

EURA, in *Geography*, a town of Sweden, in the government of Abo; 17 miles N.E. of Abo.

EVRA, a town of Abyssinia; 12 miles S.E. of Siré.

EVRACMINNA, a town of Sweden, in the government of Abo; 17 miles S. of Biorneborg.

EVRAN, a town of France, in the department of the North Coasts, and chief place of a canton in the district of Dinan, four miles S. of it. The place contains 3573, and the canton 9175 inhabitants, on a territorial extent of 117½ kiliometres and seven communes.

EURAN Islands, a cluster of small islands, on the east side of the gulf of Bothnia. N. lat. 63° 54'. E. long. 22° 39'.

EURANIUM, in *Ancient Geography*, a town of Asia Minor, in Caria.

EURE, in *Geography*, a river of France, which has its source in the forest of Logny, and terminates in the Seine, above Pont de l'Arche. Its course is northward, and extends 36 leagues.

Eure, formerly *Ouche*, a department of the second or northern region of France, in 49° N. latitude, bounded on the north by the department of the Lower Seine, on the east by that of the Oise, on the south by the departments of the Eure and Loire and the Orne, and on the west by the department of the Calvados. It takes its name from the river Eure, which traverses it; and its capital is Evreux. It contains 307 square leagues, and 415,574 inhabitants in five districts, *viz.* Pontaudemer, Louviers, Les Andelys, Evreux, and Bernay, 35 cantons, and 843 communes. Its fertile soil yields grain, hemp, flax, and pastures; and it has considerable forests.

Eure *and Loire*, a department of the second or northern region of France, in 48° 15' N. lat. composed of a part of *Beauce* and of *Perche*, bounded on the N.W. by the department of the Eure, on the east by the departments of the Seine and Oise and the Loiret, on the south by the departments of the Cher and Loiret, and on the west by the departments of the Orne and Sarte. It takes its name from the rivers Loire and Eure, which water it; and its capital is Chartres. It contains 300 square leagues, and 259,967 inhabitants. It is divided into four districts, *viz.* Nogent-le-Rotrou, Chartres, Chateaudun, and Dreux; 23 cantons, and 460 communes. This department, on account of its great fertility, is called the granary of Paris, and it abounds in fruits and rich pastures

EVRE, or Yevre, a river of France, which discharges itself into the Cher by two streams, one near Vierson, the other at Bourges.

EVRECY, a town of France, in the department of the Calvados, and chief place of a canton in the district of Caen; seven miles S.W. of Caen. The place contains 850, and the canton 13,110 inhabitants, on a territorial extent of 145 kiliometres, and 29 communes.

EVREGNIES, a town of France, in the department of Jemmappe; nine miles N.N.W. of Tourney.

EUREOS, in *Natural History*, the name of a stone, described by Pliny, and seeming plainly to be the same with the tecolithus, which he mentions in another place, and to be the stone now called *lapis Judaicus*, and known at this time to be the petrified spine of a sort of echinus marinus, or sea urchin.

EVREUX, Mediolanum, *Eborice*, or *Civitas Evergorum*, in *Geography*, a town of France, in the department of the Eure, of which it is the capital, and chief place of a district. Its north division contains 4200, and the canton 10,458 inhabitants, and the south division 4226, and its canton 10,853 inhabitants; the territorial extent comprehends 345 kiliometres, and each division includes 30 communes. Before the revolution this was the see of a bishop, suffragan of Rouen; containing nine parish churches, two abbies, and ten convents. This is an ancient and considerable town, with large suburbs, situated in a deep and fruitful vale on the river Eton, 23 miles N.W. from Paris. Its cathedral is a fine Gothic structure. The manufactures of Evreux consist of woollen and linen cloth, and its trade of rice, grain, wine, and cyder; but they are not considerable. N. lat. 49° 2'. E. long. 1° 15'.

EURIA, in *Ancient Geography*, a town of Greece, in Epirus.

EURIPIDES, in *Biography*, the contemporary and rival of Sophocles, and one of the most ancient Greek tragedians, was born in the isle of Salamis, in the first year of the 75th olympiad, B.C. 480, according to many writers, though the Arundelian marble places his birth five years earlier. His father's name was Mnesarchus, an Athenian, and that of his mother was Clito, a seller of herbs, according to the report of Aristophanes, the avowed enemy of Euripides; but by the testimony of later grammarians, founded on the authority of Philochorus, an ancient writer, she was of noble descent. Before the birth of his son, Mnesarchus is said to have consulted the oracle of Apollo concerning his future destiny, and to have received for answer, "that the child who should be born to him would reach the summit of glory, and gain the honour of the sacred garland," which was understood to signify the crown of victory at the olympic games. When Greece was invaded by Xerxes, Mnesarchus and his wife retired for safety, among other Athenians, to the island of Salamis. In the autumn of the year 480 B.C. when this invasion took place, the fate of Greece was in a great measure decided by the naval victory of Salamis over the Persians; and on the same day, it is said, Euripides was born, who in memory of this battle, fought in the narrow channel, or *Euripus*, which divides Salamis from the continent, received his name. Euripides, at subsequent periods of his life, was accustomed to frequent the island of his nativity, where was shewn a cave, in which some of his tragedies are said to have been composed. Euripides, in conformity to the suggestion of the oracle, and also to the custom of the country, qualified himself for honourable and successful contest at the public games, by an early initiation in the usual gymnastic exercises; but his views were directed to nobler pursuits. Accordingly, whilst he paid some attention to the art of painting, he studied rhetoric under Prodicus, celebrated for the allegory of the choice of Hercules, preserved by Xenophon, and received instructions in physics from Anaxagoras, and in morals from Socrates. In his 18th year he first applied himself to the composition of tragedies, the number of which, during the course of his life, amounted, as some say, to 75, but according to others, to 92. He does not appear, however, to have been very successful in his exhibitions on the theatre, for no more than five of his performances gained the prize at the olympic games: but they were privately read with avidity and highly applauded by his countrymen. To this purpose we may mention the following fact. After the

 unfortunate

unfortunate expedition of the Athenians againſt Syracuſe, ſeveral captives were kindly treated by the Sicilians, and obtained relief from indigence and wretchedneſs, by going about from place to place, reciting and ſinging the verſes of Euripides. Upon their return to their own country, the poet received their perſonal acknowledgments. Socrates was the friend of Euripides, and is ſaid to have given him advice and aſſiſtance in the compoſition of ſome of his dramas; and he occaſionally attended the public exhibition of them. In the character of Palamedes the poet was ſuppoſed to have delineated that of Socrates; and ſome verſes are quoted addreſſing the Greeks as having ſlain the beſt and wiſeſt of their nation, which the audience applied to the fate of this philoſopher, burſting into tears at the recollection of their crime. As Socrates had become an object of public perſecution and calumny before the repreſentation of the Palamedes, ſome application of the character to his circumſtances might probably have been intended by the poet. But his death could only be alluded to by way of probable anticipation, as he ſurvived Euripides ſome years. The remarkable effect aſcribed to the paſſage of the Palamedes juſt mentioned might poſſibly have taken place at ſome repreſentation of that play ſubſequent to the death of Socrates. Euripides was the conſtant rival of Sophocles, and their mutual jealouſy ſeems to have degenerated into declared enmity. Our poet was frequently the object of raillery to Ariſtophanes. Euripides was twice married; but as he was diſappointed in his expectation of domeſtic happineſs, he is ſaid to have indulged a kind of antipathy to women, for which this circumſtance has been pleaded as an apology. Hence he obtained the name of Μισογυνης, *woman-hater*, though his editor, Barnes, ſtrenuouſly defends him from the charge implied in this appellation, obſerving, that if he has deſcribed ſome females with all the vices incident to human nature, yet he has delineated many others with all the virtues that can adorn their ſex; and Sophocles is ſaid to have obſerved, that the hatred which he expreſſed againſt women was confined to the ſtage. In advanced life he enjoyed ſo little felicity at Athens, that he accepted an invitation to the court of Archelaus, king of Macedonia, where he was honourably treated, though he did not altogether eſcape the effects of malicious jealouſy. To the conſequence of a quarrel from this cauſe ſome have aſcribed his tragical death; for as he was walking in a wood, the king's hounds were let looſe upon him, and tore him in pieces. Others ſay that his death was owing to natural decay. He died at the age of about 75 years. The Athenians ſent embaſſadors to Macedonia, to requeſt the removal of his body to his native country; but Archelaus refuſing to comply with their requeſt, cauſed him to be interred with great magnificence, and erected in honour of him a noble monument in the vicinity of Pella, his chief city. The Athenians appointed a public mourning on occaſion of his death, and erected in memory of him a cenotaph on the road leading from the city to the Piræus. The following epitaph is aſcribed to Thucydides, the hiſtorian.

> " Μναμα μεν Ελλας απασ' Ευριπιδου· ος̣α δ'ισχει
> Γη Μακεδων, ἡ γαρ δεξατο τερμα βιου.
> Πατρις δ'Ελλαδος Ελλας Αθηναι· πλειςα δε Μουσαις
> Τερψας, εκ πολλων και τον επαινον εχει."

"All Greece is the monument of Euripides; the Macedonian land poſſeſſes his bones, for there he reached the boundary of his life. His country is Athens, the Greece of Greece; having afforded general delight by his muſe, he enjoys the recompence of general praiſe."

It has been recorded to the reproach of Euripides, that many of the maxims which he attributes to his dramatic characters are favourable to vice; and though he cannot be wholly exculpated from this charge, he abounds with moral maxims, expreſſed in noble and elegant language, which deeply impreſs the mind of the reader. He has been alſo charged with moroſeneſs of temper; but however this be, he introduces numerous paſſages of tender and delicate pathos. As a tragedian, when compared with Sophocles, it ſeems to be the general opinion, that with leſs pomp of diction, leſs force and elevation of character, and leſs knowledge of dramatic effect than his rival, he more excels in tenderneſs, ſuavity, and moral ſentiment. Ariſtotle calls him the "moſt tragical" of all the poets, meaning either that he was the moſt ſkilful in the drama, or the moſt pathetic. Euripides, it ſhould be recollected, was the favourite poet of Milton. Poſſeſſing a high notion of the preceptive office of the theatre, he was once deſired by the auditors to retrench a paſſage in one of his plays, but he ſtepped forward and ſaid, "I do not write in order to learn from you, but to teach you." Of his works nineteen compleat plays, and the commencement of a twentieth, are ſtill remaining. Of theſe, both ſingly and collectively, there are ſeveral editions. The beſt of the whole works are thoſe of Baſil, 1551, of Plantin, 1571, of Commelin, 1597, of Paul Stephens, 1604, 1611, of Barnes, *Camb.* 1694, and of Muſgrave, Oxf. 1778. Bayle. Moreri. Barnes. Gen. Biog.

EURIPUS, Ευριπος, in *Hydrography*, properly ſignifies a certain ſtrait of the ſea which divides Eubœa from Attica, Bœotia, and Locris, where the currents are ſo ſtrong that the ſea is ſaid to ebb and flow ſeven times a day; in which place, as the ſtory commonly goes, Ariſtotle drowned himſelf out of chagrin, for not being able to account for ſo unuſual a motion. This ſtrait was ſo narrow overagainſt Chalcis as ſcarcely to admit a galley. It is now called the gulf of Negropont.

Euripus has ſince become a general name for all ſtraits, where the water is in great motion and agitation.

The ancient circuſes had their Euripi, which were no other than pits or ditches, on each ſide of the courſe, into which it was very dangerous falling with their horſes and chariots as they ran races. The term Euripus was more particularly applied by the Romans to three canals or ditches which encompaſſed the circus on three ſides, and which were filled occaſionally, to repreſent naumachiæ or ſea-battles.

The ſame people called their ſmaller fountains or canals in their gardens Euripuſes; and their largeſt, as caſcades, &c. *Niles.*

EUROCLYDON, of Ευρος, *eaſt-wind*, and κλυδων, *wave*, is a ſpecies of wind, of which we have an account only in Acts, xvii. 14 and concerning the nature of which critics have been much divided. Bochart, Grotius, Bentley, and others, ſubſtitute another reading, ſupported by the Alexandrian MS. and the Vulgate, *viz.* Ευρακυλων, or *Euroaquilo*; but Mr. Bryant defends the common reading, and conſiders the Euroclydon, *i. e.* Ευρος κλυζων, as an eaſt-wind that cauſes a deep ſea or vaſt inundation. He maintains, in oppoſition to Dr. Bentley's reaſoning, who ſuppoſes that the mariners in the ſhip, the voyage of which is recited in this paſſage, were Romans, that they were Greeks of Alexandria, and that the ſhip was an Alexandrine ſhip, employed in the traffic of carrying corn to Italy; and therefore, that the mariners had a name in their own language for the particular typhonic or ſtormy wind here mentioned. He alſo ſhews from the paſſage itſelf, that the tempeſtuous wind called Euroclydon, beat (κατ' αυτης) upon the iſland of Crete; and therefore, as this is a relative expreſſion, referring to the

the situation of the person who speaks of it, who was at that time to the windward, or south of it, the wind blew upon shore, and must have come from the south or south-east; which, he adds, is fully warranted from the point where the ship was, and the direction it ran in afterwards, which was towards the north and north-west. Bryant's Observations, &c. 1767, p. 1. &c.

EURO-Auster. } See Winds.
Euro-*Notus.* }

EUROMA, in *Ancient Geography*, a town of Asia, in Phœnicia.

EUROMUS, a town of Asia, in Caria; situated E. of mount Grius, N. of mount Latmus, and N.W. of the town of Mylasa. It had a theatre and a magnificent temple.

EVRON, in *Geography*, a town of France, in the department of the Mayenne, and chief-place of a canton, in the district of Laval; 15 miles E.N.E. of Laval. This place contains 4044 and the canton 13,213 inhabitants, on a territorial extent of 205 kiliometres and 11 communes. The fairs of this town are frequented.

EUROPA, in *Mythology*, daughter of Agenor, king of Phœnicia, by his wife Telaphassa, who was so beautiful, that, according to the fable, Jupiter is said to have fallen in love with her, and to have ordered Mercury to convey her to the sea-shore, where that god, having transformed himself into a bull, took her upon his back, and transported her into Crete. Some have explained this fable by alleging that a captain of Candia, named Taurus, carried off that princess, after he had taken the city of Tyre from Agenor; but others, with greater probability, assert, that some merchants of Crete, having arrived upon the coasts of Phœnicia, and seen the young Europa, were so much struck with her beauty, that they carried her off for their king Asterius; and as their ship bore upon the fore-castle a white bull, and that king of Crete had assumed the name of Jupiter, it was hence fabled that the god had transformed himself into a bull, in order to carry off the princess. Asterius is said to have married her, and to have had by her three sons; after which she is reported to have engaged the attachment and esteem of the Cretans to such a degree, that they worshipped her after her death as a divinity. They even instituted a feast in honour of her, which was called Hellotia. They afterwards gave her the surname of Minerva, and celebrated to her honour that festival which was consecrated to that goddess among the Cretans. Several authors have been of opinion that Europe took its name from this princess; but the learned Bochart believes that this part of the world was so denominated from the whiteness of its inhabitants. M. Gebelin, however, deduces the name of Europa from *Wrab*, signifying Occidental, and expressing its situation with regard to Asia.

Europa *rocks*, in *Geography*, rocks in the strait of Mozambique. S. lat. 21° 30′. E. long. 40° 16′.

EUROPE, one of the four grand divisions, or quarters, as they have been somewhat improperly called, of the terraqueous globe. Although Europe be less considerable in extent than Asia, or America, or even Africa, it claims on a variety of accounts our more particular attention. In modern times it has been the seat of literature and science; in this part of the globe every kind of cultivation and improvement has made the most rapid progress, and it has been distinguished, not only by the general temperature of its climate, the fertility of its soil, and the abundance of its productions for the supply of necessity and the gratification of luxury, but more especially for the wisdom, strength, and courage of its inhabitants, and for the excellence of its government, laws, and religion. The boundaries of Europe were very inaccurately ascertained by the ancient geographers, and the name itself seems to have originated in a small district near the Hellespont. More than a third part of Europe, towards the north and east, has only been known with precision in modern times. It lies chiefly in the temperate zone, north of Africa, and north-west of Asia, between 35° 25′ and 71° 23′ N. lat. and between 9° 40′ W. and 61° 5′ E. longitude. From the Portuguese cape, denominated by our mariners the rock of Lisbon, in the west, to the Uralian mountains in the east, the length may be about 3,300 British miles; and the breadth from Cape Nord in Danish Lapland to Cape Matapan, the southern extremity of Greece, may be about 2,350. The contents in square miles have been variously estimated, but at a medium may be stated at about $2\frac{1}{2}$ millions. On the south, Europe is bounded by the Mediterranean sea, on the west by the Atlantic, which contains the most remote European islands, the Azores and Iceland, Greenland being regarded as a part of North America. On the north the boundary is the Arctic ocean, comprehending the remote isles of Spitzbergen, and Novaya Zemlia, or the New Land. "Toward the east the limits, (says Mr. Pinkerton,) admit of some discussion: the Uralian mountains, a grand natural limit, not extending to the Arctic ocean, the river Cara, which flows into the sea of Karshoye, is admitted as a boundary. The Uralian limit extends to about 56° of N. latitude; to the south of which the grand confines of Europe and Asia have been sought in the petty distinctions of Russian governments. More natural limits might be obtained by tracing the river Ousa from its source, to its junction with the Belaia. Thence along the Kama to the Volga, which would constitute a striking natural division, to the town of Sarepta; whence a short ideal line, the only one admitted in this delineation, will lead due west to the river Don, which would complete the unascertained boundary; that on the north and west of the Euxine being clear and precise."

The ancient inhabitants of Europe consisted of Celts in the west and south; Fins in the north-east; and Laps or Laplanders, resembling the Samoieds of Asia in the farthest north, who enriched their rude language by adopting that of the more civilized Fins. The ancient inhabitants, who seem to have been thinly scattered, were driven towards the west and north by the Scythians or Goths from Asia, whose descendants occupy the greater part of Europe; by the Sarmatians or Slavonic tribes, also from Asia, the ancestors of the Russians, Poles, &c. and who were accompanied by the Heruli, using what is now called the Lettic speech, to be found in Prussia, Lithuania, Samogitia, Courland, and Livonia, somewhat akin to the Slavonic language, with various shades of distinction. The colony of Iberi, northern Mauretani, passed into Spain at a very early period; and the later accession of Hungarians and Turks from Asia may likewise be commemmorated. The present population of Europe is commonly estimated at 150,000,000; and though some writers have asserted that this quarter of the globe was anciently more populous than it is now, the opinion does not seem to be well founded. It will not readily be adopted by those who duly consider the number and magnitude of modern cities, towns, and villages; the abolition of feudal wars; the adoption of a mode of combat less destructive than that which formerly prevailed; the gradual extirpation of superstition, fanaticism, barbarity, and slavery; and the many extensive improvements made in agriculture, by eradicating forests, draining marshes, cultivating wastes, and opening canals of communication in the interior countries.

countries. It is generally allowed, that, notwithftanding the ravages of war, and emigrations to foreign parts, the population of moft European ftates has been, for fome time paft, increafing. The prevalence of the Chriftian religion throughout Europe, except in fome parts of Turkey, has been favourable to knowledge, induftry, and civilization; and it has contributed to conftitute the whole of Europe, as it were, into one republic, fo that any ufeful difcovery made in one ftate paffes rapidly to the reft. The mutual intercourfe between the different ftates of Europe is very much facilitated by its inland feas, as well as navigable rivers and canals. Of the inland feas the principal are the Mediterranean, the Baltic, and the White fea, which fee refpectively. Its other feas are the German, often ftyled the North fea, the Irifh fea, and various parts of the Atlantic. The gulfs and bays of Europe are very numerous, among which we may reckon the following, *viz.* the Bothnian and Finland gulfs; the Murray frith, and Frith of Forth, on the eaft coaft of Scotland; the bay of Bifcay, a large inlet of the Atlantic, on the eaft bounded by France, and on the fouth by Spain; the gulfs of the Mediterranean, *viz.* that of Lyons, S. of France; that of Genoa, between Corfica and the Genoefe republic; the gulf of Venice, between Italy and Greece; the gulf of Lepanto, N. of Morea; the Archipelago between Greece and Afia Minor; the fea of Marmara between Europe and Afia; and the fea of Azoph on the north coaft of the Euxine. The moft confiderable ftraits are that of Waygatz at the N. E. extremity of Europe; the found of Elfinore between the ifland of Zealand and Sweden; the Little Belt between Funen and Jutland; the Categat, or entrance into the Baltic; the ftrait of Dover, or Englifh channel, between England and France; the Briftol channel, between England and Wales; St. George's channel, between Great Britain and Ireland; Pentland frith, between Scotland and the Orkney Ifles; the ftrait of Gibraltar, between Spain and Africa; the ftrait of Meffina, between Italy and Sicily; the Dardanelles ftrait, or fouth entrance into the fea of Marmara; the ftrait of Conftantinople, that forms a communication between the fea of Marmara and the Euxine; and the ftrait of Caffa, between the Euxine and the fea of Azoph. The moft remarkable capes are North Cape, the extreme point of Lapland; Cape Finifterre, on the N. W. coaft of Spain; Cape St. Vincent, the S. W. extremity of Portugal; and Cape Matapan, the S. point of the Morea. Its principal lakes are thofe of Onega, Ladoga, and Peipus, in Ruffia; thofe of Geneva and Conftance, S. W. and N. of Switzerland; Lago Maggiore, and others, in the northern parts of Italy. The largeft rivers are the Volga, Don, and Dwina, in Ruffia; the Dnieper on the eaft border of Poland; the Danube, between Hungary and European Turkey; the Rhine and Elbe in Germany; the Rhone in France; the Po and Tyber in Italy; the Tago in Spain; the Scheldt and Meufe in the Netherlands; the Thames and Severn in England; the Tay in Scotland, the Shannon in Ireland, &c. &c. The principal chains of mountains are the Carpathian or Krapach mountains, between Poland and Hungary; the Alps, between France, Switzerland, and Italy; the Apennines, in Italy; the Pyrenées between France and Spain; and the extenfive ridge that feparates Norway from Sweden. The moft diftinguifhed iflands are Great Britain and Ireland, the Orkney Ifles, the Hebrides, Zealand, and Funen, in the Baltic; Iceland, in the North fea; and in the Mediterranean, Ivica, Majorca, Minorca, Sardinia, Corfica, Sicily, Malta, Candia, and the iflands of the Archipelago.

The principal European ftates are the Britifh empire, including England, Scotland, and Ireland; the ftates of Denmark, comprehending Denmark with the adjacent iflands, Norway and Iceland; Sweden; Ruffia, formerly called Mufcovy; Holland; France, including the Netherlands, Italian ftates, and other late acquifitions; Switzerland; Germany and Auftria; Pruffia; Bohemia and Hungary; Poland, now difmembered; Spain; Portugal; Sicily; Malta; and Turkey in Europe. See each under its appropriate title.

EUROPEAN Hours. See Hour.

European *Ocean*. See Ocean.

EUROPUS, in *Ancient Geography*, a town of Afia, in Parthia, founded, as Strabo fays, by Nicator, and called by the Parthians *Arfacia*.—Alfo, a town of Afia, in Syria, fituated on the banks of the Euphrates, E. of Hicropolis, and S. of Zeugma.—Alfo, a town of Afia, in Caria.—Alfo, a town of Macedonia.—Alfo, a river of Greece, in Theffaly, which rofe in mount Citarius, and flowed into the Peneus.

EUROTAS, a river of Laconia, which commenced on the frontiers of Arcadia, watered Sparta, and proceeding fouthward, difcharged itfelf into the Laconic gulf.—Alfo, a river of Greece, in Theffaly, near mount Olympus.—Alfo, a river of Italy, near Tarentum, the fame with the river Galefus, according to Polybius.

EURUS, in *Mythology*, the genius of the fouth-eaft wind, according to the Grecian divifion of the compafs into eight points; but according to the Roman divifion into four, Eurus was the intelligence that prefided over the whole eaftern quarter of the heavens. (See Wind.) "Eurus," fays Spence, "according to the Roman poets, feems to have his character compofed from the Apeliotes and Eurus of the Greeks: by one defcription of him he fhould have a look that feems delighted, and in another he is fpoken of as playful and wanton. He is fometimes defcribed as impetuous, and fometimes as difordered with the ftorm he has been driving along the fea. Horace gives us a picture of the former, and Valerius Flaccus of the latter. I fhould be apt to imagine, from fome expreffions in the poets, that he was fometimes reprefented on horfeback, or perhaps in a chariot, whirling through the air; but there are fo few remains of the ancient artifts relating to thefe airy beings, that we have nothing from them to confirm any fuch conjecture."

EURYA, in *Botany*, fuppofed to be from ευρυς, *broad* or *ample*, the application of which to this plant we do not, from any part of the defcription or figure, perceive. Thunb. Jap. 11. Schreb. 321. Willd. Sp. Pl. v. 2. 856. Mart. Mill. Dict. v. 2. Juff. 432. Clafs and order, *Dodecandria Monogynia*. Nat. Ord. uncertain, Juff.

Gen. Ch. *Cal.* Perianth inferior, of five ovate, concave, obtufe, fmall leaves, with two leffer ones at its bafe. *Cor.* Petals five, roundifh-ovate, concave, the fize of the calyx. Nectary a glandular ring round the bafe of the germen. *Stam.* Filaments thirteen, extremely fhort; anthers erect, fquare, almoft as long as the corolla. *Pift.* Germen fuperior, roundifh, fmooth; ftyle awl-fhaped, fhorter than the ftamens; ftigmas three, reflexed. *Peric.* Capfule globofe, tipped with the permanent ftyle, fmooth, of five valves and five cells, fcarcely fo big as a pepper-corn. *Seeds* feveral, obfcurely triangular, dotted, brown, deftitute of pubefcence.

Obf. Thunberg obferved the flowers to be moft frequently dioecious.

Eff. Ch. Calyx double; the inner of five equal leaves; the outer of two fmaller ones. Petals five. Capfule fuperior, of five cells and five valves. Seeds numerous.

E. *japonica.* Thunb. Jap. 191. t. 25. (Fisakaki; Kæmpf. Amœn. Exot. 778.) A Japanese shrub, common on the hills about Nagasaki, flowering in September and October, and cultivated in gardens for the sake of its elegance. It is smooth in every part. *Branches* slender, alternate, leafy. *Leaves* alternate, stalked, elliptic-lanceolate with a blunt point, serrated, compared by Kæmpfer to those of tea, evergreen, yellowish beneath, an inch or two long. *Flowers* axillary, in pairs, stalked, small, white or reddish. Thunberg describes the fruit as above; but Kæmpfer says "the *berries* resemble those of juniper, and are juicy, giving a stain like ultramarine, and containing from ten to twenty hardish brown seeds, crackling under the teeth." If Thunberg adverted to this description, he might perhaps deduce the generic name, though incorrectly, from ευ, *well*, and ρυας, *a flowing of juice*, or *a falling of berries*.

EURYALE, in *Mythology*, one of the Gorgons, daughter of Phorcys, and sister of Medusa: she was subject neither to old age nor death.

EURYAMPUS, in *Ancient Geography*, a town of Macedonia, in Magnesia.

EURYANDRA, in *Botany*, from ευρυς, *broad*, and ανηρ, *a male*, because the male organs, or stamens, are dilated at the summit. Forst. Gen. t. 41. Schreb. 367. Juss. 280. See TETRACERA; to which genus Schreber, in his emendanda, 833, and Willdenow, Sp. Pl. v. 2. 1242, have at the recommendation of Solander referred it.

EURYDICE, in *Mythology*, the wife of Orpheus, who, flying from Aristæus that endeavoured to ravish her, was slain by a serpent. Her husband went down to the shades, and by the force of his music persuaded Pluto and Proserpine to give him leave to carry back his wife; which they granted, provided he did not look on her till he came to the light; but he, breaking the condition, was forced to leave her behind him.

EURYMEDON, in *Ancient Geography*, *Zacuth*, a river of Asia, in ancient Pamphylia, which had its source in mount Taurus, passed the town of Aspenus, and discharged itself into the sea of Pamphylia.

EURYMENÆ, a town of Greece, in Thessaly.

EURYNOME, in *Mythology*, the mother of the three Graces.

EURYNOMIA, Ευρυνομεια, in *Antiquity*, an anniversary solemnity in honour of Eurynome, by some thought to be the same with Diana, by others one of Oceanus's daughters.

EURYPHON, the Cnidian physician, in *Biography*, was a contemporary of Hippocrates, but probably older in years, since he is deemed the author of the Cnidian aphorisms, which are quoted by Hippocrates. These two physicians are said by Soranus to have met in consultation in the presence of king Perdiccas. Euryphon is mentioned by Plato the comedian, as having produced many scars on the skin of Cinesias, the son of Evagoras, by the employment of actual cauteries for the cure of empyema, or pulmonary consumption; a practice which Hippocrates pursued. See Le Clerc Hist. de la Med.

EURYTHMIA, from ευ and ρυθμος, *order*, an old term in *Surgery*, signifying adroitness in handling instruments.

EURYTHMY, Ευρυθμια, in *Architecture*, *Painting*, and *Sculpture*, a certain majesty, elegance, and easiness, appearing in the composition of divers members or parts of a body, building, or painting, and resulting from the fine proportions thereof.

The word is Greek, and signifies literally a *consonance* or *fine agreement*, or, as we call it, a *harmony of all the parts*, being compounded of ευ, *well*, and ρυθμος, *rythmus*, *cadence*, or *agreement of numbers*, *sounds*, or the like things.

Vitruvius ranks eurythmia among the essential parts of architecture; he describes it as consisting in the beauty of the construction or assemblage of the several parts of the work, which renders its aspect or whole appearance graceful; *e. gr.* when the height corresponds to the breadth, and the breadth to the length, &c.

"From these three ideas or designs, *viz.* orthography, scenography, and profile, it is that eurythmy, *majestica*, and *venusta species edificii*, do result, which creates that agreeable harmony between the several dimensions, so as nothing seems disproportionate, too long for this, or too broad for that, but corresponds in a just and regular symmetry, and consent of all the parts with the whole." Evelyn's Account of Archit. &c.

EUSCOM, in *Geography*, a river of Canada, which runs into lake St. Clair. N. lat. 42° 45′. W. long. 82° 25′.

EUSDALE, or EYSDALE, a small island on the W. coast of Scotland, noted for its quarries of slate. N. lat. 56° 13′. W. long. 5° 48′.

EUSEBES, the name of a species of marble mentioned by Pliny: he has given us no description of it, but only tells us, that there was a seat made of it in the temple of Hercules at Tyre, from which the priests pretended that the gods used to arise.

EUSEBIANS, a denomination given to the sect of Arians, on account of the favour and countenance which Eusebius, bishop of Cæsarea, shewed and procured for them at their first rise; or rather from the protection afforded to Arius, and the adoption of his opinions by Eusebius bishop of Nicomedia. See ARIANS.

EUSEBIUS, pope, in *Biography*, a native of Greece, son of a physician, perhaps he himself at one period was a physician, succeeded Marcellus in the see of Rome. It is believed that he filled the pontificate but a very few months. He was a violent opponent to the re-admission of lapsed Christians to communion, and his conduct on this head created great dissensions at Rome, to put an end to which the emperor Maxentius banished him to Sicily. Moreri. Bower.

EUSEBIUS, surnamed *Pamphilus*, was born at Cæsarea in Palestine, of which he was afterwards bishop, about the year 270. Of his parents, and his instructors in early life, we have no account; nor is any thing recorded concerning his family. His talents and learning may, however, be justly appreciated by his numerous and valuable works. Having been ordained presbyter, probably, by Agapius, bishop of Cæsarea, he set up a school in that city, which produced many learned men, and whilst he was in this situation he formed an intimate acquaintance and friendship with Pamphilus, a learned presbyter of the same church, who is supposed to have afforded him much assistance in his studies. When Pamphilus was imprisoned in the year 307, Eusebius attended him to animate his fortitude and comfort him in his distress: and after the martyrdom of his friend in 309, he removed to Tyre, where he witnessed the firmness and patience with which many Christians endured the severity of persecution. From thence he went to Egypt, where the same scene was exhibited, and where he himself was imprisoned. As he did not suffer in common with others, some persons have insinuated, that he procured his liberty by sacrificing, or by some other mean compliance, unbecoming his Christian principles and profession. But Dr. Lardner has alleged several circumstances which evince this accusation to be altogether unfounded. At the close of the Dioclesian persecution, Eusebius returned to Palestine, and succeeded Agapius, according to the more general opinion, as bishop of Cæsarea in the year 315. It is certain, however, that he was bishop of Cæsarea in the year 320 at the latest. After this period he was present at most of the synods held in that part of the world; and on all occasions distinguished himself by recommending peace and mutual forbearance. At the famous council of Nice in 325, he was placed by command of Constantine on the right hand of the throne, and opened the meeting by a panegyrical address. At this council he seems to have been desirous of compromising the dispute between Arius, to whose sentiments he probably inclined, and the orthodox party; and with this view proposed a creed, which all the fathers allowed to be unexceptionable. Some of the most zealous partizans, however, suggested the propriety of introducing the word ὁμοουσιος, or *consubstantial*, as applicable to the Son; and the motion for this purpose was carried by a majority. Eusebius for some time demurred, alleging that the expression was unscriptural; but at length, being allowed to subscribe to the term in his own sense of it, he submitted; and the word became afterwards the test of orthodox belief, but very ineffectual for allaying the dissensions of the Christian church. In the year 330 Eusebius concurred with the council at Antioch in deposing Eustathius the bishop; but though the bishops and people concurred in electing him for this see, which was more honourable and profitable than that of Cæsarea, he peremptorily refused the acceptance of it. Although they applied to Constantine for the interposition of his authority, Eusebius wrote to the emperor, and obtained his permission to decline it, accompanied with encomiums on his moderation and disinterestedness, which he justly merited. At the council of Tyre in 335 he joined those bishops who condemned the proceedings of Athanasius, bishop of Alexandria; and he was deputed to attend the emperor, in order to justify the measures that had been adopted against that prelate. On occasion of this visit to Constantinople, he pronounced his panegyric on the emperor, and obtained singular marks of Constantine's condescension and favour. After his return to Cæsarea, the emperor kept up an epistolary correspondence with him, specimens of which are preserved in Eusebius's life of that prince. This work was written soon after the death of the emperor; nor did the bishop long survive, for he died in the year 339 or 340. Of the learning and application of Eusebius, his works afford ample evidence. "From his works it appears," says Tillemont, "that he had read all sorts of Greek authors, whether philosophers, historians, or divines, of Egypt, Phœnicia, Asia, Europe, and Africa." Eusebius had opportunities for conversing with the most learned men of his time, and he had access to the best libraries: so that from these different resources he was able to compile works of various kinds, in which he exercised a laudable caution with respect to his authorities and facts, and in which he also manifests a considerable degree of candour and impartiality. His works, however, as compositions, claim no very high commendation, as they are destitute of elegance and perspicuity. Upon the whole we may observe, that he was a good man as well as a learned scholar; zealously attached to religion, without bigotry; an enemy to ecclesiastical tyranny and discord, and always desirous of accommodating differences, and reconciling contending parties. Nevertheless Dr. Lardner mentions with disapprobation his concurrence with the Arian party in the harsh treatment given to Eustathius, bishop of Antioch, Athanasius of Alexandria, and Marcellus of Ancyra. As to his sentiments with regard to the doctrine, warmly controverted in his time, Dr. Jortin inclines to think, that he was neither an Arian nor an Athanasian, but that he endeavoured to steer a middle course, and yet inclining more to the Arians than to the Athanasians. Dr. Lardner, with his usual caution, observes, that this is a question which cannot be easily decided.

Of the works of Eusebius we can here enumerate only the principal, referring for an account of the rest to the writers cited at the close of this article. The first that deserves mention is the "Ecclesiastical History," in ten books, published in 326, and containing the history of the Christian church from the birth of Christ to his own times. The best edition is that of Valesius, published at Cambridge by Reading in three volumes folio. This contains Eusebius's "Life of Constantine," in four books, written in 337 or 338, and other ecclesiastical historians, Socrates, Theodoret, &c. In this history we have several passages concerning the canon of scripture; in which the author treats of the order of the gospels; of the scriptures universally acknowledged, and of those that are not such; of the epistles, &c. (See CANON.) Eusebius's "Chronicle" was a work of prodigious labour and learning; and is preserved only in a Latin version of Jerome. The "Evangelical Preparation," in 15 books, and ten books of the "Evangelical Demonstration," which originally comprehended 20 books, are still extant; and contain the most learned defence of Christianity against both Jews and Pagans, transmitted to us from antiquity. A beautiful edition of these valuable works was published in Greek, by Robert Stephens, in 1544 and 1545, in 2 vols. fol., and reprinted at Paris, in 1628, in 2 vols. fol., with a Latin version of the former, and various readings from different MSS. and notes by Francis Vigerius, and Donatus's Latin version of the latter. Eusebius was also the author of a "Commentary upon the 150 Psalms," published by Montfaucon in 1705, as far as the 119th psalm: "A Commentary upon the Prophecies of Isaiah," published likewise by Montfaucon: "An Exposition of the Song of Songs," published by Meursius in 1627; "A Treatise against Hierocles" who had made a comparison of Apollonius Tyanæus with Jesus Christ, still extant in the original Greek; "Two books against Marcellus," who revived the heresy of Sabellius, and "Three books of Ecclesiastical Theology," written in 336; "An Apology for Origen," in 6 books, the joint work of Eusebius and Pamphilus, now existing in a Latin version; "Ten Evangelical Canons," or rules for harmonizing the gospels; the "Topics," in two books, being a kind of dictionary of places mentioned in the Scriptures; "A description of the Church of the Sepulchre at Jerusalem, &c." composed in 335; "An Oration in praise of Constantine," which is as much an argument for the truth of the Christian religion, as a panegyric upon the emperor, and much commended by Du Pin and Lardner; the "Life of Constantine," in 4 books, already mentioned: "Fourteen small pieces in Latin," published by James Sirmond in 1643, 8vo. and many other treatises, that are no longer extant. Fabr. Bibl. Græc. v. vi. Cave's H. L. vol. i. Lardner's Works, vol. iv. Jortin's Rem. on E. H. vol. ii.

EUSEBIUS, first of all bishop of Berytus in Phœnicia, and afterwards of Nicomedia, in Bithynia, was advanced to the see of Constantinople in 338 or 339. He was a relation of the emperor Julian, who was educated by him, and probably also of Constantine: and as he was a man not only distinguished by his abilities and learning, but favoured with free access to the court, his influence on behalf of the Arian party,

party, to which he was attached, was always of great importance to their caufe. From the protection afforded to Arius and his followers by Eufebius they were frequently denominated "Eufebians." Although he remonftrated againft the proceedings of the court of Nice in 325, at which he was prefent, he fubfcribed the creed, probably with the fame explanation which was given by the bifhop of Cæfarea of the fame name. That this was the cafe we may infer from the patronage which he afforded to the Arians, and which caufed Conftantine to depofe him from his fee and to fend him into exile. He was afterwards, *viz.* in 328 or 329, recalled, and reftored to his fee, as well as to the favour of the emperor. Afterwards, when the Arian party became triumphant at the court of Conftantinople, he encouraged the perfecution of thofe who had been the perfecutors of Arius. Having maintained his credit and influence with Conftantine till his death, he gained in an equal, if not greater, degree, the confidence of his fon Conftantius; who promoted him, in 338, to the fee of Conftantinople. In this high ftation he was active in promoting the Arian interefts, and in perfecuting the Catholics. Soon after the council of Antioch, held in 341, probably in the fame or the fucceeding year, he terminated his career. Eufebius was eminent for his abilities and learning; and his friends have extolled his piety and virtue: but no fufficient apology can be offered for his intolerance. His writings were numerous, but none of them remain, except a "Letter concerning Arius and his Opinions," preferved by Theodoret. Fabr. Bibl. Græc. vol. vi. Cave's H. L. vol. i. Lardner's Works, vol. iv.

Eusebius, bifhop of Emefa, who flourifhed about the year 340, was defcended of a very honourable family, and born at Edeffa in Mefopotamia, at which place he enjoyed the benefit of a learned education, and of early inftruction in the facred fcriptures. He afterwards removed to Paleftine, where he ftudied under Patrophilus of Scythopolis, and Eufebius of Cæfarea. He likewife went to Antioch, and from thence to Alexandria, in which city he ftudied philofophy, and then returned to Antioch. Some time after that, having refufed the offer of the fee of Alexandria, from which Athanafius was depofed in 341, he was appointed bifhop of Emefa; where his diftinguifhed proficiency in literature and the fciences led the ignorant populace to charge him with the practice of magical arts. Under this accufation, he was obliged to retire to Laodicea, and to feek the protection of George, bifhop of that city, who was afterwards his biographer. When the prejudices of the mifguided people at Emefa fubfided, he returned thither, and here he fpent the greater part of the remainder of his life, which terminated at Antioch about the year 360. He is generally thought to have embraced the Arian tenets: though Cave thinks that he fhould be ranked among the Semi-Arians. However this be, his character was held in high eftimation for virtue and piety, as well as for learning and eloquence. Although he was great and good, as Sozomen fays, he experienced the envy of thofe who are offended at other men's virtues. The emperor Conftantius, however, was much pleafed with him, and his attendance was always required by that prince in his expeditions againft the Perfians. He wrote a great number of books, which were chiefly treatifes againft the Jews, againft the Novatians, and againft the Manichæans; 10 books upon the epiftle to the Galatians; and many fhort homilies upon the gofpels. His works are in general loft. His treatife againft the Jews is faid to be ftill extant in a Greek MS. in the library at Vienna. The homilies, that have been publifhed under his name at Paris in 1575, and at Antwerp in 1602, 8vo. are now allowed to be the productions of other writers. Socr. Hift. Eccl. l. iii. Cave's H. L. vol. i. Lardner's Works, vol. iv.

Eusebius, bifhop of Verceil, or Vercelli, in Italy, was born in Sardinia; and flourifhed about the year 354. In this year he was deputed by pope Liberius to plead the caufe of Athanafius, after his expulfion from Alexandria, before the emperor Conftantius; and in the council at Milan he was a zealous advocate for the depofed bifhop, and for the Nicene creed. The Arian party, however, prevailed, and a decree was paffed for condemning the conduct of Athanafius. Eufebius refifted, and for his unyielding fteadinefs he was banifhed to Scythopolis in Syria, afterwards to Cappadocia, and laft of all into the Upper Thebais. The caufe of orthodoxy, nothwithftanding all his fufferings, found him an undaunted and perfevering advocate. Upon the acceffion of Julian to the empire, he and other friends were allowed to return home; and during the remainder of his life he maintained his invincible attachment to the Catholic doctrine, and his zeal in promoting it. He died about the year 370, or foon after. Moft of his works have been loft: but it is faid that in the cathedral church at Verceil there is a MS., containing a Latin verfion of the four Gofpels, which is inferted in the "Evangeliarium Quadruplex Latinæ Verfionis Antiquæ, feu veteris Italicæ," publifhed by Jofeph Bianchini, at Rome, in 1749. Cave's H. L. vol. i. Lardner's Works, vol. iv. chap. 90.

Eusebius, bifhop of Dorylæum in Phrygia in the fifth century, was at firft an eminent advocate at Conftantinople, but embracing the ecclefiaftical life, he obtained the above-mentioned fee, and diftinguifhed himfelf by his oppofition to the Eutychians. Some few of his works remain, which are of a polemical nature, and not worth mentioning. Cave's Hift. Lit. vol. i.

EUSENE, in *Ancient Geography*, a town of Afia, in Paphlagonia. Ptolemy.

EUSHAR, in *Geography*, a town of Afiatic Turkey, in Natolia; 24 miles E. of Ifharteh.

EUSHEIM, a town of Germany, in the principality of Wurzburg; 3 miles N.W. of Volckach.

EUSIMARA, in *Ancient Geography*, a town of Afia, in Melitenè, a country of Cappadocia, feated on the bank of the Euphrates. Ptolemy.

EUSKIRCHEN, in *Geography*, a town of France, in the department of the Roer; 20 miles S.E. of Juliers.

EUSTACE, or Eustatia, an inconfiderable American ifland, about 20 miles in circuit, forming with a long point of land the entrance to the harbour of St. Auguftine, in Eaft Florida. It was alfo called Metanzas, or Slaughter, from a butchery made upon it by the Spaniards.

EUSTACHE, David, in *Biography*, a French proteftant minifter, at Montpellier, affifted at the national fynod held at London in 1659, as deputy of the province of Lower Languedoc, and was nominated by the affembly to prefent to the king the letter which they had addreffed to him. He performed the tafk much to the fatisfaction of thofe who had appointed him to the office. He was author of many theological pieces and fermons; the titles of fome of the former are "Salutary Remedies againft a Departure from God;" "The Triumph of Faith;" "An Anfwer to the Queftion afked of the Proteftants, where was your Church before Luther;" "The Orator Tertullus convicted;" which was a reply to the harangue fuppofed to be made by the wife men of the pretended reformed religion to the queen Maria Therefa, upon her entrance into the kingdom, in which they declared that being informed fhe had expreffed great concern that part of the king her hufband's fubjects were

were heretics, they came to leffen that concern by embracing her majefty's religion, and that this they did after having been fatisfied, by the teftimony of their moft famous authors; that one may be faved in the Romifh religion. Moreri. Bayle.

EUSTACHIAN Tube, in *Anatomy*, is the paffage by which air is conveyed from the fauces to the tympanum of the car, fo called from an Italian anatomift. See Ear.

Eustachian *valve*, is a part formed in the right auricle of the heart. See Heart.

EUSTACHIUS, Bartholomew, in *Biography*, one of the moft celebrated anatomifts of the fixteenth century, was a native of a little village in Italy, called San Severino. He purfued his ftudies at Rome, where he firft conceived a bias in favour of medicine, and efpecially of anatomy, which he cultivated with fuch fuccefs, that he was appointed to the profeffor's chair in that college. This is nearly the fum of our knowledge refpecting the life of this celebrated man: he died at Rome in 1574. Euftachius was the author of feveral works, the greater part of which is loft. His treatife "De Controverfiis Anatomicorum," which was one of the moft confiderable of his productions, is much regretted. Thofe of his writings, which remain, confift of his Opufcula, which appeared under the following titles, "Opufcula Anatomica, nempe de Renum ftructura, officio, et adminiftratione: de auditûs organo: offium examen: de motu capitis: de vena quæ azygos dicitur, et de alia, quæ in flexu brachii communem profundam producit: de dentibus." Venet. 1563, and again in 1674, with the notes of Pinus. An edition was alfo publifhed at Leyden, 1707, under the fuperintendance of Boerhaave.

Euftachius was the author of feveral difcoveries in anatomy; he was the firft who defcribed the renal capfules, and the thoracic duct; and his name, ftill attached to the paffage leading from the throat to the internal ear, (the Euftachian tube,) announces the origin of our knowledge on that fubject. A feries of figures engraved on copper were mentioned in his Opufcula as nearly finifhed; but they were loft for more than 150 years, and were difcovered, and publifhed at Rome in 1714, by Lancifi, phyfician to pope Clement XI. in one volume folio. Thefe plates were again publifhed, but not well printed, at Geneva in 1717. The edition of Rome in 1728 is excellent; but the one publifhed at the fame city, 1740, by Petrioli, is lefs valuable. The fame work was twice publifhed at Leyden, under the direction of Albinus, *viz.* in 1744 and 1762.

Euftachius edited the lexicon of Erotian at Venice in 1666, under the title of "Erotiani, Græci fcriptoris vetuftiffimi, vocum, quæ apud Hippocratem funt, collectio, cum annotationibus Euftachii," in 4to. Eloy. Dict. Hift.

EUSTATHIANS, in *Ecclefiaftical Hiftory*, a name given to the Catholics of Antioch in the fourth century, on occafion of their refufal to acknowledge any other bifhop befide St. Euftathius, bifhop of Sebafté in Armenia, depofed by the Arians.

The denomination was given them during the epifcopate of Paulinus, whom the Arians fubftituted for St. Euftathius, about the year 330, when they began to hold their affemblies apart About the year 350, Leontius of Phrygia, called the Eunuch, who was an Arian, and was put in the fee of Antioch, defired the Euftathians to perform their fervice in his church; which they accepted; and the church of Antioch ferved indifferently thus both for the Arians and Catholics.

This, we are told, gave occafion to two inftitutions, which have fubfifted in the church ever fince; the firft was pfalmody in two choirs; though Mr. Baillet thinks, that if they inftituted an alternate pfalmody between two choirs, it was between two Catholic choirs, and not by way of refponfe to an Arian choir. The fecond was the doxology, *Glory be to the Father, and the Son, and the Holy Ghoft.*

This conduct, which feemed to imply a kind of communion with the Arians, gave great offence to abundance of Catholics, who began to hold feparate meetings, and thus formed the fchifm of Antioch. Upon this the reft, who continued to meet in the church, ceafed to be called Euftathians; and that appellation became reftrained to the diffenting party.

St. Flavianus, bifhop of Antioch, in 381, and one of his fucceffors Alexander, in 482, brought to pafs a coalition or re-union between the Euftathians and the body of the church of Antioch, defcribed with much folemnity by Theodoret, Eccl. lib. iii. cap. 2.

Eustathians were alfo a fect of heretics in the fourth century, denominated from their founder Euftathius, a monk fo foolifhly fond of his own profeffion, that he condemned all other conditions of life. Whether this Euftathius was the fame with the bifhop of Sebafté and chief of the Semiarians, it is not eafy to determine.

He excluded married people from falvation; prohibited his followers from praying in their houfes, and obliged them to quit all they had as incompatible with the hopes of heaven.

He drew them out of the other affemblies of Chriftians to hold fecret ones with him, and made them wear a particular habit; he appointed them to faft on Sundays; and taught them that the ordinary fafts of the church were needlefs, after they had attained to a certain degree of purity which he pretended to. He fhewed great horror for chapels built in honour of martyrs, and the affemblies held therein.

Several women, feduced by his reafons, forfook their hufbands, and abundance of flaves deferted their mafters' houfes.

He was condemned at the council of Gangra, in Paphlagonia, held between the years 326 and 341. Socr. lib. ii. cap. 43 and Sozom. lib. iv. cap. 24. Hard. Concil. Coll. tom. i. p. 530.

EUSTATHIUS, in *Biography*, a faint in the Greek and Roman churches, and bifhop of Antioch, was tranflated to that fee from the bifhopric of Beræa, in Syria, about the year 323. He was a ftrenuous opponent of the Arian doctrine, and is faid to have been the firft ecclefiaftic of confequence who wrote againft it. He was diftinguifhed by his zeal at the council of Nice in 325, and by his exertions in carrying the decifions of that council into effect. This conduct fo much exafperated the Arian bifhops, that they got him accufed of adhering to the doctrine of Sabellius, rather than to that of the council of Nice. His enemies alfo fuborned an infamous woman to appear before the fynod of the Eaftern bifhops, to charge Euftathius with being father of a child which fhe held in her arms: other charges, equally difreputable, were made againft him: of thefe he was declared guilty, and depofed from his paftoral office. He was afterwards banifhed to Trajanopolis in Thrace, where he died. Of his numerous writings we have few remains, excepting the fragments collected by Fabricius. Jerome thought highly of his talents; Sozomen commends him for his piety and eloquence, and fays that his works were in high eftimation in his time. By Theodoret he is called the great Euftathius: but Socrates and others fpeak very flightingly of his talents, and Socrates fays he is one of thofe obfcure perfons who had endeavoured to raife his own reputation by oppoſing Origen. He is generally admitted to have been the author of "A Diſſertation concerning the Ventriloquiſt or Pythoneſs," mentioned in Samuel, firſt book, chap. xxvii. written againſt Origen on that ſubject. This was publiſhed by Allatius in Greek, with a Latin verſion, in 1629, and may be found in the 29th volume of the "Bibliotheca Patrum," and in the eighth volume of the "Critici Sacri." Fabr. Bib. Græc. vol. viii. Cave's H. L. vol. i. Lardner's Works, vol. iv.

EUSTATIA, or Eustatius, *St.*, in *Geography*, one of the leeward Caribbee iſlands; which is a huge pyramidal rock riſing out of the ſea, about 29 miles in compaſs; but for its ſize the Dutch, by their induſtry, rendered it one of the moſt valuable of the Caribbees. The ſides of the mountains are laid out in pretty ſettlements; but they have neither ſprings nor rivers. Sugar and tobacco have been the chief produce of this iſland, which the Dutch have cultivated even to the top of the pyramid, which terminates in a plain ſurrounded with woods, having a hollow in the middle that ſerves as a den for wild beaſts. This iſland has afforded ſubſiſtence for five thouſand white people, and fifteen thouſand negroes, who rear hogs, kids, rabbits, and all kinds of poultry in ſuch abundance, that they have been able to ſupply even their neighbours. It has but one landing place, which the original occupiers, finding difficult of acceſs, fortified, ſo as to render it almoſt impregnable. Such for many years was the policy of the Dutch in the government of this iſland, that they have been jealous of admitting any ſtrangers into their harbour, and kept them ignorant of its internal riches, whilſt it has ſerved as a ſtorehouſe for all European commodities. The property of it was firſt granted by the States-General to certain merchants of Fluſhing. It was firſt ſettled about the year 1600; but in the wars between the Engliſh and Dutch in 1665, the latter were diſpoſſeſſed of it by an armament from Jamaica. The Engliſh were afterwards diſpoſſeſſed by the combined forces of the Dutch and French; and the latter kept poſſeſſion of it till it was reſtored to the Dutch by the treaty of Breda. Soon after the revolution, the French ejected the Dutch from this iſland, whence they were again driven by the Engliſh under ſir Timothy Thornhill, who, with a view to the protection of the Dutch, left a ſmall Engliſh garriſon in the fort. The peace of Ryſwick reſtored the Dutch to the entire poſſeſſion of the iſland. In the year 1781 this iſland was obliged to ſurrender to the Engliſh under admiral Rodney, who confiſcated the private property of the inhabitants under a plea that they had aſſiſted France and the United States with naval and other ſtores. Before the cloſe of the year it was retaken by the French under the command of the marquis de Bouille; but reſtored to the Dutch at the peace in 1783. It is diſtant 9 miles N. W. from St. Chriſtopher's. N. lat. 17° 30′. W. long. 63° 8′.

Eustatia, is alſo the name of a town in the fore-mentioned iſland.

EUSTATIUS, in *Biography*, archbiſhop of Theſſalonica, flouriſhed in the 12th century, under the emperors Manuel, Alexius, and Andronicus Comnenus. He is celebrated for his great learning as a grammarian and critic, and is eſpecially known as a commentator on Homer and Dionyſius the geographer. His annotations on the former are copious, and abound in hiſtorical and philological deſcriptions: they were publiſhed at Rome in four volumes folio, between the years 1542 and 1550, and have been re-printed, particularly at Florence in 1730, with the notes and tranſlations of Politi and Salvini. The commentaries on Dionyſius were firſt printed in the Greek, by Robert Stephens in 1547, and have been ſeveral times re-printed. A Latin verſion of them was given by Politi in 1742, at Geneva, in two volumes octavo. Moreri.

EUSTEPHIA, in *Botany*, ευϛεφιος, *wearing a beautiful crown*, alluding to the coronet formed in the mouth of the flower, by the tranſverſe ſegments of the ſtamens. Cavan. Ic. v. 3. 20. Willd. Sp. Pl. v. 2. 48. Vent. Regn. Veg. v. 2. 282. Claſs and order, *Hexandria Monogynia.* Nat. Ord. *Spathaceæ*, Linn. *Narciſſi*, Juſſ.

Gen. Ch. *Cal.* Sheath oblong, divided to the baſe into four acute ſegments, withering. *Cor.* ſuperior, of one petal, tubular, regular, in ſix deep, linear, obtuſe, nearly equal ſegments, three of which are internal; without any appendage at the mouth. Nectary ſix little cavities in the baſe or tube of the corolla. *Stam.* Filaments ſix, inſerted into the bottom of the corolla, juſt above each nectariferous pore, linear, flat, ſomewhat longer than the corolla, and three-cleft juſt where they emerge from it, the middle ſegment longeſt, erect, ſlender, bearing the anther, the lateral ones ſhort, and horizontally divaricated, forming a crown in the mouth of the corolla; anthers incumbent, ovate. *Piſt.* Germen inferior, turbinate, triangular; ſtyle thread-ſhaped, the length of the ſtamens; ſtigma ſwelling, undivided. *Peric.* as far as can be judged from the germen, a capſule of three cells. *Seeds* . . . .

Eſſ. Ch. Calyx a divided ſheath. Corolla ſuperior, regular, tubular, cylindrical, in ſix deep ſegments. Nectary ſix pores in the baſe of the corolla. Filaments with two lateral points.

1. E. *coccinea*, Cavan. Ic. t. 238. Flowered in the royal garden at Madrid in May 1794, but its native country is unknown. *Root* perennial, bulbous. *Leaves* radical, ſeveral, linear, obtuſe, ſomewhat falcated. *Stalk* ſolitary, above a foot high, ſtout, ſmooth, ſlightly compreſſed. *Flowers* four in a terminal umbel, drooping, ſcarlet, reſembling thoſe of *Cyrtanthus anguſtifolius*, but very diſtinct in their ſtructure. *Sheath* nearly as long as the partial flower-ſtalks and flowers together.

EUSTOCHIUM, or Eustochia, in *Biography*, a Roman lady in the 4th century, who is highly ſpoken of by St. Jerome, was a deſcendant from the families of the Scipios and Paulus Æmilius, and rendered herſelf celebrated for the proficiency which ſhe had made in literature. She was well acquainted with the Hebrew and Greek, as well as the Latin tongues, and converſant with the moſt important theological ſubjects. In the Catholic world her memory is cheriſhed on account of her early devotedneſs to a religious courſe. She profeſſed herſelf a diſciple of St. Jerome, whom ſhe followed from Rome to Cyprus, and thence to Antioch, Egypt, and numerous other places, and at length fixed her reſidence in a monaſtery at Bethlehem. Her mother Paula deſerted a young family to accompany her in theſe excurſions. Moreri.

EUSTRATIUS, a preſbyter of the church of Conſtantinople, flouriſhed about the year 578, and was author of "A Treatiſe concerning the Souls of the Dead," intended to prove that the ſouls of all men are active after their ſeparation from the body, and that they act differently according to the difference of their merits. He was author alſo of "The Life of the Patriarch Eutychius," which appears to have been a funeral oration pronounced by Euſtratius in the great church at Conſtantinople, a ſhort time after the death of the ſubject of it.

Eustratius, archbiſhop of Nice in the twelfth century, is mentioned by Anna Comnena, and other Latin writers, as a perſon of profound learning and ſkill, as well in civil as eccleſiaſtical affairs. He was author of "A Treatiſe againſt Chryſolanus concerning the proceſſion of the

Holy

Holy Spirit," and of other unpublished treatises. The only works of his which have been committed to the press are "Commentaries on the latter Analysis of Aristotle," published in Greek at Venice, in 1534: and "Commentaries on the Ethics of Aristotle," published likewise in Greek at the same place, 1536, and at Paris in Latin, 1543. Moreri.

EUSTYLE, formed of ευ, *bene*, *well*, and ϛυλος, *column*, in *Architecture*, a kind of edifice, where the columns are placed at a most convenient distance one from another, the intercolumniations being all just two diameters and a quarter of the column, except those in the middle of the fronts, before and behind, which are three diameters distant.

The eustyle is a medium between the pycnostyle, and arcostyle.

Vitruvius, lib. iii. cap. 2 observes, that the eustyle is the most approved of all the manners of intercolumniation, and that it surpasses all the rest in conveniency, beauty, and strength.

EUTACA, in *Geography*, a mountain of Egypt, near the Red sea; 12 miles S. of Suez.

EUTAM, a small island of the West Indies, near the east coast of Porto-Rico. N. lat. 18° 18'. W. long. 64° 41'.

EUTERPE, in *Botany*, ευτερπης, *pleasing or agreeable*. Gærtn. v. 1. 24. t. 9. Juss. 453. Supposed by Jussieu to be the same with his *Corypha Sabal*, see our CORYPHA, sp. 3, which Adanson likewise made a distinct genus. If it be so, Gærtner's classical appellation may well take place of the barbarous Sabal.

EUTERPE, of ευ, *well*, and τερπω, *I delight*, in *Mythology*, one of the nine Muses, which presided over wind-instruments: she is represented with a crown of flowers, playing on a double flute, with Cupid at her knees. Sometimes she has a mask in her left hand, and a club in her right. To her the invention of tragedy is ascribed.

EUTHIA, a term in the *Ancient Music*, which implies a succession of notes proceeding from grave to acute. Euthia was one of the parts of the ancient Melopœia.

EUTHYMIA, Ευθυμια, among the Greeks, signified such a disposition or state of the mind, as could not be ruffled either by good or bad fortune, by sickness or health, good or evil. Mem. Acad. Inscript. vol. xiv. p. 131.

EUTHYMIUS, in *Biography*, flourished in the tenth century, first as a monk, and afterwards, by his talents and virtues, he so far recommended himself to notice, that he obtained the appointment of "Syncelle," an office of high rank under the patriarch, and he was also chosen confessor by the emperor Leo VI. In 906 the patriarch Nicholas was deposed by the emperor, and Euthymius was elevated to it in his stead. Upon the death of Leo, his successor Alexander II. re-established Nicholas in the patriarchal chair, and sentenced Euthymius to banishment, a punishment which he bore with fortitude and patience till his death, in or about the year 920. Another patriarch of Constantinople, of the name of Euthymius, obtained that dignity in the year 1410, and enjoyed it till his death in 1416. Moreri.

EUTHYMIUS ZIGABENUS, was a monk of the order of St. Basil, who flourished at Constantinople about the beginning of the twelfth century. By his superior talents he acquired the patronage and esteem of the emperor Alexius Comnenus, at whose command he drew up his Panoplia, or defence of the orthodox faith against all heresies. It consists chiefly of passages selected from the writings of the ancient Greek fathers on different points, in which heretics have departed from the Catholic doctrine. Euthymius was also the author of "A Commentary upon the Psalms and Canticles," of which a Latin version was published by Saulius in 1530, and since that time more than once reprinted; "A Commentary on the four Evangelists," selected from the ancient fathers; "Commentaries on the Epistles of St. Paul;" "A Treatise against the Heresies of the Massalians, &c." Moreri.

EUTHYPOROS, from ευθυς, *straight*, and ποριζω, *to pass into*, among the old terms of *Surgery*, meant extension, made in a straight line, in order to reduce fractures, and dislocation.

EUTIN, in *Geography*, a town of Germany, in the bishopric of Lubeck, situated by the side of a lake, the usual residence of the prince bishop, the bishopric, like that of Osnaburg, being secular; 20 miles N. of Lubeck. N. lat. 54° 10'. E. long. 10° 32'.

EUTOCIUS, in *Biography*, a considerable mathematician, who lived at the time of the decline of the sciences in Greece, was a native of Ascalon, in Palestine, and a disciple of Isidorus, one of the celebrated architects employed by the emperor Justinian. He probably flourished about the commencement of the sixth century, though we have no particulars respecting his life; but his works reflect much honour on his memory. He wrote elaborate and perspicuous "Commentaries on the books of Archimedes concerning the Sphere and Cylinder;" and also on the first four books of the Conics of Apollonius Pergæus. These commentaries have not only elucidated many difficult passages in those profound writers, but have tended to throw light on the history of mathematics. There have been many editions of them, but the most magnificent was that in the edition of the works of Archimedes, printed at Oxford in folio, in the year 1792, which was prepared for the press by Torelli of Verona; and that in Dr. Halley's edition of the eight books of Apollonius, published at Oxford in 1710. Moreri. Montucla.

EUTROPIUS, a Latin historian of the fourth century, is supposed to have been a native of Acquitain. He bore arms under Julian, in his expedition against the Persians, and is said to have risen to the senatorian rank. He wrote several works, of which the only one remaining is an abridgment of the Roman history, in ten books, from the foundation of the city to the reign of the emperor Valens. This is a neat compendium, and has long since been received as a school-book. Moreri.

EUTROPIUS, the eunuch minister of the emperor Arcadius, who rose by base and infamous practices from the vilest condition to the highest pitch of opulence and power, was probably a native of Asia. In the year 395 he was made great-chamberlain to Arcadius, emperor of the East. After the fall of Rufinus, he succeeded that minister in the confidence of his master, and rose to unlimited authority. All persons of whatever rank humbled themselves before the favourite, who became the capricious disposer of honours and emoluments of every kind, and in 399 he, an eunuch, even assumed the dignity of consul, a disgrace to Rome never before equalled. Honours, if such they may be denominated, of every kind were accumulated upon him: the towns were filled with his statues, and he was entitled the third founder of Constantinople. His predominant passion was the love of money, and of course the most shameful venality directed all appointments to the high offices of the state. As a security to his person, a law of treason was passed, which extended the penalties of that crime to every attempt against the ministers and servants, as well as against the person of the emperor. Such a shield was not sufficient to defend him from the influence of court intrigue. An in-

sult

ſult which he offered to the empreſs cauſed her to implore the protection of her huſband, and at the ſame moment complaints were offered againſt him from other quarters, which induced the emperor to ſign his condemnation, and the fallen and juſtly execrated favourite was obliged to ſeek refuge in the ſanctuary of a church, from the pulpit of which Chryſoſtom pronounced an eloquent diſcourſe, pointing him out to the people as an example of the inſtability of human grandeur. He afterwards ſurrendered himſelf on promiſe that his life ſhould be ſpared, and was condemned to perpetual exile in Cyprus. Thither he was conveyed, but being haſtily brought back and tried on another charge, he was condemned and beheaded in the year 399. Gibbon.

EUTYCHIA, in *Ancient Geography*, an iſland of the Ægean ſea, before the Pagaſci gulf.

EUTYCHIANS, in *Eccleſiaſtical Hiſtory*, ancient heretics, who denied the duplicity of natures in Chriſt; thus denominated from Eutyches, the archimandrite, or abbot of a monaſtery at Conſtantinople, who began to propagate his opinion A. D. 448.

The averſion Eutyches bore to the hereſy of Neſtorius threw him into another extreme not leſs dangerous than that he ſo warmly oppoſed; though ſome paſſages in St. Cyril, which raiſed the unity of the perſon of Jeſus Chriſt very high, contributed likewiſe to his deluſion. At firſt he held that the *Logos*, *Word*, brought his body down with him from heaven; which was a near approach to the hereſy of Apollinarius; and, though he afterwards teſtified the contrary, in a ſynod at Conſtantinople, wherein he was condemned, yet he could not be brought to acknowledge that the body of Jeſus Chriſt was conſubſtantial with ours.

In effect, he did not ſeem quite ſteady and conſiſtent in his ſentiments; for he appeared to allow of two natures, even before the union; which was apparently a conſequence he drew from the principles of the Platonic philoſophy, which ſuppoſes a pre-exiſtence of ſouls; accordingly he believed that the ſoul of Jeſus Chriſt had been united to the divinity, before the incarnation; but then he allowed no diſtinction of natures in Jeſus Chriſt ſince his incarnation.

See the diſſertation of H. Hardouin, "De Sacramento Altaris;" wherein that Jeſuit endeavours to unfold all the ſentiments of the Eutychians.

This hereſy was firſt condemned in a ſynod held at Conſtantinople, by Flavian, in 448, approved by the council of Epheſus, called *Conventus latronum*, in 449, and re-examined and fulminated, in the general council of Chalcedon, in 451. The legates of pope Leo, who aſſiſted at it, maintained, that it was not enough to define, that there were two natures in Jeſus Chriſt, but inſiſted ſtrenuouſly, that, to remove all equivocations, they muſt add theſe terms, *without being changed, or confounded, or divided.*

The hereſy of the Eutychians, which made a very great progreſs throughout the Eaſt, at length became divided into ſeveral branches. Nicephorus makes mention of no fewer than twelve; ſome called *ſchematici*, or *apparentes*, as only attributing to Jeſus Chriſt, a phantom, or appearance of fleſh; and no real fleſh; others *Theodoſians*, from Theodoſius, biſhop of Alexandria; others *Jacobites*, from one James, *Jacobus*, of Syria; which branch eſtabliſhed itſelf principally in Armenia, where it ſtill ſubſiſts. Others were called *Acephali*, q. d. *without head*; and *Severians*, from a monk called Severus, who ſeized on the ſee of Antioch in 513.

Theſe laſt were ſubdivided into five factions, *viz.* *Agnoetæ*, who attributed ſome ignorance to Jeſus Chriſt; the followers of Paul; Μελαινοι, that is, the *black Angelites*, thus called from the place where they were aſſembled; laſtly, *Adrites*, and *Cononites*.

Eutychians was alſo the name of another ſect, half Arian, half Eunomian, which aroſe at Conſtantinople in the fourth century.

It being then a matter of mighty controverſy among the Eunomians at Conſtantinople, whether or no the Son of God knew the laſt day and hour of the world, particularly with regard to that paſſage in the Goſpel of St. Matthew, chap. xxiv. ver. 36. or, rather, that in St. Mark, xiii. 32. where it is expreſſed, that *the Son did not know it, but the Father only*; Eutychius made no ſcruple to maintain, even in writing, that the Son did not know it; which ſentiment diſpleaſing the leaders of the Eunomian party, he ſeparated from them, and made a journey to Eunomius, who was then in exile.

That heretic acquieſced fully in Eutychius's doctrine, and admitted him to his communion; Eunomius dying ſoon after, the chief of the Eunomians at Conſtantinople refuſed to admit Eutychius; who, upon this, formed a particular ſect of ſuch as adhered to him, called *Eutychians*.

This ſame Eutychius, and one Theophronius, as was ſaid in Sozomen's time, were the occaſions of all the changes made by the Eunomians in the adminiſtration of baptiſm; which conſiſted, according to Nicephorus, in only uſing one immerſion, and not doing it in the name of the Trinity, but in memory of the death of Jeſus Chriſt.

Nicephorus calls the chief of that ſect not Eutychius, but Eupſychius, and his followers Eunomioeupſychians.

EUTYCHIANUS, in *Biography*, biſhop of Rome, ſucceeded to that high office on the death of Felix, in the year 275, and preſided over the church about eight or nine years, when he died. Catholics have conſidered him as a martyr to the cauſe of truth; but hiſtorians, in general, infer, from the unmoleſted ſtate of Chriſtians, at that period, in Rome, that he died a natural death. There are two decretal epiſtles of this pope extant, relative to ſubjects of eccleſiaſtical diſcipline. Moreri. Bower.

EUTYCHIUS, patriarch of Conſtantinople, was born in the year 512. He was brought up to the eccleſiaſtical profeſſion, and obtained in early life the epiſcopal dignity in a town of Pontus, which he afterwards relinquiſhed, and entered into a monaſtery in the city of Amaſæa. In 552 he was deputed by the biſhop of that city to Conſtantinople, as his repreſentative, in the approaching general council that was to be held there. Before the meeting of the council, he obtained the favour of Juſtinian, who raiſed him to the patriarchate of Conſtantinople, which became vacant in the year 553, by the death of Mennas. Almoſt immediately after he had aſſumed the new character, he preſided at the council in which the opinions of Origen and his followers were condemned. Some years after, *viz.* in the year 564, Juſtinian endeavoured to obtain the patriarch's ſanction to a doctrine which he had adopted, *viz.* that the body of Jeſus Chriſt was rendered incorruptible before his reſurrection, by the union of the divine and human natures; but when Eutychius ſteadily refuſed to countenance the opinion, the emperor depoſed him from the patriarchate and ſent him into exile. In 578, he was reinſtated in the ſee of Conſtantinople, by the emperor Tiberius II. and he died in the year 585, at the age of 73. There is extant, in the fifth volume of the "Collectio Conciliorum," an epiſtle of his to pope Vigilius.

He was author of other pieces; of thefe a fragment of one only remains, "Concerning the Souls of the Dead." Moreri.

EUXINE SEA, called the *Black Sea*, as it is faid, either from its black rocks, or dangerous navigation, an inland fea, fituated partly in Europe, and partly in Afia; bounded on the north by the government of Caucafus and Ekatarinoflaf, on the eaft by Mingrelia and Georgia, on the fouth by Natolia, and on the weft by European Turkey. This fea is divided into the Euxine proper, the Pontus Euxinus, computed to be 1000 verfts in length, and 500 in breadth, and the fea of Azof, (fee AZOF) the Palus Mæotides of the ancients, which, without including the bay of Taganroh, is ftated to be 200 verfts long, and 160 verfts broad. Both thefe are now entirely within the confines of the Ruffian empire. The fea of Azof, called palus, or a marfh, by the ancients, becaufe it was polluted by mud, is united to the Euxine by the ftraits of Caffa, or the ancient Cimmerian Bofphorus. The moft important of the bays formed by thefe feas are the Liman, at the mouth of the Dnieper, the bay near Perekop, and that clofe to Yenikalé. The moft confiderable ifland belonging to thefe feas in the vicinity of the Ruffian coafts, is Taman. The principal harbours are Caffa, now Theodofia, Sebaftopol, Koflof, Balaklava, and fome others. At the weftern extremity of thefe feas, within the province of Taurida, is a very large pool, called Sivafh, or the Putrid fea, which is about 140 verfts long, and 54 broad. The chief rivers that fall into the Euxine, are the Kuban, or Hypanis of the ancients, the Don, or ancient Tanais, the Dnieper or Boryfthenes of ancient geographers, and the Bogur, which rifes in Poland, parting that kingdom, and a portion of European Turkey from Ruffia, and at Otchakof, falls into the Euxine. The Euxine fea was formerly denominated αξινος, or *inhofpitable*, on account of the barbarity of the inhabitants of its coafts; but when they became civilized by their commerce with the Greeks, the name was changed into ευξινος, i. e. *hofpitable*, or favourable to ftrangers.

EUZET, a town of France, in the department of the Gard; nine miles W. N. W. of Uzes.

EUZOIUS, in *Biography*, was in early life a deacon of the church of Alexandria, from which office he was expelled by Alexander, bifhop of that fee, at the fame time with Arius, on account of his efpoufing the principles of that celebrated character. They were both involved in the like condemnation at the council of Nice. About the year 355, he prefented a confeffion of faith to the emperor Conftantine, which met with the approbation of that fovereign, and which was the means of bringing him into confequence at the imperial court, when the orthodox party were thrown in the back ground. He was appointed to the fee of Antioch, and called upon to baptife the emperor Conftantius. His influence was now very confiderable, and to this the friends of Athanafius attribute much of the perfecution by which that bifhop was harraffed. Moreri.

EUZOIUS, bifhop of Cæfarea, was educated in that city at the fame time with Gregory Nazianzen. On the death of Acacius he obtained the bifhopric of Cæfarea, after maintaining a violent conteft with the different rival candidates. He was in principle an Arian, or nearly fo, and on that account was depofed from his fee under the reign of the emperor Theodofius, about the year 380. He was author of numerous treatifes now loft; poffeffed with much learning, and was very diligent in the difcharge of his epifcopal functions; but he is principally celebrated on account of his great exertions in promoting the interefts of fcience and literature. He manifefted much zeal in the reftoration and improvement of the library at Cæfarea, which had been originally collected by Origen and Pamphilus, and was at this period fallen into decay. To this object he devoted his time and labour, taking care that faithful tranfcripts fhould be procured of fuch books as were in a perifhing ftate, and increafing their numbers by new collections. Moreri.

EWAGE, *Ewagium*, in our *Old Writers*, the fame with *aquage*, which is toll paid for water-paffage. It is derived from the French *eau*, water.

EWALD, JOHN, in *Biography*, a Danifh poet, was born at Copenhagen in the year 1743. His father was a clergyman, and when he found his own end approaching he fent his fon for education to Slefwick, and died in a few hours after. Licht, the perfon to whofe care young Ewald was entrufted, treated him in every refpect as his own fon, and gave him free accefs to his library. The books moft agreeable to his tafte were romances, which he read with the greateft avidity. The adventures of Tom Jones and Robinfon Crufoe, particularly the latter, had made fuch an impreffion on his mind, and had excited his paffions fo ftrongly, that he eloped from Slefwick in his thirteenth year, in order to proceed to Holland, that he might undertake a voyage to Batavia, in the hope of being fhipwrecked and thrown on fome defert ifland. Scarcely had he travelled four miles, before he was overtaken by his preceptor and friend, who carried him back by force. At another time having read and heard of many romantic tales refpecting faints and martyrs, he was defirous of becoming a martyr for the caufe of Chriftianity. At length he refolved upon the profeffion of a foldier, which being oppofed by his friends, he left home, in company with his brother, and joined the Pruffian fervice, from this he deferted to the Auftrian army, in which he was firft a drummer, and then a ferjeant. A commiffion was offered him, provided he would embrace the Catholic religion, which he abfolutely refufed, and in a fhort time deferted again. On his return to Denmark he devoted himfelf to theology, and ftudied with fo much deligence as to be fit for examination in the courfe of a year. He had paid his addreffes to a lady, who, fufpecting him not to be in earneft, gave her hand to another: this fo affected Ewald as to produce a complete change in his difpofition, and to give his ideas a melancholy caft. He now abandoned himfelf to pleafure, and injured his conftitution. To give vent to the effufions of his mind, he wrote a piece, called "The Temple of Good Fortune," which proved the fource of all his future fame. It obtained the approbation of the fociety of Belles-lettres; and procured him the friendfhip of M. Carftens, a zealous votary of the mufes, which he enjoyed, without interruption, during the remainder of his life. On the death of Frederic V. in 1766, he compofed an elegy, which was received with univerfal approbation, and Ewald, intoxicated with the praifes beftowed upon his work, began to confider himfelf one of the greateft poets that Denmark had ever produced. The fociety of Belles-lettres propofed as the fubject of a prize the beft ode on any of the attributes of the deity, and Ewald, determined to try his fortune, made choice of the divine goodnefs, and had already formed his plan, when he learned that Benzon, one of his moft intimate friends, was employed on the fame fubject. Unwilling to enter the conteft with a friend he abandoned his fubject, and wrote his Adam and Eve, a fort of half drama, in one act, which poffeffed much merit, but without order or any regard to the laws of compofition. He hoped that this might obtain the prize, but was difappointed, and began to ftudy poetry, being now refolved to read; and not to write any more for two years. The works of Corneille and Klopſtock fell into his hands, and gave his taſte a new direction. His next work was "Rolfe Krage," a tragedy in the ſtyle of Oſſian, and "The ſongs of Skalden," which he wrote under the eye of Klopſtock, who had a very great and ſincere affection for him. During the time he was employed on this piece, he was attacked by a diſeaſe, under which he languiſhed for ten years. It proceeded from the gout, and was often attended with excruciating pain, yet his ſpirits and cheerfulneſs rarely forſook him, and he wrote in the intervals of his eaſe ſome ſmall theatrical pieces, which in part related to preſent times and manners, and which abounded with humour and the keeneſt ſatire. Ewald had obtained from the king a penſion of a hundred dollars, but this being inſufficient for his maintenance, he was obliged, by writing temporary poems, to gain a part of his livelihood, till the profits ariſing from the repreſentation of his theatrical pieces, and from the ſale of his works, ſhould place him beyond the fear of want. He died at Copenhagen in March 1781, in the thirty-eighth year of his age. In ſtrength of imagination, ſpirit and originality, Ewald ſurpaſſes all the other Daniſh poets. His excellent qualities gained him the affection of thoſe who knew him. He never proſtituted his muſe to improper purpoſes, and never, ſays his biographer, did an immoral or pernicious line flow from his pen. A complete edition of his works was publiſhed at Copenhagen between the year 1781—1791. Gen. Biog.

EWANICZOW, in *Geography*, a town of Poland, in the palatinate of Kaminiec; 64 miles N.N.W. of Kaminiec.

EWANO, a town of Poland, in Galicia; 36 miles S.E. of Halicz.

EWE, a ſmall iſland on the W. coaſt of Scotland, at the entrance of Loch Ewe. N. lat. 57° 53′. W. long. 5° 37′.

EWE, in *Rural Economy*, the female of the ſheep kind of animals. It is of very great importance in the forming of this ſort of ſtock to have good ewes. (See SHEEP.) It is the practice in ſome of the more northern diſtricts to have recourſe to the milking of the ewes in order to make cheeſe from it. But it is ſaid to have been lately found ſo injurious to the animals, and to be attended with ſo little profit, that it is, at preſent, much on the decline.

EWE-*Cheeſe*, is that ſort of cheeſe which is prepared from the milk of the ewe. It is a very ſtrong pungent kind of cheeſe, which is not well reliſhed by many. Some, however, conſider it as very rich and excellent, preferring it to the other ſorts of cheeſe. In ſome places theſe cheeſes are made of a conſiderable ſize, perhaps, nearly as large as thoſe of the Cheſhire dairies, one, two, or three hundred ewes being milked regularly for the purpoſe. See CHEESE.

EWELL, in *Geography*, is a market town in the hundred of Copthorne, and county of Surry, ſituated at the foot of Banſtead downs, diſtant S.E. by E. of London 13 miles. The weekly market is held on Thurſdays, and it has two annual fairs, one the 12th of May, the other the 29th of October. The number of houſes, according to the returns in 1801, is 194, and of inhabitants 1112. Here is the head of an extraordinary ſpring, which forms a curious natural jet d'eau, breaking out in ſeveral places. After watering Epſom-court meadows it flows in a fine ſtream called the Malden, and falls into the river Thames at Kingſton.

Near this town ſtood the magnificent palace, from its grandeur and ſplendid decorations, denominated "None-Such," erected by king Henry the Eighth. Charles the Second having conferred it upon his favourite miſtreſs, the infamous ducheſs of Cleveland, ſhe cauſed it to be taken down, and ſold the materials.

EWENNY, a river which has its ſource in the mountains to the north of Peterſton ſuper montem, and paſſing by Coychurch and Ewenny priory, joins the river Ogmore near Merthyr Mawr, below which it falls into the Briſtol channel. A phenomenon on this ſtream has given riſe to a geological error, which has generally been credited without proper inveſtigation, that the river makes a "dip under a mountain, appearing again near Nevern bridge, after a ſubterraneous paſſage of two miles." "Mr. Lethieuller obſerves, "that between Merthyr Mawr, near which alſo were deep ſands, and New-inn bridge, the river Ogmore, or rather a branch of it, runs a quarter of a mile under the hill, paſſing alſo under ſeveral natural bridges; after which, iſſuing out with great violence, it joins the main ſtream. The maps again here miſtake in giving this river the name of Ogmore before its junction with the Ewenny, after which only it aſſumes that name, being called before the Bridgend river, as it comes from Bridgend, where it runs under ground a a little to the north of that place, and appears again from under Ogmore hill." See Archæologia, vol. iv. p. 27. It occurs near the junction of the Ewenny with the river Ogmore. From the foot of a long ridge of down, where the hill makes a bold eſcarpement to the vale, iſſues a large body of water, exceeding the quantity previouſly flowing down the river, except after rains. In its paſſage from under the hill it is heard to boil and rage, and ruſhes out with foaming impetuoſity, as though it had met with violent interruption in its courſe; and forms two ſtreams, which immediately appear different in the velocity of their motions and quality of their contents; one being what is vulgarly called *hard*, and the other *ſoft* water. The ſtream to the ſouthward is ſought for culinary, and that to the northward for lavatory purpoſes. In trying it, Mr. Evans obſerves, "the water from the oppoſite ſides of the ſtream had a different effect upon the tongue and palate, and by a brief analyſis it was diſcovered, that the one contained a portion of calcareous matter in ſolution; and the other left but little reſidue, which was of an argillaceous nature." An attempt was then made to aſcertain whether the river might not enter ſome other part of the hill, and by a ſubterraneous paſſage here ſeek daylight again, as is reported of the Deveril in Wiltſhire, and the Mole in Surry. But after a fruitleſs ſearch the ſmalleſt veſtige of ſuch a ſubterraneous courſe could not be traced. The phenomenon therefore in queſtion appears to proceed from two powerful ſprings, riſing in the internal parts of the hill, the ſtreams of which having flowed ſeparately, here unite, but without intermingling their waters, till they join the Ewenny. Evans's Tour in South Wales.

EWENNY *Priory*, in *Antiquity*, was a monaſtery of the Benedictine order, founded by John Maurice de Lundres, Lord of Ogmore, A. D. 1140; and given as a cell to Glouceſter Abbey. Its revenues, as valued at the diſſolution, were 78*l.* 0*s.* 8*d.* It ſtands cloſe to the road leading from Newton to Pyle in Glamorganſhire, South Wales, in a marſhy plain, near the banks of the river Ewenny. It was ſurrounded by ſtrong embattled walls, having two gateways; and the one forming the principal entrance had two portculliſes: theſe, with parts of maſſive towers viſible among its ruins, indicate it was intended as a place of ſecurity, as well as religious retirement. The buildings appear to have been very extenſive, and ſome rooms, which formed the abbot's lodge yet remaining, are large and ſtately; particularly the great hall or refectory. But the abbey church, ſtill ſtanding, is a noble edifice, the ſimple and uniform architecture of which muſt be gratifying to every admirer of the arts. It is a maſſive building of a cruciform ſhape, conſiſt-

 ing

ing of a nave, two tranfepts, and a choir; in which heavy circular arches reft upon round bulky columns with fimple capitals: the windows alfo and door-ways have all the circular arch, which have induced fome to refer it to a Saxon period. The whole certainly denotes the earlieft Norman ftyle of architecture. The curious ftone vaulted groined roof of the choir claims particular attention; and the neglected effigies of the founder, bearing this infcription, "Ici gift Morice de Lundres le fundur, Deu li rende fun labur. Am." In the fouth tranfept lies another rude ftone figure of a knight in armour, which has generally been thought commemorative of Pain de Tuberville lord of Coity. But fir Richard Hoare has fhewn this ftatement, which originated with Camden, to be erroneous. After having the tomb cleaned, he was enabled to read the infcription thus,

"Sire Roger de Remi gift ici
Deu de fon alme eit merci am."

The perfon here named "De Remi," fir Richard fuppofes to have been fome friend, and follower of Morice de Lundres. The floor of the church has been paved with glazed porcelain tiles, ornamented with various devices, fuch as are feen in other buildings of a fimilar nature; but few now remain. The nave is at prefent ufed as the parifh church for divine worfhip, and the choir has a cemetery for diftinguifhed families in the vicinity: monuments for whom, particularly that of Carne, adorn its walls. It muft be matter of regret to thofe interefted in ancient buildings, to fee the prefent dilapidated ftate of this once noble ftructure: in many places rooflefs, the windows unglazed, the roof of the choir cracked, the fepulchral monuments broken, and thrown carelefsly about; and this noble fanctuary, which has ftood near feven hundred years, and exhibits the moft perfect fpecimen of early Norman architecture of any church in the kingdom, rapidly approaching to its diffolution. Evans's Tour in South Wales, and the Tranflation of Gyraldus's Itinerarium by fir Richard Colt Hoare.

EWER, in *Rural Economy*, a term fometimes provincially applied to the udder of the cow, or other animal. See UDDER.

EWES, or EUS, in *Geography*, a river of Scotland, which joins the Efk at Langholm, in Dumfries-fhire; and the valley through which it paffes is called Ewefdale.

EWRY, an office in the king's houfhold, where they take care of the linen for the king's table; lay the cloth, and ferve up water in filver ewers after dinner, whence the office takes its name.

EXACERBATION, in *Medicine*, fignifies the increafe or return of the fymptoms in thofe fevers of the remittent, intermittent, or even continued clafs, in which the febrile condition is renewed at regular periods, or becomes augmented. It is nearly fynonymous with *Paroxyfm*; but is more particularly reftricted to the periodical increafe of the remittent, or continued fevers, in which there is no abfolute ceffation of the febrile ftate. The evening exacerbation of hectic fever is a familiar example. Dr. Cullen afferts his belief, that there are commonly two exacerbations and remiffions both of hectic and of continued fever in the day; the one in the forenoon, the other in the evening: that of the morning, however, if it really occurs, is lefs diftinct, and many practitioners have been unable to detect it. See FEVER, and HECTIC.

EXACHORD. See HEXACHORD.

EXACHORDE, *Fr.* ESSACORDO, *Ital.*, an inftrument with fix ftrings, or a fyftem compofed of fix founds, fuch as the hexachord of Guido, which fee.

EXACTION, in *Law*, a wrong done by an officer, or one pretending to have authority: in taking a reward, or fee, for that in which the law allows not of any.

The difference between exaction and extortion, confifts in this; that extortion is, where the officer takes more than his due; and exaction, where he wrefts a fee, or reward, where none is due.

EXACTIS, in *Natural Hiftory*, a name given by Linkius, and fome other authors, to a fpecies of ftar-fifh, of the more branched kind, whofe rays are fix in number, when they firft part from the body, but very foon branch out into a great number more. See STAR-*fifh*.

EXACTOR REGIS, in *Law*, the king's exactor, or collector. Sometimes it is taken for the fheriff. But generally, "quicunque publicas pecunias, tributa, vectigalia & res fifco debitas exigit, proprie nominatur exactor regis."

EXACUM, in *Botany*, a name which Pliny fays has been given to the Leffer Centaury, becaufe it carries off all bad medicines by ftool, apparently from ἐξ, *out of*, and ἀκόω, *to drive*, or *force onward*. Linn. Gen. 57. Schreb. 77. Willd. Sp. Pl. v. 1. 634. Sm. Fl. Brit. 182. Mart. Mill. Dict. v. 2. Juff. 142 Gærtn. t. 114. Clafs and order, *Tetrandria Monogynia*. Nat. Ord. *Rotaceæ*, Linn. *Gentianæ*, Juff.

Gen. Ch. *Cal.* Perianth inferior, in four deep, ovate, flightly fpreading, permanent fegments. *Cor.* of one petal, permanent, falver-fhaped; tube inflated, the length of the calyx; limb in four deep, roundifh, fpreading lobes. *Stam.* Filaments four, thread-fhaped, inferted into the tube, not fo long as the limb; anthers roundifh. *Pift.* Germen fuperior, oval, filling the tube; ftyle thread-fhaped, rather oblique, the length of the ftamens; ftigma capitate. *Peric.* Capfule elliptical, as long as the calyx, compreffed, with a longitudinal furrow at each fide, of two cells, burfting at the top. *Seeds* numerous, fmall, roundifh, affixed to a central receptacle which forms the partition of the capfule.

Eff. Ch. Calyx in four fegments. Corolla falver-fhaped, with an inflated tube. Capfule fuperior, with two furrows, two cells, and many feeds, burfting at the top. Stigma capitate.

Obf. The flowers in fome fpecies are five-cleft, with a correfpondent number of ftamens.

Since this genus was founded by Linnæus on the examination of fome dried Eaft Indian fpecimens of his *E. feffile* and *pedunculatum*, Sp. Pl. 163, feveral fpecies have been added to it by different botanifts, either entire new difcoveries, or feparated from the old genus of *Gentiana*. Vahl has alfo referred hither the *Coutoubea* of Aublet, Guian. t. 27, 28, with unqueftionable propriety, though Juffieu and Schreber have kept it feparate, the latter by the name of *Picrium*, alluding to its bitternefs.

Our only Britifh fpecies is *E. filiforme*, Engl. Bot. t. 235, found in fpongy or fandy bogs, in Dorfetfhire, Devonfhire, and Cornwall, flowering in July. This is a fmall, flender, inconfpicuous annual, with a branched *ftem*; oppofite, feffile, lanceolate *leaves*; and fmall, terminal, folitary, yellow *flowers*, expanded only while the fun fhines bright upon them. It was the *Gentiana filiformis* of Linnæus and all following authors, till referred to *Exacum* in Engl. Bot.

E. *vifcofum*. Sm. Ic. Pict. t. 18. (Gentiana vifcofa; Ait. Hort. Kew. v. 1. 321.) has pentandrous five-cleft flowers. This is a handfome green-houfe plant, brought from the Canary iflands by Mr. Maffon. The *ftem* is fhrubby, three feet high, with oblong ribbed *leaves*, and large terminal panicles of yellow *flowers*.

The annual fpecies are fcarcely to be cultivated, no fuccefsful cessful method of raising them from seed in a garden having yet been discovered.

EXÆRESIS, from ἐξ, *out of*, and αἱρεῖν, *to remove*, in *Surgery*, was divided by the ancients into six branches, namely, synthesis, diæresis, exæresis, aphæresis, prosthesis, and diorthrosis. Exæresis implied all such methods and operations, as had for their object the removal of diseased, redundant, or extraneous substances from the body.

EXAGGERATION, in *Rhetoric*, a figure whereby we enlarge or heighten things; making them appear more than they really are, whether as to goodness, badness, or other qualities.

The word is formed of the Latin *exaggero*, *I exaggerate*; which is a compound of *ex* and *agger*, *a mound*, or *elevation of earth*. See Hyperbole.

Exaggeration, in *Painting*, is a method of representing things, wherein they are loaded too much, or marked too strongly; whether in respect of the design, or the colouring, or the position of the object.

Exaggerating differs from caricaturing, in that the latter perverts, or gives a turn to the features, &c. of a face which they had not; whereas the former only improves, or heightens what they had.

The latter is a kind of burlesque on the object, and is generally meant to ridicule: the former is usually an exalting or enlivening of the beauties of the object, beyond what nature allows. The painter is obliged to have recourse to an exaggeration of colours, both on account of the surface of his ground, the distance of his work, and of time, and the air, which diminish and weaken the force of the colours; but this exaggeration must be conducted in such a manner, as not to put the objects out of their natural characters. The term exaggeration is not now in use. See Style in *Painting*.

EXAGON. See Hexagon.

EXA'LMA, from ἐξάλλω, *to leap out*, in *Surgery*, a dislocation of the vertebræ, according to Hippocrates.

EXALTACION, in *Geography*, a town of South America, in the government of Moyes; 50 miles S. of Trinidad.

Exaltation *of the Cross*. See *Exaltation of the* Cross.

EXALTATION, Elevation, is chiefly used in a figurative sense, for the raising or advancing a person to some ecclesiastical dignity; and particularly to the papacy.

The term exaltation is, in some measure, appropriated to the pope; and expresses his inauguration, coronation, taking possession, and the beginning of his pontificate.

We shall here add, that the cross was delivered up by a treaty of peace made with Siroes, Chosroes' son. The institution of this treaty is commonly said to have been signalized by a miracle; in that Heraclius could not stir out of Jerusalem with the cross, while he had the imperial vestments on, enriched with gold, and precious stones; but bore it with ease, in a common dress.

But, long before the empire of Heraclius, there had been a feast of the same denomination observed both in the Greek and Latin churches, on occasion of what our Saviour said in St. John, xii. 32. "And I, if I be exalted, or lifted up, will draw all men unto me." And again, in ch. viii. ver. 28. "When ye have exalted, or lifted up, the Son of man, then shall ye know that I am he." F. Du Soulier assures us, that M. Chastelain was of opinion, this feast had been instituted, at least at Jerusalem, two hundred and forty years before Heraclius.

The feast of the dedication of the temple built by Constantine, was held, says Nicephorus, on the fourteenth of September, the day on which the temple had been consecrated, in the year 335; and this feast was also called the exaltation of the cross, because it was a ceremony therein, for the bishop of Jerusalem to ascend a high place, built by Constantine for that purpose, in manner of a pulpit, called by the Greeks, the "sacred mysteries of God," or, "the holiness of God," and there hoist up the cross, for all the people to see it.

Exaltation, in *Physics*, denotes the act, or operation, of elevating, purifying, subtilizing, or perfecting, any natural body, its principles and parts; also the quality, or disposition, which bodies acquire by such operation.

The term exaltation has been peculiarly affected by the ancient chemists and alchemists; who imagining it to have some extraordinary emphasis, are employing it on every occasion.

Exaltation, in *Astrology*, is a dignity which a planet acquires in certain signs, or parts of the zodiac; which dignity is supposed to give it an extraordinary virtue, efficacy, and influence. The opposite sign, or part of the zodiac, is called the dejection of the planet.

Thus, the 15th degree of Cancer is the exaltation of Jupiter, according to Albumazar, because it was the ascendant of that planet at the time of the creation; that of the sun is in the 19th degree of Aries; and its dejection in Libra; that of the moon is in Taurus, &c. Ptolemy gives the reason of this in his first book De Quadrup.

EXAMEN, or Examination, an exact and careful search, or inquiry, in order to discover the truth or falsehood of a thing.

EXAMILION, &c. See Hexamilion, &c.

EXAMINATION, Self, is a point much insisted on by divines, and particularly the ancient fathers, by way of preparation to repentance. St. Ignatius reduces it to five points; *viz.* 1. A returning of thanks to God for his benefits. 2. A begging of grace and light, to know and distinguish our sins. 3. A running over all our actions, occupations, thoughts, and words, in order to learn what has been offensive to God. 4. A begging of pardon, and conceiving a sincere sorrow for having displeased him. And, 5. Making a firm resolution not to offend him any more; and taking the necessary precautions to preserve ourselves from it.

Examination *of Bankrupt*, in *Law*. See Bankrupt.

Examination *of Prisoners*. See Commitment.

Examination, or Inspection, *Trial by*, is when, for the greater expedition of a cause, in some point or issue being either the principal question, or arising collaterally out of it, but being evidently the object of sense, the judges of the court, upon the testimony of their own senses, shall decide the point in dispute. Thus, in case of a suit to reverse a fine for non-age of the cognizor, or to set aside a statute or recognizance entered into by an infant; in this, and in similar cases, a writ shall issue to the sheriff (9 Rep. 31.), commanding him that he constrain the said party to appear, that it may be ascertained by the view of his body by the king's justices, whether he be of full age or not. If, however, the court, upon inspection, has any doubt of the age of the party, it may proceed to take proofs of the fact; and, particularly, may examine the infant himself upon an oath of *voir dire*, *veritatem dicere*, that is, to make true answer to such questions as the court shall demand of him; or the court may examine his mother, his godfather, or the like. (2 Roll. Abr. 573.) In like manner, if a defendant pleads in abatement of the suit that the plaintiff is *dead*, and one appears and calls himself the plaintiff, which the defendant denies; in this case the judges shall determine, by inſpection and examination, whether he be the plaintiff or not. (9 Rep. 30.) Alſo, if a man be found by a jury an idiot, *à nativitate*, he may come in perſon into the chancery before the chancellor, or be brought there by his friends, to be inſpected and examined, whether idiot or not; and if, upon ſuch view and inquiry, it appears he is not ſo, the verdict of the jury, and all the proceedings thereon, are utterly void and inſtantly of no effect. (Ibid. 31.) The trial by inſpection may be alſo uſed, upon an appeal of maihem, when the iſſue joined is whether it be maihem or no maihem, this ſhall be decided by the court upon inſpection, for which purpoſe they may call in the aſſiſtance of ſurgeons. (2 Roll. Abr. 578.) And by analogy to this, in an action of treſpaſs for maihem, the court (upon view of ſuch maihem as the plaintiff has laid in his declaration, or which is certified by the judges who tried the cauſe to be the ſame as was given in evidence to the jury) may increaſe the damages at their own diſcretion (1 Sid. 108); as may alſo be the caſe upon view of an atrocious battery. (Hardr. 408.) But then the battery muſt likewiſe be alleged ſo certainly in the declaration, that it may appear to be the ſame with the battery inſpected. Alſo, to aſcertain any circumſtances relative to a particular day paſt, it hath been tried by an inſpection of the almanac by the court. Thus, upon a writ of error from an inferior court, that of Lynn, the error aſſigned was that the judgment given was on a Sunday, it appearing to be on the 26th February, 26 Eliz. and upon inſpection of the almanacs of that year, it was found that the 26th of February in that year actually fell upon a Sunday: this was held to be a ſufficient trial, and that a trial by a jury was not neceſſary, although it was an error in fact, and ſo the judgment was reverſed. (Cro. Eliz. 227.) But, in all theſe caſes, the judges, if they conceive a doubt, may order it to be tried by a jury. Blackſt. Com. vol. iii.

Examination *of witneſſes*, in the trial by jury, derives peculiar advantage from its being conducted openly, *vivâ voce*, in the preſence of all mankind. This mode of examination is much more conducive to the clearing up of truth, than the private and ſecret examination taken down in writing before an officer or his clerk, in the eccleſiaſtical courts, and all others that have borrowed their practice from the civil law, where a witneſs may frequently depoſe that in private, which he will be aſhamed to teſtify in a public and ſolemn tribunal. Beſides, the occaſional queſtions of the judge, the jury, and the counſel, propounded to the witneſſes on a ſudden, will ſift out the truth much better than a formal ſet of interrogatories previouſly penned and ſettled; and the confronting of adverſe witneſſes is alſo another opportunity of obtaining a clear diſcovery, which can never be had upon any other method of trial. Nor is the preſence of the judge, during the examination, a matter of ſmall importance; for, beſides the reſpect and awe with which his preſence will naturally inſpire the witneſs, he is able by uſe and experience to keep the evidence from wandering from the point in iſſue. In ſhort, by this method of examination, and this only, the perſons who are to decide upon the evidence have an opportunity of obſerving the quality, age, education, underſtanding, behaviour, and inclination of the witneſs; in which points all perſons muſt appear alike, when their depoſitions are reduced to writing, and read to the judge, in the abſence of thoſe who made them; and yet as much may be frequently collected from the manner in which the evidence is delivered as from the matter of it. See Evidence.

Examination *of witneſſes* in Chancery is done with a view to the proof of facts that are diſputed, and their depoſitions are taken in writing, according to the manner of the civil law. For this purpoſe interrogatories are formed, or queſtions in writing; which, and which only, are to be propoſed to, and aſked of, the witneſſes in the cauſe. For the examination of witneſſes in or near London, there is an examiner's office appointed; but for ſuch as live in the country, a commiſſion is granted to four commiſſioners, two named on each ſide, or any three or two of them, to take the depoſitions there. And if the witneſſes reſide beyond ſeas, a commiſſion may be had to examine them there upon their own oaths, and (if foreigners) upon the oaths of ſkilful interpreters. And it hath been eſtabliſhed that the depoſition of an heathen who believes in the Supreme Being, taken by commiſſion in the moſt ſolemn manner according to the cuſtom of his own country, may be read in evidence. The commiſſioners are ſworn to take the examinations truly and without partiality, and not to divulge them till publiſhed in the court of chancery; and their clerks are alſo ſworn to ſecrecy. The witneſſes are compellable by proceſs of *ſubpœna*, as in the courts of common law, to appear and ſubmit to examination. And when their depoſitions are taken, they are tranſmitted to the court with the ſame care that the anſwer of a defendant is ſent. See Commission *to examine witneſſes*, and Interrogatories.

EXAMINERS, in *Chancery*, are two officers, whoſe buſineſs is to examine, on oath, the witneſſes produced on both ſides, upon ſuch interrogatories as the parties to the ſuit do exhibit for the purpoſe.

EXAMPLE, in *Rhetoric*, denotes an imperfect kind of induction or argumentation; whereby it is proved, that a thing which has happened on ſome other occaſion, will happen again, on the preſent one, from the ſimilitude of the caſes. That is uſually called an example, which is brought either to prove or illuſtrate ſome general aſſertion, as if one ſhould ſay, that "human bodies may be brought to ſuſtain the greateſt labours by uſe and exerciſe:" and in order to prove this ſhould relate what is ſaid of Milo of Croton, that "by the conſtant practice of carrying a calf ſeveral furlongs every day, he ſhould carry it as far after it was grown to its full ſize." (Eraſm. Chil. p. 193.) But the word example is uſed in oratory for any kind of ſimilitude; or, as Voſſius defines it (Orat. Partit. l. iii. c. 7. § 16.), "When one thing is inferred from another, by reaſon of the likeneſs which appears between them." Hence it is called an "imperfect induction," which infers ſomething from ſeveral others of a like nature. With regard to examples, we may obſerve, that thoſe have the greateſt force in reaſoning, which are taken from facts. See Induction.

EXANIA, from *ex*, *out of*, and *anus*, the complaint now more commonly named by practitioners in ſurgery prolapſus ani. See Prolapsus.

EXANNUAL Roll. In the old way of exhibiting ſheriff's accounts, the illeviable fines and deſperate debts were tranſcribed into a roll, under this name, which was yearly read, to ſee what might be gotten by it.

EXANTHEMA, in *Medicine*, ſynonymous with *efflo-reſcence*, from ἐξ, and ἄνθος, *a flower*, a term applied by the older writers nearly in the ſame ſenſe in which we now employ the word *eruption*, and comprehending every ſpecies of ſpot, diſcolouration, or elevation of the ſkin. The ſyſtematic noſologiſts at preſent underſtand by this word all eruptions on the ſkin, which are accompanied with fever; ſuch as the ſmall-pox, meaſles, ſcarlet fever, &c. Dr. Willan uſes the term in a more limited ſenſe, *viz.* to expreſs that appearance only which is in Engliſh denominated a *raſh*; which is a bluſh or "redneſs of the ſkin, varying as to extent, continuity, and brightneſs of colour, and occaſioned by an unufual quantity of blood diftributed to feveral of the cutaneous veins, in fome inftances with partial extravafation." The exanthemata conftitute the third order of Dr. Willan's claffification of cutaneous difeafes, including the meafles, fcarlet fever, nettle-rafh, rofeola, purpura, and erythema. See Cutaneous *difeafes*, and thefe words refpectively. See alfo Cullen Nofol. Method. clafs i. order iii. Willan on Cutan. Dif. ord. iii.

EXARCH, Ἔξαρχος, in *Antiquity*, an appellation given, by the emperors of the Eaft, to certain officers fent into Italy, in quality of vicars, or rather prefects, to defend that part of Italy which was yet under their obedience; particularly the city of Ravenna, againft the Lombards, who had made themfelves mafters of the greateft part of the reft.

The refidence of the exarch was at Ravenna; which city, with that of Rome, were all that was left to the emperors. The firft exarch was Longinus, who was fent in the year 568 by the emperor Juftin II. the fucceffor of Juftinian, to govern Italy in the room of Narfes. Longinus, being invefted with abfolute authority and power, fuppreffed the magiftrates, who had been previoufly appointed to govern the provinces of Italy; and he himfelf took the title of exarch, which by the Greeks was given to thofe who prefided over a diocefe, and confequently over the numerous provinces of which the diocefe was compofed. This title was adopted by the fucceffors of Longinus, who, refiding, as he had done, at Ravenna, were on that account called the exarchs of Ravenna. They governed all Italy, naming and removing the magiftrates, called dukes, at their pleafure; and to them the people had recourfe in all matters of confequence. Longinus was fent by Juftin to rule all Italy; but a great part of that country, in the firft year of his government, was feized on by the Lombards, who had been called in by Narfes. This magiftrate maintained the power and authority of the emperors of the Eaft in Italy for the fpace of 183 years, that is, from the year 568, when Longinus was fent into Italy, to the year 751, when Eutychius, the laft exarch, was expelled, and Ravenna taken by Aftulphus, or Aftolphus, king of the Lombards. See Lombards.

According to Gibbon (Decline and Fall of the Roman Empire, vol. vii.) Narfes was the firft and moft powerful of the exarchs, and adminiftered above fifteen years the kingdom of Italy. A duke was ftationed for the defence and military command of each of the principal cities of Italy; and the eye of Narfes pervaded the ample profpect from Calabria to the Alps. During a period of 200 years, fays the hiftorian, (vol. viii.) Italy was unequally divided between the kingdom of the Lombards and the exarchate of Ravenna; and 18 fucceffive exarchs were invefted, in the decline of the empire, with the full remains of civil, of military, and even of ecclefiaftical power. Their immediate jurifdiction, which was afterwards confecrated as the patrimony of St. Peter, extended over the modern Romagna, the marfhes or vallies of Ferrara and Commachio, five maritime cities from Rimini to Ancona, and a fecond, inland Pentapolis, between the Adriatic coaft and the hills of the Apennines. Three fubordinate provinces, of Rome, of Venice, and of Naples, which were feparated by hoftile lands from the palace of Ravenna, acknowledged, both in peace and war, the fupremacy of the exarch. The remainder of Italy was poffeffed by the Lombards. When Aftulphus, as we have already mentioned, had made himfelf mafter of the exarchate, he thought that he had a juft title to all the places depending on that domain, and confequently to the Roman dukedom and to Rome itfelf. He, therefore, required by a meffenger the inhabitants of that city to acknowledge him for their fovereign; and at the fame time began his march towards Rome. The pope, Stephen II., was alarmed, and attempted to divert Aftulphus from his declared purpofe of plundering Rome and maffacring the inhabitants, by a folemn embaffy; but the king, rejecting the prefents accompanying this embaffy, infifted upon being acknowledged by the pope and the Romans for their fovereign. The pope in this diftrefs applies to the emperor; but Conftantine was not in a condition to affift him. He then determined to recur to the protection of France, which had been transferred, fome years before, from the Merovingian to the Carlovingian line; and the celebrated Pepin, fon to Charles Martel, was then king. Indeed Pepin had previoufly promifed to pope Zachary, that he would protect his fee againft all its enemies, efpecially againft the Lombards. Pope Stephen vifited France in perfon; and having ftated the deplorable condition to which he was reduced by the Lombards, and implored his affiftance and protection, Pepin promifed to affift him againft the Lombards with the whole ftrength of his kingdom, and to drive them out of the exarchate and Pentapolis, which were to be reftored, as Pepin underftood, to the emperor, from whom the Lombards had taken them; but the pope, finding the king well-difpofed, took advantage of this favourable opportunity for aggrandizing himfelf; and, therefore, infinuated to Pepin, that he could not better acquit himfelf of his obligations to the apoftolic fee, confult the welfare of his foul, or reward him for the dangers he had undergone, and the pains he had taken for the fafety of Italy, and the church, than by granting both the exarchate and Pentapolis to St. Peter, that is, to himfelf. The pope, at the fame time, pretended that Conftantine had forfeited all right to thofe countries, by forfaking the protection of Italy, and perfecuting the church. Pepin not only put him in poffeffion of the exarchate and Pentapolis, if he fhould fucceed in expelling the Lombards, but confirmed his promife with an oath, in which his fons Charles and Carloman concurred. In confequence of this engagement Pepin marched with his army againft the Lombards, and having routed them, Aftulphus fled precipitately to Pavia. Pepin purfued him, and having befieged his capital, granted him peace on condition of his reftoring the places which he had feized in the Roman dukedom, together with the exarchate and Pentapolis, to the pope. Hoftages were alfo delivered in order to fecure the fulfilment of this condition. Aftulphus, regardlefs of his oath and hoftages, invaded the Roman dukedom, feized feveral cities, and befieged Rome itfelf. In this extremity, Stephen had again recourfe to his protector, who, highly incenfed at the treachery of Aftulphus, marched again into Italy, and clofely invefted Pavia, into which the Lombard king had retired. Aftulphus once more fued for peace, which was granted him upon his promifing to perform immediately the treaty made the year before, and, befides, to furrender to the pope the city of Commachio, which was then a place of great importance. Pepin then renewed his donation; and having caufed a new inftrument to be drawn up, he caufed it to be delivered, figned by himfelf, by his two fons, Charles and Carloman, and by the chief barons and prelates of France, into the pope's hands. He then left Italy, and returned with his army to France. The exarchate comprifed, according to Sigonius (ad ann. 756) the following cities, *viz.* Ravenna, Bologna, Imola, Faenza, Forlimpopoli, Forli, Cefena, Bobbio, Ferrara, Commachio, Adria, Servia, and Secchia, which were all delivered to the pope, except Faenza and Ferrara. Pentapolis, or Morca d'Ancona, comprehended Rimini, Pefaro, Pesaro, Conca, Fano, Sinigaglia, Ancona, Osimo, Umana, Jesi, Fossombrone, Monteferetro, Urbino, the Balnesian territory, Cagli, Luceoli, and Eugubio, with their territories and districts, as appears by the donation of Lewis the Pious, by which Pepin's donation was confirmed. The pope committed the government of the exarchate to the archbishop of Ravenna, who thereupon took the title of exarch, not as archbishop, but as an officer of the pope, now a temporal prince. Thus was the sceptre added to the keys, the sovereignty to the priesthood, and the popes were enriched with the spoils of the Lombard kings, and the Roman emperors. As those countries belonged, without doubt, to Constantine their emperor, some authors have thought that this donation was made in his name, and that this gave rise to the fable of the donation of Constantine the Great. Hence it appears that the popes by degrees became sovereigns of Rome. The exarchate of Ravenna, says Petrus de Marca, being yielded to the pope, the government of Rome, of course, devolved upon him; for the Roman dukedom had been always subject to the exarch. The pope, therefore, when he became master of the exarchate, claimed the administration, and continued to govern Rome, not as sovereign, but only with the authority that had been vested in the exarch, till the year 876, when the authority of the emperors, successors of Charlemagne, declining in Italy, Charles the Bald yielded all his claim to, and sovereignty over Rome, to the apostolic see. Hence Constantine Porphyrogenitus, describing the state of Europe in his time, that is, about the year 914, writes, that Rome was subject to the pope, as its sovereign. It was upon the declension of the western empire, when it was confined to Germany alone, that the pope, as well as the several princes of Italy, assumed the sovereignty, which they afterwards enjoyed. The donation of Pepin was confirmed by Charlemagne at the request of pope Adrian; for having ordered Iterius, his secretary, to draw up a new instrument, he signed it himself, caused it to be signed by the abbots, bishops, and other great men, who had attended him to Rome, and, with his own hand, laid it on the altar of St. Peter.

F. Papebroch, in his Propylæum ad Acta Sanct. Maii, has a dissertation on the power and office of the exarch of Italy, in the election and ordination of the pope.

The emperor Frederic created Heraclius, archbishop of Lions, a descendant of the illustrious house of Montboissier, exarch of the whole kingdom of Burgundy; a dignity, till that time, unknown any where but in Italy, particularly in the city of Ravenna. Menestrier. Hist. de Lyons.

Homer, Philo, and other ancient authors, give likewise the name exarchus to the choragus, or master of the singers, in the ancient choruses, or him who sung first; the word αρχω, or αρχομαι, signifying equally *to begin*, and *to command*.

EXARCH *of a diocese*, was anciently the same with primate. This dignity was inferior to the patriarchal, yet greater than the metropolitan.

EXARCH also denotes an officer still subsisting in the Greek church; being a kind of deputy or legate *a latere* of the patriarch, whose office it is to visit the provinces allotted him, in order to inform himself of the lives and manners of the clergy; take cognizance of ecclesiastical causes; the manner of celebrating divine service; the administration of the sacraments, particularly confession; the observance of the canons; monastic discipline; affairs of marriages, divorces, &c. but, above all, to take an account of the several revenues which the patriarch receives from several churches; and particularly as to what regards the collecting of the same.

The exarch, after having greatly enriched himself in his post, frequently rises to the patriarchate itself.

EXARCH is also used, in the *Eastern Church Antiquity*, for a general, or superior over several monasteries; the same that we otherwise call archimandrite: being exempted, by the patriarch of Constantinople, from the jurisdiction of the bishops; as are now the generals of the Romish monastic orders.

In 493, Sebas was established exarch, or chief, of all the anchorets within the territory of Jerusalem. Du Bois.

EXA'RMA, from εξαιρομαι, *to be elevated*, in *Surgery*, a high, prominent, swelling.

EXARTHRE'MA, from εξ, *out of*, and αρθρον, *a joint*, an old term, having the same signification as the word dislocation. See LUXATION.

EXA'RTHROS, from εξ, *out of*, and αρθρον, *a joint*, a term denoting a person whose joints are so large and mis-shapen, that they look as if they were luxated.

EXARTICULATION, a dislocation of some of the jointed bones; or a breach of articulation. See LUXATION.

EXAUCTORATIO, among the Romans, differed from *missio*, or a discharge. In the latter, the soldiers were quite dismissed from the service; and this was done after they had served twenty years: but in the former case, they only lost their pay, being still kept under their colours or *vexilla*, though not under the eagle, *aquila*, which was the standard of the legion. Whence, instead of *legionarii*, they were called *subsignani*, and were still retained till they had either served out their time, or had lands assigned them. The exauctoratio commonly took place after they had served seventeen years.

EXAUDET, in *Biography*, a performer on the violin in the opera band at Paris from 1749 to 1760; remarkable for nothing as a composer, but for the minuet which bears his name in France, and which in England is better known by the title of "Marshal Saxe's Minuet," the best "Minuetto per ballo," or for dancing, perhaps, that ever was composed.

EXCALCEATION, *ex*, *off*, and *calceus*, *shoe*, *discalceation*, or the act of putting off the shoes.

Among the Hebrews there was a particular law, whereby a widow, whom her husband's brother refused to marry, had a right to summon him into a court of justice; and, upon his refusal, might excalceate him, *i. e.* pull off one of his shoes, and spit in his face; which were both actions of great ignominy among that people.

The house of the person who had undergone them was thenceforward called the house of the excalceated.

EXALCED, EXCALCEATI, different orders of friars, hermits, and nuns, who amongst their other austerities went barefooted, or wore nothing on their feet but sandals, were distinguished by the name of excalced, as the Franciscans, Carmelites, Poor Clares, &c. whilst other branches of the same institute, but less rigid, were called calced, from their members wearing shoes. A particular branch of the Waldenses, Vaudois, or poor men of Lyons, in the 12th century, laid great stress on the wearing of sabots or wooden clogs instead of shoes, and therefore obtained the name of Sabatati and Insabatati.

EXCAMBIATOR. See EXCAMBIO, and EXCHANGE.

EXCAVATION, formed of *ex*, and *cavus*, *hollow*, or *cave*, a *pit*, &c. the act of hollowing or digging a cavity, particularly in the ground.

The excavation of the foundations of a building, by the Italians

Italians called *cavatione*, is ſettled by Palladio at a ſixth part of the height of the whole building: unleſs there be cellars underground, in which caſe he would have it ſomewhat more.

Excavation *of Vallies*, in *Geology*, is a ſubject which has exerciſed the thoughts of many ingenious men, the greater part of whom have ſuppoſed that theſe ſtupendous and important operations were effected by violent currents of water, which at ſome period made their way down them: but a more careful examination has ſhewn, that in ſcarcely any inſtances are the excavated materials to be found, or any part of them, as muſt inevitably have happened at the bends and junctions of vallies, particularly thoſe which lie far inland, had the mere waſhing of water been the cauſe of vallies: but Mr. Farey, and Dr. William Richardſon, have of late, and ſeparately as it ſhould ſeem, come to the concluſion (Philoſophical Magazine, vol. xxxiii. p. 204 and 262.) that theſe excavations were effected by cauſes acting "from above the ſurface of the earth," which completely carried off the matter which once filled up the vallies, and originally joined thoſe correſponding parts of ſtrata, whoſe edges are now in a great number of inſtances to be traced in their oppoſite ſides: theſe opinions of the former gentlemen have been already ſlightly noticed, and referred to, in our articles Coal, Colliery, and others.

EXCELLENCY, a quality, or title of honour given to ambaſſadors, and other perſons, who are not qualified for that of highneſs, as not being princes; and yet are to be elevated above the other inferior dignities.

In England, and France, the title is now peculiar to ambaſſadors: but it is very common in Germany and Italy. Thoſe to whom it was firſt appropriated were the princes of the blood of the ſeveral royal houſes; but they quitted it for that of highneſs, upon ſeveral great lords aſſuming excellency.

The ambaſſadors have only borne it ſince the year 1593, when Henry IV. of France ſent the duke de Nevers ambaſſador to the pope, when he was firſt complimented with excellency. After that, the ſame appellation was given to all the other ambaſſadors reſiding at that court; from whence the practice ſpread through the other courts.

The ambaſſadors of Venice have only had it ſince the year 1636, when the emperor and king of Spain conſented to allow it them.

The ambaſſadors of the crowned heads diſpute the giving of that title to the ambaſſadors from the princes of Italy; where the practice is not eſtabliſhed.

The court of Rome never allowed the quality of excellency to any ambaſſador who was a churchman, as judging it a ſecular title. The common rules and meaſures of excellency were a little variable, with reſpect to the court of Rome. The ambaſſadors of France, at Rome, anciently gave the title of excellency to all the relations of the pope then reigning; to the Conſtable Colonna; to the duke of Bracciano, and the eldeſt ſons of all thoſe lords; as alſo the dukes of Savelli, Ceſarini, &c. But they have been ſince more reſerved in this reſpect; though they ſtill honoured all the Roman princeſſes with excellency.

The court of Rome, in their turn, and the Roman princes, beſtowed the ſame title on the chancellor, miniſters, and ſecretaries of ſtate, and preſidents of the ſovereign courts of France; the preſidents of the councils in Spain; the chancellor of Poland; and thoſe of the firſt dignities of other ſtates, if they were not eccleſiaſtics.

The word excellency was, anciently, a title of kings and emperors; accordingly Anaſtaſius the library-keeper calls Charlemagne his excellency. The ſame title is ſtill given to the ſenate of Venice: where, after ſaluting the doge under the title of *ſereniſſimo*, the ſenators are addreſſed under thoſe of your *excellencies*. The Liber Diurnis Pontif. Rom. gives the title excellency to the exarch and patricians.

The Italian and French have improved on ſimple excellency; and made *excellentiſſimo*, and *excellentiſſime*, which have been beſtowed on certain popes, kings, &c.

EXCELSIS. See Gloria *in excelſis*.

EXCENTRIC, in *Geometry*, is applied where two circles, or ſpheres, though contained, in ſome meaſure, within each other, yet have not the ſame centre; and, conſequently, are not parallel; in oppoſition to concentric, where they are parallel, having one and the ſame common centre. The ſun's orbit is excentric, with regard to the globe of our earth: Mars is very excentric, with regard to the ſun; that is, his motion is about a very different centre.

Excentric *Theory*, in *Ancient Aſtronomy*, one of the theories adopted by the ancient aſtronomers to explain and calculate the different irregularities which they had obſerved to take place in the motions of the heavenly bodies.

It is not exactly aſcertained at what period practical aſtronomy had attained ſufficient perfection to indicate the neceſſity of ſuch a theory. Probably both the Indian and Egyptian aſtronomers were early acquainted with the more obvious inequality in the ſun's orbit; but Hipparchus is the firſt aſtronomical writer who ſeems to have aimed at determining it with any degree of preciſion.

The theory embraced by Hipparchus is ſaid to have been firſt taught in Greece by the diſciples of Pythagoras. Though their knowledge on the ſubject is ſuppoſed to have been derived from the oriental nations, yet it is highly probable they contributed to ſtrengthen the prejudices in favour of circular and uniform motion, which afterwards proved the ſource of ſo much difficulty and error in all the ſyſtems of ancient aſtronomy. It was from this prejudice, early aſſumed as a principle, that nature could not, conſiſtently with the obſerved ſimplicity of her deſigns, adopt any other form for the celeſtial orbits than that of perfect circles, nor any other motion than what was perfectly uniform. The problem, therefore, that occupied the aſtronomers and philoſophers of thoſe days, was to explain the various irregularities which they obſerved in the planetary motions, without infringing on the above principle.

There were two theories choſen for this purpoſe, nearly equivalent in their principle, the concentric and the excentric.

In the concentric theory the earth was ſuppoſed to be placed in the centre of a circle, on the circumference of which the centre of another circle revolved, and on the circumference of this ſecond circle, called an epicycle, the planet was ſuppoſed to move. The firſt circle was called the *deferent*, and by aſſigning a ſuitable ratio to the deferent circle, and to its correſponding epicycle, ſome of the more obvious irregularities were pretty accurately repreſented. *Fig.* 110. *Plate* XIII. *Aſtronomy*, is the repreſentation of the concentric theory. Let C be the centre both of the earth and of the circle F B D, and let H G K be a ſmaller circle, or epicycle, whoſe centre B moves uniformly in the circumference F B D, from weſt to eaſt, or *in conſequentia*, while the ſun moves alſo uniformly and with the ſame velocity in the circumference of the epicycle, *in antecedentia* in the upper part, but *in conſequentia* in the lower part. If the point G of the epicycle, called its apogee, as being moſt diſtant from the earth, be ſuppoſed at the beginning of the anomaliſtic revolution to be placed in the point A of C F produced; and if when it comes to G, the arc G H be taken ſimilar to F B, the point H will be be the place of the ſun when the centre of the epicycle has moved from F to B. If then in C F, to which B H is parallel, we take C E = B H, and on E as a centre, with the diſtance E A = C F, deſcribe the circle A H P, the ſun would be ſeen from E to move in this circle equably; for the angle A E H is equal to the angle F C B; but ſeen from C, the centre of the earth, it will appear to move in it inequably; for the angle A C H, in the firſt circle of anomaly, that is, in the paſſage of the ſun from A to P, is always leſs than A E H or F C B; and its true place H will be leſs advanced in longitude than its mean place B. When again the centre of the epicycle or the mean place of the ſun, having deſcribed a ſemicircle, ſhall have come to D, the ſun, having deſcribed a ſemicircle of the epicycle, will be found in P, the perigee of the orbit A H P, and its mean and true places B and H will be ſeen from C to coincide as they did in the apogee A. But in the ſun's paſſage from P to A, that is, in the ſecond ſemicircle of anomaly, his true place H, as ſeen from C, will be always more advanced in longitude than his mean place B: for in this ſemicircle the angle P C H is always greater than P E H or D C B. The angle E H C or B C H, which is the difference between the mean and true places of the ſun, is called the equation of the orbit, and it is evident that this equation will be greateſt in N or M, where the centre B of the epicycle is 90° diſtant from either of the apſides.

It was thus that the ancients originally proceeded in their repreſentation of the ſolar inequalities, and the repreſentation ſeemed to be ſufficiently juſtified by obſervation: at leaſt, till the days of T. Brahé, no obſervations had been made with ſufficient accuracy to ſubject it to ſuſpicion. Their ſucceſs alſo, while no lunar inequality except the ſimple anomaliſtical one was diſcovered, was equal in the application of the ſame concentric theory to the motions of the moon: and having, in two caſes, thus ſucceſsfully, by means of one ſubordinate ſphere or epicycle, reconciled apparent inequality of motion with real uniformity, it was natural to ſuppoſe that other inequalities, though more various and complicated, might be explained in a ſimilar manner, and required only the addition of other epicycles. The ſame method of procedure, therefore, was continued, and every new inequality which obſervation diſcovered, was accounted for by a new ſphere or epicycle producing it, till the whole number employed in the ſyſtem amounted to 34. Ariſtotle, on narrower examination, found theſe inſufficient, and added to them 22: but ſtill they were deemed inſufficient; and the number was at laſt increaſed to 72. But though it was not till long after the days of Ariſtotle, that the theory was carried to ſuch a degree of extravagance, the multiplication of epicycles rendered it, even in his time, almoſt as intricate and complex as the appearances which it was intended to explain. Some examples of this kind will occur on the revival of it by Copernicus and T. Brahé: and when Hipparchus and Ptolemy introduced excentric orbits, and by means of them ſomewhat diminiſhed the multiplicity of the ſpheres employed by their predeceſſors, they were thought to do a ſignal ſervice to aſtronomy.

The manner in which Hipparchus explained the ſolar inequalities, in his excentric theory, was to this purpoſe. Let O (*fig.* 111.) be the centre of the earth and of the ſtarry ſphere. Let B C D E be the ecliptic, or great circle in the *primum mobile* in which the ſun ſeems to perform his annual revolutions; and, in the ſame plane, but on a different centre Z, let the circle A L P be deſcribed. This is the circle, or orbit, in which the ſun is ſuppoſed actually to move, and to deſcribe round its centre equal arcs or angles in equal times: or rather, he is ſuppoſed to be carried round by the equable motion of the circle itſelf; which, becauſe its centre is not occupied by the earth, is called an excentric circle. It is evident, in this repreſentation, that if the earth were placed in Z, a ſpectator on it would perceive the ſun, ſince he is ſuppoſed to move uniformly in the excentric, to move alſo uniformly in the ecliptic. But the earth is placed in O, at the diſtance O Z from the centre of the excentric; and therefore, when his motions are referred to the ecliptic by a ſpectator in O, they muſt appear unequal. When, for example, he departs from A the apogee of the excentric, and comes to K, he would be ſeen from Z in the point R of the ecliptic; but from O, the centre of the earth, he is ſeen in C, a point leſs advanced in longitude. On the contrary, when he departs from P, the perigee of the excentric, and comes to N, his place in the ecliptic, as ſeen from Z, is the point V; but ſeen from O it is the point F, more advanced in longitude than V. Any line, as Z K, drawn from the centre of the excentric to the ſun, or any parallel to it drawn from O, is called the line of mean motion, and determines the mean anomaly A Z K; and any line, as O K, drawn from the ſun to the centre of the earth, is called the line of true motion, and determines the true anomaly A O K; and the angle O K Z, which is the difference between the mean and true anomalies, is the equation of the orbit. In the apogee and perigee this equation vaniſhes, in the ſame manner as in the concentric theory, becauſe there the lines of mean and true motion coincide; and at the points L, L, where a perpendicular to the line of apſides, drawn through O, meets the excentric, it comes to its greateſt amount. Thus, by the ſingle ſuppoſition that the ſolar orbit was excentric to the earth, Hipparchus ſupplied the place of the epicycle added to the concentric: nor is it difficult to perceive that the repreſentations, given by both theories of the ſolar inequalities, were in their effects preciſely the ſame.

In both theſe theories, it is evident that the inequalities of the ſun were conſidered as purely optical: and what was principally required was to find the point O, in the line A P of the apſides, in which the earth muſt be ſituated, in order to give to the ſolar motions the juſt inequality which obſervation required; and to determine the longitude A of the ſolar apogee, that is, the point B of the ecliptic to which it is referred from O. Without finding the juſt excentricity O Z, the calculated differences, or equations, between the ſun's mean and true places, would not correſpond with the obſerved differences: and without diſcovering the poſition of the apogee, the calculated equations, however accurate, would not be applied in their proper places. In theſe inveſtigations the procedure of Hipparchus was as follows.

Let B (*fig.* 112.) be the place of the ſun at the vernal equinox, B D an arc of the excentric equal to his mean motion for $94\frac{1}{2}$ days, that is, from the vernal equinox to the ſummer ſolſtice, D F an arc equal to his mean motion for $92\frac{1}{2}$ days, or from that ſolſtice to the autumnal equinox: let the chord B F be drawn, and from D another chord D E G perpendicular to B F. The point E of the interſection of theſe chords is evidently the point where the earth muſt be ſituated: for it is the only point from which B, D, F, G, can appear at the diſtance of 90° from one another, and as they appear actually in the heavens.

It was required, therefore, to determine the excentricity E C, or the diſtance of the point E from C, the centre of the ſolar orbit. Since the arc B D F of the mean motion, and which the ancients ſuppoſed to be the only real motion of the ſun, from B the vernal to F the autumnal

nal equinox, is given by means of the annual revolution, and confifts of 184° 20′, its half B H will confift of 92° 10′. Through H draw the diameter H C; and through C the centre of the orbit, the diameter C K perpendicular to H C, and meeting D E in L; and join C E. If from B D, the mean motion for $94\frac{1}{2}$ days, and = 93° 9′ we fubtract B H = 92° 10′, the remainder D H will be found = 59′: and if from B H we fubtract the quadrant K H, the remainder B K will be = 2° 10′. Therefore C L and E L, the fines of the arcs D H, B K, will be given in parts of C D = 10,000; the former to wit = 172, and the latter = 378. Therefore the excentricity E C, being the hypothenufe of the right-angled triangle E L C, will be found in the fame parts: for $EC^2 = CL^2 + EL^2$, and therefore E C = 415.

By producing E C to meet the excentric in A and P, we fhall have the line A P of the apfides: and the longitude of A the apogee will be found from the fame triangle E L C; for C E : E L : : R : fin. E C L = K C A = B E A = 65° 30′. Since B therefore reprefents the point of Aries, the place A of the apogee fell fhort of the folftitial point D, 24° 30′, in the days of Hipparchus. It is now between 9° and 10° more advanced.

When the excentricity and the longitude of the apfides were thus determined, the equations of the orbit, or the differences between the mean and true places of the fun, were obtained by a very fimple trigonometrical computation. For in the excentric theory, (*fig.* 111.) when this equation comes to its greateft magnitude, in the points L, L, or M, M, where perpendiculars to the line of apfides drawn through O or Z meet the excentric, the excentricity O Z becomes the tangent of the angle Z M O to the radius of the orbit Z M: and at any other point K, with the excentricity O Z, the radius Z K, and the angle K Z O the fupplement of the mean anomaly A Z K, the equation Z K O will be found by the analogy K Z + Z O : K Z − Z O : : tan. $\frac{1}{2}$ A Z K : tan. $\frac{1}{2}$ (Z O K − Z K O). The calculation will be precifely the fame in the concentric theory if E C be taken in C A, (*fig.* 110.) equal to the radius of the epicycle, that is, to the excentricity O Z, (*fig.* 111.) and will produce the fame refults: and the excentric theory will be found to differ from the concentric only in fimplicity. It is probably needlefs to obferve that the parallels O L and Z M will mark the fame point in the zodiac.

Though thefe theories were thought fufficient to explain the folar motion, in that imperfect ftate of practical aftronomy, yet they were found entirely to fail when applied to the obferved motions of the moon and planets. A new fcheme was therefore adopted by Ptolemy, in which, however, the principle of uniform motion was in fact abandoned. This confifted in affuming an imaginary point as the centre of a new circle, called the equant; and it was fuppofed that to a fpectator fituated in that point the motion of the planet would appear to be uniform. It is not now exactly known if the Greek aftronomers invented this theory, or if they received it by tradition from the eaftern nations, but it is a curious circumftance to obferve, in the hiftory of the fcience of aftronomy, how very near the truth the ancients arrived by trial and obfervation; for their deferent circle and epicycle reduced the figure of the orbit really to an oval form, and the two points in which they placed the earth and the centre of the equant were many centuries afterwards difcovered to be no other than the foci of an elliptic orbit. The true theory was kept out of fight by an obftinate adherence to an ancient prejudice, for what a fingular method was nature fuppofed to take, in order to adhere to this principle of uniform and circular motion; after a number of unmeaning efforts, fhe only accomplifhed an *apparent* uniform motion round an imaginary point, in which no fpectator could ever poffibly be placed to admire the beauty of the contrivance:

The mode of determining the equant was as follows.

Let A be the centre of the earth, (*fig.* 113.) fuppofe the centre of the world D, the centre of the orbit of a planet, or of the excentric circle, F K M L E, called the deferent, (fee Epicycle.) Upon the point F is defcribed the epicycle G Q, and above D a point E is affumed, equal to the excentricity A D, and from the point E another circle is defcribed, R K O L R, of the fame magnitude as the deferent. This fecond circle is called the equant, becaufe the centre of the epicycle, which moves upon the deferent, has neverthelefs an equal motion round the centre E of the equant, for the epicycle defcribes its deferent with an unequal motion, which fhould difappear when referred to the centre of the equant, fo that the angle, fuch as F E I, formed by the line of apfides A F, and by the line drawn to the centre of the epicycle, arrived at I, may be always equal in equal times; for this reafon Ptolemy calls the point E the point of equality. The angle F A I is the true anomaly of the excentric, the angle F E I the mean anomaly, and which is always formed at the centre of the equant.

Kepler had endeavoured to explain phyfically the caufe of the equant, that is, why there fhould be a point E different from the point D, about which the motion was regular and uniform, (Myfter. Cofmogr. c. 22.) He was perfuaded the caufe was general, and that the equant muft take place in the orbit of the earth, as well as in the other planets. Neither Tycho nor Copernicus had employed an equant, but Kepler was perfuaded that the points E and D in an excentric were not the fame, particularly when Tycho informed him that the annual orbit, or excentric of the fun, appeared to him not to be always the fame.

Kepler fufpected that this variation arofe from the point of equality not being the centre of the circle; and in the courfe of his inveftigation of this queftion, he was led to the difcovery of the bifection of the excentricity in the cafe of the earth, whereas the ancients only admitted it in the cafe of the fuperior planets. See Excentricity, *bifection of.*

EXCENTRICITY *of the Orbit of a Planet*, in *Aftronomy*, is the diftance between the centre and the focus of the ellipfe in which it revolves. The difcovery of the excentricity in the orbits of the fun and moon is attributed to Hipparchus, who wrote a treatife on this fubject 150 years before our era.

The excentricity of the orbit is computed from the greateft equation of the centre, by the following proportion: As 57° 17′ 44.″8, (the arc = rad.) is to half the greateft equation, fo is rad. = 1 to the excentricity. See Equation, and Elliptic *Motion.*

But when the greateft equation has been found, and accurately determined by obfervation, the excentricity may be practically deduced by ufing the rule of falfe pofition, or by fuppofing the excentricity known, and finding by trial the greateft equation correfponding to it

The excentricities of the planetary orbits are ufually calculated on a fcale which fuppofes the mean diftance of the earth from the fun divided into one hundred thoufand parts, and the excentricity is expreffed in proportional parts of that fcale.

The following formula for calculating the excentricity is given by Lambert in the Ephem. de Berlin.

Let

Let E be the greateſt equation of the centre, e the excentricity, make $\frac{E}{57.} = \alpha$.

The excentricity will then be expreſſed by the following ſeries.

$$e = \frac{1}{2}\alpha - \frac{11}{768}\alpha^3 - \frac{587}{93040}\alpha^5 - \frac{40583}{2642411520}\alpha^7 -, \&c.$$

The quantity α is always a ſmall fraction, particularly for the ſun; if we ſuppoſe with La Place, $E = 2^\circ.1409$ decimal for 1750. Then,

$$\alpha = \frac{2.1409}{63.6620} = 0.033629$$

$$\tfrac{1}{2}\alpha = 0.016814.$$

The ſecond term, $\frac{11}{768}\alpha^3$, is leſs than 0.000001, and may therefore be entirely neglected.

Table *of Excentricities according to different Authors.*

Planets.	Kepler.	Caſſini.	Halley.	La Lande.	Log. of Excen. in parts of the mean diſtance.
Mercury	8150	$8092\frac{1}{2}$	7970	7955.4	9.3128399
Venus	501	517	504.985	498	7.8378910
The Sun	1800	169	1691.90	1681.395	8.2253628
Mars	14115.5	14155	14170	14183.7	8.9688921
Jupiter	25074	2506	25078.6	25013.3	8.6819346
Saturn	54143.5	5432	54381.4	53640.42	8.7499109
Herſchel				90804	8.6774873

The following table of excentricities in parts of the major axis is taken from the "Syſtem of the World," by La Place.

Mercury	-	0.205513
Venus	-	0.006885
Earth	-	0.016814
Mars	-	0.093808
Jupiter	-	0.048877
Saturn	-	0.056223
Uranus	-	0.046683

The ſecular variation of theſe numbers is as follows: (the ſign — indicates a diminution.)

Mercury	-	+ 0.000003369
Venus	-	— 0.000062905
The Earth	-	— 0.000045572
Mars	-	+ 0.000090685
Jupiter	-	+ 0.000134254
Saturn	-	— 0.000261553
Uranus	-	— 0 000026228

Excentricity, *biſection of.* The biſection of the excentricity is a curious principle aſſumed by Ptolemy, and the ancient aſtronomers, to explain the irregularities of the planetary motions. It is thus deſcribed by Dr. Small.

The inequalities of the planets were ſo various and intricate, that the explications of them were for a long time extremely imperfect, and ſo partial, that no Grecian aſtronomer before Ptolemy had ſuppoſed it practicable to give a compleat theory of all. In the more ancient times the explications of them appear to have been made by orbits concentric to the earth, and charged with epicycles: but, as Ptolemy had found no method of repreſenting the ſecond inequalities, except by means of epicycles, ſo, to avoid the perplexity occaſioned by the multiplication of them, he gave the preference to an excentric orbit for the repreſentation of the firſt; and, by the ſuperior ſimplicity of the repreſentation, the authority of the excentric theory was for many centuries eſtabliſhed. With reſpect to thoſe firſt inequalities, at leaſt of the ſuperior planets, it appears to have been originally ſuppoſed, that they might be ſufficiently accounted for by the more ſimple ſolar hypotheſis. For, if the planet, in conſequence of its ſecond inequalities, be repreſented as moving in the circumference $a\,b\,c$ (*fig.* 111) of an epicycle, the centre A L P Q, of this epicycle, will repreſent the places which it would occupy, if it were diveſted of all ſecond inequality: and it was thought a ſufficient explication of the firſt inequality, to ſuppoſe that this centre moved equally round Z, the centre of the orbit, and conſequently inequably round O, the centre of the earth. But when, according to Kepler's conjectures on this ſubject, they endeavoured to account for the inequality of the latitudes in oppoſition, and of the digreſſions of the planets, eſpecially their greateſt digreſſions, from the point oppoſite to the ſun, by variations of their diſtances from O, it appeared that the point Z, round which the planet moved equably, could not be the ſame with the centre of the orbit; for, both the latitudes, and alſo the angles $a\,O\,c$, $d\,O\,f$, which the epicycle ſubtended at the centre of the earth, were found to be greater at the apogee, and leſs at the perigee than the limits of the excentric A L P Q permitted; and that, conſequently, the centre of the orbit occupied a place nearer than Z to the centre of the earth. It was therefore a matter of much greater difficulty to form an hypotheſis for the motions of the planets, than for thoſe of the ſun: for, if their firſt inequalities required one determined excentricity, or diſtance between the centre of uniform motion and the centre of the earth, the variations of their latitudes, and of their ſecond inequalities, ſhewed that this was not the excentricity of the orbit in which the epicycle moved, and that this orbit evidently required another. In what proportion the diſtance Z O between the centre of uniform motion and the centre of the earth ought to be divided by the centre of the orbit, appears to have been for a long time a matter of much uncertainty. But Ptolemy tells us that, on applying himſelf to inveſtigate the meaſure of the approach of the centre of the epicycle, within the circle A L P O at the apogee, and its conſequent withdrawing from it beyond the perigee, he found, by multiplied obſervations, that the centre of the orbit lay preciſely in the middle, between Z the centre of uniform motion, and O the centre of the earth. This is the famous principle, known by the name of the biſection of the excentricity: and, as Ptolemy gives no account of the means by which it was diſcovered, nor of the obſervations from which it was inferred, his aſſuming it has juſtly excited the wonder of all aſtronomers. The greater part believed him to have aſſumed it merely from conjecture, and not to have derived it, as Kepler more generouſly ſuppoſed, from any obſervations; and there ſeems to be ſome reaſon for thinking that it came to him by tradition, from the more ancient aſtronomy of the Eaſt.

EXCEPTIO, in the *Roman Law*. See Pleading.

EXCEPTION, ſomething reſerved, or ſet aſide, and not included in a rule.

It is become proverbial, that there is no rule without an exception; intimating, that it is impoſſible to comprehend all the particular caſes under one and the ſame maxim. But it is dangerous following the exception preferably to the rule.

Exception, in *Law*, is a ſtop or ſtay to an action.

The term is uſed indifferently, both in the civil and common

mon law; and in each exceptions are divided into *dilatory* and *peremptory*.

In law proceedings, exception is a denial of a matter alleged in bar to the action; and in chancery it is that which is alleged againft the fufficiency of an anfwer, &c. Exception, in a general fenfe, includes all the kinds of defence, or vindication, which a perfon, againft whom a procefs is brought, makes ufe of to prevent or retard its effect.

The civilians reckon three kinds of exceptions; *viz. declinatory*, whereby the authority of the judge or court is difallowed; *dilatory*, intended to defer or prevent the thing from coming to an iffue; and *peremptory*, which are proper and pertinent allegations, founded on fome prefumption that ftands for the defendant; as want of age, or other quality, in the party; or other matter that may be decided, without entering into a full difcuffion of the merits of the caufe.

Exception *to evidence*, is where a demurrer is offered in any civil caufe, on account of the infufficiency of the evidence given, and the court does not agree to it; in which cafe the court or judge are required to feal a bill of exceptions, by ftat. Weftm. 2. 13 Edw. I. cap. 31. which is in the nature of an appeal, examined in the next immediate fuperior court, upon a writ of error after judgment given in the court below. See Demurrer, and Evidence.

Exception, *in deeds and writings*, is the faving of a particular thing out of a general one granted by deed, as a room, fhop, or cellar, out of a houfe; a field, or timber-trees, out of land, &c. Exceptions of this kind muft not crofs the grant, nor be repugnant to it, or elfe they are void of courfe; yet there may be a kind of exception, or faving out of an exception, fo as to make a thing as if never excepted; as where a leafe is made of a rectory, excepting the parfonage-houfe, faving to the leffee a chamber, this fhall pafs by the leafe.

EXCEPTIVE Conjunction. See Conjunction.

Exceptive *propofitions*, are thofe wherein fomething is affirmed of a whole fubject, abating fome one of the parts thereof, which is *excepted* by a particle, thence called an exceptive particle, or particle of exception.

Thus, "All the fects of the ancient philofophers, except the Platonifts, held God to be corporeal. Covetoufnefs is inexcufable in refpect of every thing, but time."

EXCESS is diftinguifhed into *natural* and *moral*: the firft, is a part whereby one quantity is greater than another. Thus, we fay, this line is longer than that; but the excefs is inconfiderable.

The latter is an intemperance, or going beyond the juft bounds and meafures prefcribed for any thing. Thus, we fay, excefs in wine, women, &c. is prejudicial to the health.

EXCESSIVE, in *Mufic*, is ufed as a prefix to denote the excefs of certain tempered intervals above the true intervals of the fame name; it is generally oppofed to defective, *viz.* when there is a deficiency to the fame extent as there is here an excefs; but their ufe is not limited to any certain quantity of excefs or defect, they being fometimes applied in conjunction with or to reprefent the diafchifm, fometimes with enharmonic diefis, at others with minimum femitone, &c.; whereas the prefixes, redundant and deficient, are ufed only with the major comma, and hence the word comma is fometimes omitted; and in like manner the prefixes fuperfluous and diminifhed are confined to the minor femitone, which laft word is therefore fometimes omitted in naming the clafs of intervals, which are increafed or leffened by a minor femitone.

EXCHANGE, in *Commerce*, and *Political Economy*, is the act of paying or receiving money in one country for its equivalent in the money of another country, by means of bills of exchange.

This fcience, therefore, comprehends both the reduction of monies, and the negociation of bills: it determines the relative value of the currencies of all nations, and fhews how foreign debts are difcharged, loans and fubfidies paid, and other remittances made from one place to another, without the rifk or expence of tranfporting fpecie.

This important fubject may be confidered under the five following heads, namely:

1. Bills of exchange.—2. Par of exchange.—3. Courfe of exchange.—4. Monies of exchange.—5. Arbitration of exchange.

Bills of exchange.—A bill of exchange is a written order for the payment of a certain fum of money at an appointed time. It is a mercantile contract in which four perfons are moftly concerned, *viz.* 1. The *drawer*, who receives the value. 2. His debtor in a diftant place, upon whom the bill is drawn, who is called the *drawee*, and who is to accept and pay it. 3. The perfon who gives value for the bill, and who is called the *buyer* and *remitter*; and, 4. The perfon to whom it is ordered to be paid, who is called the *payee*, and who may, by indorfement, pafs it to any other holder.

Moft mercantile payments are made in bills of exchange, which, until due, generally pafs from hand to hand, like any other circulating medium. The laws of all trading nations afford the moft ready and effectual means of enforcing the payment of bills, and hence that credit which they fo univerfally obtain, and which greatly facilitates the operations of commerce.—For the laws, cuftoms, and regulations of bills of exchange, fee Bill *of exchange*, and *Mercantile* Law. See alfo Agio, Usance, and Days *of Grace*.

Bills are diftinguifhed into inland and foreign, according as they are made payable in the country where they are drawn, or in a foreign country. Their functions, however, are fimilar in both cafes, and therefore in explaining the theory of exchange, we fhall begin with the operations of inland bills as the moft fimple and familiar.

Suppofe A. of London is creditor to B. of Edinburgh 100*l.* and C. of London debtor to D. of Edinburgh 100*l.* thefe two debts may be difcharged by the operation of one bill: thus, A. draws on B. and fells his bill to C. who remits it to D. and the latter receives the amount from B. when due. Here, by a transfer of claims, the London debtor pays the London creditor, and the Edinburgh debtor the Edinburgh creditor.

By the foregoing example it appears that reciprocal and equal debts due between two places, may be difcharged without any cafh remittance, and it may be fuppofed that fuch an operation is of equal convenience to the parties concerned, in both places; but when debts are unequal, the advantage muft be likewife different, as the obligation of remittance is no longer mutual; for the debtor place muft pay its balance either by fending cafh or bills; and as the latter mode is generally preferred for feveral reafons, an increafed demand for fuch bills muft be the confequence; and this enhances their price, as it would that of any other faleable article.

This is the plain principle of exchange which is conftantly exemplified in the premium paid for inland bills on London; for this city, being the grand emporium of commerce that furnifhes moft other places of the kingdom with foreign merchandize, and being alfo the refidence of numerous

numerous landlords whofe rents muft be remitted to them from the country, it has generally a large balance of debt in its favour, a great part of which muft be fent in bills; this creates a demand, and confequently a premium which is moftly commuted for time; thus, if A. of London be creditor to B. of Edinburgh 200*l.* and C. of London debtor to D. of Edinburgh only 100*l.* the balance of 100*l.* againft Edinburgh cannot be cancelled by a transfer of claims, but muft, we will fuppofe, be remitted by a bill, which can be only obtained at a certain number of days after date. The moft general term for bills from Edinburgh on London is 40 days, and the intereft for this time is about $\frac{1}{2}$ *per cent.* The number of days here is called the exchange, which has been known to vary confiderably according to the balance of debt, or the plenty or fcarcity of bills. A fimilar premium or date is allowed for bills from all other places of Great Britain on the capital, but bills at fight on any of thofe places may be generally had in London without any premium whatever.

Although the principle of foreign exchange is the fame as that of inland, yet the former is more complicated in its operations than the latter, owing to the denominations of money not being the fame. This caufes a difference in the mode of paying the premium for bills; in which, however, the date is taken into confideration as well as the comparative rates at which the monies are valued.

In foreign exchange one place always gives another a fixed fum or piece of money for a variable price, which fluctuates according to the balance of debt, as before ftated: the former is called the certain price, and the latter the uncertain price. Thus London is faid to give to Paris the certain for the uncertain; that is, the pound fterling for a variable number of francs; and to give to Spain the uncertain for the certain; that is, a variable number of pence fterling for the dollar of exchange.

Whatever the uncertain price is, at any time, is called the courfe of exchange. Now fuppofe Paris gives London 25 francs for the pound fterling, and that this fum is found to contain the fame quantity of pure filver as 20 fhillings, then the exchange is faid to be at par; but if France fhould give a higher price, it is faid to be in favour of London, and *vice verfâ.* This is the common mode of judging whether the exchange be favourable or unfavourable to a place, though it is not always the correct method, nor that which merchants generally act upon. But before we enter into any further explanation of the courfe of exchange, or the caufes of its fluctuation, it will be neceffary to explain more fully what is to be underftood by the par of exchange, a fubject on which there is fome difference of opinion, even among writers of the firft authority.

Par of Exchange.

The par of exchange may be confidered under two general heads; namely, the *intrinfic par,* and the *commercial par,* each of which admits of fubordinate divifions and diftinctions.

The intrinfic par of exchange is the value of the money of one country compared with that of another, with refpect both to weight and finenefs. Thus, two fums of different countries are intrinfically at par when they contain an equal quantity of the fame kind of pure metal, feparated from its alloy, which is always deemed of no value. See Coin.

There fhould be two intrinfic pars, the one between gold coins, and the other betweeen filver coins; and hence the intrinfic par of exchange can be only determined with accuracy between places which pay their bills in the fame kind of metal, as between England and Portugal, that pay in gold coin; or between France and Spain, that pay in filver coin, for the relative value between thefe metals is fcarcely ever the fame in any two countries.

It may be even obferved, that the value of the fame metal differs confiderably in different countries, and therefore this intrinfic par of exchange cannot be always confidered as a true equality in the value of monies; thus in the cafe of France and Spain, where the latter country fupplies the former with the materials of her filver coinage, filver muft be moft valuable in France, and the difference fhould be equivalent to the charges attending the removal, fuch as the duty paid (in time of peace) to the Spanifh government, for the exportation of dollars, the expences of carriage, infurance, commiffion, intereft, &c. all of which amount to nearly 7 *per cent.*

A fimilar computation might be made between gold in England and in Portugal, as the latter country fupplies the former with the materials of her gold coinage.

But where one country pays its bills in gold, and another in filver, no intrinfic par of exchange whatever can be permanently eftablifhed. An equivalency can be only afcertained by valuing as merchandize the gold of one place, and the filver of the other, according to the market price of the day; but this is the commercial par, which fhall be more fully explained below.

In afcertaining the intrinfic par between coins of the fame metal, a queftion occurs, whether the computation fhould be made according to the mint regulations of the refpective countries where the monies are ftruck, or according to actual affays. The former is the moft general method, though the latter is certainly the moft correct; for while fome governments make coins according to their full ftandard, as in England, others take advantage of the allowance for remedy, and fometimes make it a fource of confiderable emolument.

There are fome countries with which no par of exchange, either intrinfic or commercial, can be permanently fixed. Thefe are fuch as pay their bills in paper, which muft have a fluctuating and precarious value. Even the bank money of Amfterdam and Hamburgh comes in a certain degree within this defcription, as it bears a fluctuating agio againft currency.

The *commercial par* is the comparative value of the monies of different countries, according to the weight, finenefs, and market price of the metals. This is the par which merchants generally confider of importance in their exchange fpeculations, and we cannot define it better than in the following paffage, taken from the Minutes of the Committee of the Houfe of Commons, appointed in 1804, to enquire into the ftate of exchange between Ireland and England. Several of the moft intelligent merchants of both countries were examined on the occafion, and their evidence produced much new and practical information.

In the examination of Benjamin Winthrop, efq. governor of the bank of England, an interefting enquiry and inveftigation took place refpecting the par of exchange, from which the following appropriate queftion and anfwer are extracted.

Queftion.—"When a fum of Hamburgh currency, which will buy a pound of bullion of given purity in the market of Hamburgh, can purchafe a bill for a fum of Englifh currency, which will buy a pound of bullion of the fame ftandard in the Englifh market, is not then the exchange at par between thofe two countries?"

Anfwer.

Anſwer.—" I confeſs it does appear to be a complete par of exchange."

This par of exchange is variouſly denominated by different writers on political economy; thus it is called the *current*, the *momentary*, the *political*, and the *eventual par*; and though each of theſe terms ſeems to convey a correct idea of the ſubject, yet we have adopted the word *commercial* as equally appropriate and more generally underſtood.

Some notice might be here taken of what is called a *monetary par*, in which an allowance is made for ſeignorage and mint expences, and alſo of a *common* or *eſtimate par*, which generally differs from the true one; thus the pound ſterling of England is eſtimated at 11 guilders current of Holland; but ſuch definitions are of little utility in the illuſtration of exchange.

The following opinion on the par of exchange ſeems to deſerve quotation. It is tranſlated from the preface of a moſt elaborate work, entitled " Dictionaire des Arbitrages," by Francois Corbaux, publiſhed at Paris in 1802.

" Without dwelling any longer," ſays this author, " on the arbitrary notions which have been formed of the par of exchange, and without ſeeking to adopt new ones, which might be rendered very numerous, we ſhall conclude by obſerving, that although the intrinſic or pretended real par is made the foundation and principal element in the determination of the price of exchange, yet not being the ſame in the gold as in the ſilver coins, the pars of theſe two metals ſhould be kept totally diſtinct; and that beſides, as neither of them finds any direct application in the common courſe of exchange affairs, it is through ignorance that ſo much importance has been attached to them, and that they have been conſidered as the moſt correct expreſſion of the relative value of the monies of two countries. In ſhort to ſeek for a true and rational par is to ſuppoſe what cannot exiſt, that is, the fixing of different principles and elements which are ſubject to continual variation, and, after all, if this could be accompliſhed, it would preſent no object of real utility."

However well-founded the opinion of Monſieur Corbaux may be, we think it muſt be at leaſt ſatisfactory to merchants to underſtand the intrinſic par of exchange, and therefore we ſhall give new tables of it at the concluſion of the preſent article, computed both in gold and ſilver, with rules and examples for performing all ſuch calculations; and ſhall now proceed to the explanation of the courſe of exchange, which is a ſubject of great importance, whether we conſider it in a commercial or political point of view.

Courſe of Exchange.

The courſe of exchange is the current price or proportion between the monies of two places; which is always fluctuating according to circumſtances.

When merchants have occaſion to draw or remit foreign bills, they meet upon the Royal Exchange, where this kind of buſineſs in London muſt be tranſacted. The market is conſtantly attended by exchange-brokers, to whom the wants of the parties who wiſh to buy or ſell bills are privately communicated. Theſe brokers, whoſe confidential ſituation demands ſtrict impartiality, bring parties together; and ſettle the courſe of exchange for the day, as ſoon as they learn how the market ſtands with reſpect to the number of drawers and remitters. The commiſſion for this buſineſs throughout Europe, is one *per mille* (or thouſand) which is equally paid by the buyers and ſellers of bills.

When the courſe of exchange riſes above par againſt any country, it is then concluded that the balance of trade is againſt that place. Now, if England ſhould import from France goods to the value of 100,000*l.*, and export only to the value of 80,000*l.*, it may coſt England 120,000*l.* to pay the whole debt, if it ſhould be publicly known that ſo great a balance exiſts, and therefore ſecrecy is of peculiar importance in this kind of buſineſs.

The fluctuations of exchange are moſtly greater or leſs according to the known amount of the balance, and the expence and difficulty of conveying ſpecie. By the expence of ſuch conveyance is meant the carriage and inſurance, and by the difficulty the hazard of evading thoſe prohibitory regulations which, in moſt countries, impede the exportation of coin; and ſo powerful is the operation of theſe cauſes, that the exchange is ſometimes very high, or unequal, even between neighbouring countries, affording room for very profitable ſpeculations for thoſe merchants who circulate bills in the way of arbitration of exchange.

An unfavourable ſtate of the exchange with a country furniſhes a motive for exporting commodities to it. The merchant under theſe circumſtances can afford to ſell his goods as much cheaper as the premium which he receives for his bill amounts to. Hence the courſe of exchange tends to correct itſelf, and, in peace, it ſeldom continues, for any length of time, more unfavourable than the amount of the expences which might be incurred by tranſporting bullion to pay the balance which is to be remitted; for bullion may be conſidered the univerſal currency of merchants, though it is not always of ready or immediate application.

Although an unfavourable balance of trade has been generally conſidered an invariable cauſe of an unfavourable courſe of exchange, yet recent experience has ſhewn that this is not always the caſe. Thus, in the inveſtigation already alluded to, which took place in the Houſe of Commons relating to the exchange between England and Ireland, it was demonſtrated that the balance of trade was in favour of Ireland, while the courſe of exchange was highly unfavourable; it was, however, ſhewn in ſubſequent publications on the ſubject by Meſſrs. Parnell and Forſter, that though the balance of trade was in favour of Ireland, the balance of debt was unfavourable, or, in other words, the balance of remittance, on account of the number of Iriſh abſentees reſident in England; but perhaps the political ſtate of the country was the chief cauſe.

In time of war the fluctuations of the courſe of exchange are ſometimes very great, particularly where large remittances are to be made in the way of foreign loans or ſubſidies. The exchange is likewiſe lowered by any debaſement of the coin of a country, or by the depreciation of any other circulating medium. Even an exceſs of currency has the effect of turning the rate of exchange againſt that place where it prevails, as the exceſs raiſes the price of all commodities beyond their value in thoſe places where no ſuch redundancy exiſts. It may, however, be obſerved, that the nature of exchange operates to effect the general diſtribution of the ſurplus ſpecie, and to maintain the level of money throughout the commercial world. In ſhort, in all caſes, the exchange tends to an equilibrium.

Although the depreciation of the circulating medium of a country raiſes the courſe of exchange againſt it, the circumſtance is not always a diſadvantage. Thus, before the reformation of our ſilver coinage, in the reign of William the Third, the exchange between England and Holland, computed by the ſtandard of their reſpective mints, was 25 *per cent.* againſt England, but the current coin of England was more than 25 *per cent.* below its nominal or ſtandard value; and therefore the exchange was virtually in favour of of England, according to the ftatement of Dr. Adam Smith.

It may be further obferved, that the wealth of a country will fometimes raife the courfe of exchange againft it, on account of its importations of luxuries from abroad. Rich countries are likewife liable to have the courfe of exchange turned againft them by the fubfidies which they may have to remit to lefs opulent ftates, as before noticed.

Thus in 1793, the trade between Holland and England was completely open; and yet the courfe of exchange was 10 or 12 *per cent.* againft Amfterdam, owing probably to the balance of trade being fo much in favour of London. But, in 1794, when England undertook to fubfidize Pruffia, large remittances of bills were made through Amfterdam, which caufed an immediate fall in the courfe of exchange between that place and London, even below par: and therefore at fubfequent periods of the war, it has been thought prudent by the Englifh government to export fpecie on fuch occafions, rather than to turn the courfe of exchange againft London by the operation of remitting large fubfidies in bills. During the prefent war between France and Auftria (1809) the latter power has been fubfidized by the Englifh government, which has been chiefly done in bills, and this has tended to raife the exchange againft England, in the places where thofe bills were negociated. But the caufe which has operated more powerfully to produce this effect is the great exportation of goods to England, from Germany, France, and Holland, without any adequate importation of Englifh merchandize. Hence the exchange with London has been for fome time greatly in favour of thofe places, while between London and moft of the other parts of Europe it has continued nearly at par.

From what has been faid refpecting the caufes, both commercial and political, which produce the fluctuations of exchange, and which frequently counteract each other, the following fimple conclufion may be drawn; that whatever produces a demand for bills on any place tends to enhance their value, and therefore the courfe of exchange rifes and falls according to the proportion which exifts between the plenty and fcarcity of bills, that is, between the demand and the fupply.

Monies of Exchange.

The following tables contain the monies of exchange of the principal trading places of Europe, in all their varieties and combinations. Explanations are alfo given of the quotations or lifts of the courfes of exchange, which are tranfmitted from one country to another for the government and advice of merchants. Thefe quotations feldom give more than the figures of the uncertain prices, omitting the denominations of money and the certain prices, all of which are here explained.

Note.—In all the uncertain prices the words *more or lefs* are to be underftood.

Amsterdam.

Monies of Exchange.

Exchanges are computed in florins, ftivers, and pennings; or in pounds, fhillings, and pence Flemifh.

16 Pennings	=	1 Stiver
20 Stivers	=	1 Florin or guilder
2 Grotes or pence Flemifh	=	1 Stiver
12 Grotes or 6 ftivers	=	1 Shilling Flemifh
20 Shillings Flemifh, or 6 florins	=	1 Pound Flemifh.

There are two forts of money in Holland; namely, *banco* and *currency:* banco generally bears a premium againft currency of 4 or 5 *per cent.* which is called *agio.*

Quotation explained.

Amfterdam gives to	Uncertain prices.		Certain prices.
London	34 fhillings 8 grotes Flemifh	for	1 Pound fterling
France	54 Grotes Flemifh	—	3 Francs
Spain	99 Ditto	—	1 Ducat of exch.
Portugal	44 Ditto	—	1 Old crufade
Genoa	86 Ditto	—	1 Pezza of $5\frac{3}{4}$ lire
Leghorn	92 Ditto	—	1 Pezza of 8 reals
Hamburgh	34 Stivers	—	2 Marks
Vienna	20 Ditto	—	1 Rixdollar
receives from			
Antwerp	104 Florins	—	100 Florins
Breflau	144 Rixdollars	—	100 Rixdollars
Venice	96 Soldi piccoli	—	1 Florin

N. B. The exchanges of Amfterdam are always tranfacted in banco, unlefs otherwife expreffed.

Augsburg.

Monies of Exchange.

Exchanges are computed in florins and creutzers, and alfo in rixdollars and creutzers.

60 Creutzers	=	1 Florin
$1\frac{1}{2}$ Florin or 90 creutzers	=	1 Rixdollar of account.

Two forts of money are ufed here; giro, that is, money of exchange, and currency.

100 Florins of exchange = 127 Florins current.

Quotation explained.

Augfburg gives to	Uncertain prices.		Certain prices.
Amfterdam	113 Rixdollars of exchange	for	100 Rixdollars
Hamburgh	118 Ditto Ditto	—	100 Ditto
Francfort	102 Rixdollars cur.	—	100 Ditto
Leipfic	99 Ditto Ditto	—	100 Ditto
London	10 Florins 45 creutzers	—	1 Pound fterling
Paris	120 Florins current	—	300 Francs
Nuremberg	101 Florins Ditto	—	100 Florins
receives from			
Genoa	62 Soldi fuori banco	—	1 Florin
Leghorn	57 Soldi moneta buona	—	1 Ditto
Vienna	128 Florins	—	100 Ditto.

Berlin.

Monies of Exchange.

Exchanges are computed in rixdollars, good grofchen, and pfenings currency.

12 Pfenings	=	1 Good grofche
24 Good grofchen	=	1 Rixdollar of account.

Quotation explained.

Berlin gives to	Uncertain prices.		Certain prices.
Amfterdam	154 Rixdollars	for	100 Rixdollars
Breflau	$100\frac{1}{2}$ Ditto	—	100 Ditto
Hamburgh	158 Ditto	—	100 Ditto
Konigfberg	$100\frac{1}{2}$ Ditto	—	100 Ditto
Francfort	105 Ditto	—	100 Ditto
Leipfic	104 Ditto	—	100 Ditto
London	$6\frac{1}{2}$ Ditto 12 grofchen	—	1 Pound fterling
Paris	83 Rixdollars	—	300 Francs.
Augfburg	106 Ditto	—	100 Rixdollars
Vienna	60 Ditto	—	100 Ditto.

Bologna.

Bologna. See Rome.

Bremen.

Monies of Exchange.

Exchanges are computed in rixdollars, grotes, and ſwares

5 Swares = 1 Grote
72 Grotes = 1 Rixdollar of account.

Quotation explained.

Bremen gives to	Uncertain prices.		Certain prices.
Amſterdam	143 Rixdollars	for	100 Rixdollars
Hamburgh	142 Ditto	—	100 Ditto
Francfort	110 Ditto	—	100 Ditto
Leipſic	104 Ditto	—	100 Ditto
London	605 Ditto	—	100 Pounds ſterling
Nuremberg	104 Ditto	—	100 Rixdollars
Paris	20 Grotes	—	1 Franc
Vienna	90 Rixdollars	—	100 Rixdollars.

Breslau. See Berlin.

Cadiz.

Monies of Exchange.

Exchanges are computed in dollars, reals, and maravedis of old plate; alſo in ducats of exchange, and in dobloons of plate, or piſtoles of exchange.

34 Maravedis = 1 Real
8 Reals = 1 Dollar of plate
375 Maravedis of plate = 1 Ducat of exchange
4 Dollars of plate = 1 Piſtole of exchange.

N. B. Vellon, the current money of Spain, is to old plate as 17 to 32; that is,

32 Reals or maravedis vellon = {17 Reals or maravedis of old plate.

Quotation explained.

Cadiz gives to	Uncertain prices.		Certain prices.
Genoa	121 Dollars of plate	for	100 Pezze of $5\frac{3}{4}$ lire
Leghorn	130 Ditto	—	100 Pezze of 8 reals
Naples	{290 Maravedis of plate}	—	1 Ducat regno
receives from			
Amſterdam	97 Grotes Flemiſh	—	1 Ducat of exch.
London	42 Pence ſterling	—	1 Dollar of plate
Paris	78 Sous tournois	—	1 Ditto
Hamburgh	90 Grotes Flemiſh	—	1 Ducat of exch.
Liſbon	2470 Rees	—	1 Dobloon of plate

Constantinople.

Monies of Exchange.

Exchanges are computed in piaſtres, paras, and aſpers; or in piaſtres and aſpers.

3 Aſpers = 1 Para
40 Paras or 120 aſpers = 1 Piaſtre or dollar.

Quotation explained.

Conſtantinople gives to	Uncertain prices.		Certain prices.
London	17 Piaſtres	for	1 Pound ſterling
Vienna	50 Paras	—	1 Florin
Leghorn	145 Ditto	—	1 Pezza of 8 reals
Genoa	24 Ditto	—	1 Lirafuoribanco
Amſterdam	65 Ditto	—	1 Florin current
Paris	200 Piaſtres	for	300 Francs
Venice	360 Paras	—	{1 Sequin of 22 lire
receives from			
Marſeilles	{1 Franc, 50 centimes}	—	1 Piaſtre
Hamburgh	{25 Grotes Flemiſh}	—	1 Ditto
Smyrna	110 Piaſtres	—	100 Ditto.

Copenhagen.

Monies of Exchange.

Exchanges are computed in rixdollars, marks, and ſkillings Daniſh; and ſometimes in rixdollars, marks, and ſkillings lubs or Hamburgh. Pfenings are alſo ſometimes reckoned.

12 Pfenings = 1 Skilling
16 Skillings = 1 Mark
6 Marks Daniſh, or 3 marks lubs = 1 Rixdollar
2 Marks or ſkillings Daniſh = 1 Mark or ſkilling lubs.

Quotation explained.

Copenhagen gives to	Uncertain prices.		Certain prices.
Amſterdam	143 Rixdollars	for	100 Rixdollars
Hamburgh	149 Ditto	—	100 Ditto
London	{6 Rixdollars 30 ſhillings}	—	1 Pound ſterling
Paris	25 Skillings Daniſh	—	1 Franc.

Dantzic.

Monies of Exchange.

Exchanges are computed in florins, groſchen, and pfenings.

18 Pfenings = 1 Groſche
30 Groſchen = 1 Florin or gulden
3 Florins = 1 Rixdollar.

Quotation explained.

Dantzic gives to	Uncertain prices.		Certain prices.
Amſterdam	372 Groſchen	for	1 Pound Flemiſh
Hamburgh	169 Ditto	—	1 Rixdollar ſpecie
London	24 Florins	—	1 Pound ſterling
Paris	110 Rixdollars	—	300 Francs
Francfort	105 Groſchen	—	1 Rixdollar.
Leipſic	125 Rixdollars	—	100 Ditto.

Florence. See Leghorn.

Francfort.

Monies of Exchange.

Exchanges are computed in florins and creutzers; or in rixdollars and creutzers; alſo in florins and batzen.

4 Creutzers = 1 Batze
60 Creutzers, or 15 batzen = 1 Florin or gulden
90 Creutzers, or $1\frac{1}{2}$ florin = 1 Rixdollar of account.

Quotation explained.

Francfort gives to	Uncertain prices.		Certain prices.
Amſterdam	140 Rixdollars	for	100 Rixdollars current
Hamburgh	150 Ditto	—	100 Ditto banco Francfort

Francfort gives to	Uncertain prices.		Certain prices.
Augsburg	101 Rixdollars	for	100 Rixdollars banco
Vienna	60 Florins	—	100 Florins
France	79 Rixdollars	—	300 Livres
Leipsic	100½ Ditto	—	100 Rixdollars in louis d'or
Bremen	108 Ditto	—	100 Ditto
Basil	101 Ditto	—	100 Ditto in new ecus.

GENEVA.

Monies of Exchange.

Exchanges are computed in livres, sous, and deniers current; and in ecus, livres, &c.

12 Deniers	=	1 Sou or sol
20 Sous	=	1 Livre
3 Livres	=	1 Ecu.

Quotation explained.

Geneva gives to	Uncertain prices.		Certain prices.
Hamburgh	23 Sous	for	1 Mark
Leghorn	104 Ecus	—	100 Pezze of 8 reals
Genoa	95 Ditto	—	100 Pezze of 5¾ lire
Milan	98 Ditto	—	640 Current lire
Spain	44 Sous	—	1 Dollar of plate
receives from			
France	166 Francs	—	100 Livres
London	49 Pence sterling	—	1 Ecu
Amsterdam	89 Grotes Flemish	—	1 Ditto
Augsburg	127 Rixdollars current	—	100 Ditto
Basil	168 Livres tournois	—	100 Livres
Turin	84 Soldi	—	1 Ecu.

GENOA.

Monies of Exchange.

Exchanges are computed in lire, soldi, and denari di lira; or in pezze, soldi, and denari di pezza; all in currency, called *fuori banco.*

12 Denari di lira	=	1 Soldi di lira
20 Soldi di lira	=	1 Lira
12 Denari di pezza	=	1 Soldo di pezza
20 Soldi di pezza	=	1 Pezza
5¾ Lire	=	1 Pezza
4 Lire 12 soldi	=	1 Scudio di cambio, or crown of exchange
1● Lire 14 soldi	=	1 Scudo d'oro marche, or gold crown.

Quotation explained.

Genoa gives to	Uncertain prices.		Certain prices.
Leghorn	124 Soldi di lira	for	1 Pezza of 8 reals
Rome	128 Ditto	—	1 Roman crown
Naples	103 Ditto	—	1 Ducat regno
Hamburgh	45 Ditto	—	1 Mark
Vienna	30 Ditto	—	1 Florin
Augsburg	62 Ditto	—	1 Ditto
receives from			
Venice	33 Soldi piccoli	—	1 Lira
Palermo	36 Grani	—	1 Ditto
Amsterdam	85 Grotes Flemish	—	1 Pezza
France	94 Sous in francs	—	1 Ditto

Genoa receives from	Uncertain prices.		Certain prices.
Spain	620 Maravedis of plate	for	1 Gold crown
Lisbon	718 Rees	—	1 Pezza
Milan	87 Soldi	—	4 Lire
London	48 Pence sterling	—	1 Pezza

HAMBURGH.

Monies of Exchange.

Exchanges are computed in marks, schilling lubs, and pfenings; or in pounds, shillings, and pence Flemish; also in rixdollars, marks, &c.

12 Pfenings	=	1 Schilling lubs
16 Schillings	=	1 Mark
3 Marks	=	1 Rixdollar
6 Pfenings	=	1 Grote or penny Flemish
12 Grotes	=	1 Shilling Flemish
20 Shillings Flemish	=	1 Pound Flemish
Thus, 6 Schilling lubs	=	1 Shilling Flemish
7½ Marks	=	1 Pound Flemish.

There are two sorts of money in Hamburgh, called *banco* and *currency.* Banco bears an agio or premium against currency, which is generally from 20 to 25 *per cent.*

Quotation explained.

Hamburgh gives to	Uncertain prices.		Certain prices.
London	33 Shillings 7 Grotes Flem.	for	1 Pound sterling
France	26 Schilling lubs	—	3 Francs
Spain	91 Grotes Flemish	—	1 Ducat of exch.
Portugal	43 Ditto	—	1 Old crusade
Genoa	80 Ditto	—	1 Pezza of 5¾ lire
Leghorn	86 Ditto	—	1 Pezza of 8 reals
Basil	25 Schilling lubs	—	1 Ecu of 3 francs
receives from			
Amsterdam	33 Stivers	—	2 Marks
Breslau	139 Rixdollars	—	100 Rixdollars
Copenhagen	149 Ditto	—	100 Ditto
Vienna	310 Florins	—	100 Ditto
Venice	82 Soldi piccoli	—	1 Mark.

N. B. The exchanges of Hamburgh are always transacted in banco, unless otherwise expressed.

LEGHORN.

Monies of Exchange.

Exchanges are computed in pezze, soldi, and denari di pezza; sometimes in lire, soldi, and denari di lira, moneta buona.

12 Denari di pezza	=	1 Soldo di pezza
20 Soldi di pezza	=	1 Pezza of 8 reals
12 Denari di lira	=	1 Soldo di lira
20 Soldi di lira	=	1 Lira
5¾ Lire, moneta buona	=	1 Pezza of 8 reals.

Quotation explained.

Leghorn gives to	Uncertain prices.		Certain prices.
Vienna	30 Soldi moneta buona	for	1 Florin
Novi	186 Pezze	—	100 Scudi d'oro marche.

Leghorn receives from	Uncertain prices.		Certain prices.	
Rome	128 Bajocchi	for	1	Pezza of 8 reals
Naples	118 Ducats regno	—	100	Ditto
Palermo	11 Tari 15 grani	—	1	Ditto
Genoa	125 Soldi fuori banco	—	1	Ditto
Milan	136 Soldi correnti	—	1	Ditto
Florence	124 Soldi	—	1	Ditto
Turin	93 Soldi	—	1	Ditto
Venice	$10\frac{1}{2}$ Lire piccole	—	1	Ditto
France	104 Sous in francs	—	1	Ditto
London	54 Pence fterling	—	1	Ditto
Amfterdam	95 Grotes Flemifh	—	1	Ditto
Hamburgh	89 Grotes-Flemifh	—	1	Ditto
Lifbon	855 Rees	—	1	Ditto
Spain	140 Dollars of plate	—	100	Ditto
Augfburg	204 Florins current	—	100	Ditto
Bologna	96 Bolognini	—	1	Ditto
Ancona	132 Bajocchi	—	1	Ditto
Geneva	109 Ecus of 3 livres	—	100	Ditto
Peterfburg	190 Rubles	—	100	Ditto.

LEIPSIC. See BERLIN.

LISBON.

Monies of Exchange.

Exchanges are computed in rees and milrees, and alfo in old crufades.

1000 Rees = 1 Milree
400 Rees = 1 Old crufade.

Quotation explained.

Lifbon gives to	Uncertain prices.		Certain prices.
Paris	470 Rees	for	3 Francs
Genoa	746 Ditto	—	1 Pezza of $5\frac{3}{4}$ lire
Leghorn	810 Ditto	—	1 Pezza of 8 reals
Vienna	360 Ditto	—	1 Florin
Venice	66 Ditto	—	1 Lira piccola
Spain	2430 Ditto	—	1 Dobloon of plate
receives from			
London	66 Pence fterling	—	1 Milree
Amfterdam	45 Grotes Flemifh	—	1 Old crufade
Hamburgh	43 Ditto	—	1 Ditto.

MADRID.

Monies of Exchange. See CADIZ.

Quotation of Madrid on Paris explained.

Madrid receives from	Uncertain price.		Certain price.
Paris	15 Francs 40 centimes	for	1 Dobloon of plate.

The other exchanges of Madrid are fimilar to thofe of Cadiz.

MILAN.

Monies of Exchange.

Exchanges are computed in lire, foldi, and denari correnti or imperiali.

12 Denari = 1 Soldo
20 Soldi = 1 Lira
106 Lire or foldi imperiali = 150 Lire or foldi correnti
117 Soldi imperiali = 1 Scudo or crown.

Quotation explained.

Milan gives to	Uncertain prices.		Certain prices.
France	55 Soldi imperiali	for	3 Francs
Genoa	86 Soldi correnti	—	4 Lire fuori banco
Rome	138 Ditto	—	1 Roman crown
Leghorn	135 Ditto	—	1 Pezza of 8 reals
Augfburg	66 Ditto	—	1 Florin current
Venice	84 Ditto	—	1 Ducat current
Vienna	55 Ditto	—	1 Florin current
Amfterdam	57 Ditto	—	1 Florin banco
London	31 Lire correnti	—	1 Pound fterling
Hamburgh	49 Soldi correnti	—	1 Mark.

NAPLES.

Monies of Exchange.

Exchanges are computed in ducats and grains, or in ducats, carlins, and grains.

10 Grains = 1 Carlin
10 Carlins or 100 grains = 1 Ducat regno.

Quotation explained.

Naples gives to	Uncertain prices.		Certain prices.
Leghorn	120 Ducats regno	for	100 Pezze
Amfterdam	54 Grains	—	1 Florin
Spain	85 Ditto	—	1 Dollar of plate
Rome	125 Ducats	—	100 Roman crowns
Hamburgh	45 Grains	—	1 Mark
Sicily	120 Ditto	—	1 Sicilian crown
receives from			
London	42 Pence fterling	—	1 Ducat regno
Genoa	102 Soldi fuori banco	—	1 Ditto
Venice	9 Lire 15 foldi piccoli	—	1 Ditto
France	84 Sous in francs	—	1 Ditto
Lifbon	670 Rees		1 Ditto.

PALERMO.

Monies of Exchange.

Exchanges are computed in ounces, tari, and grains; and alfo in fcudi, tari, and grains.

20 Grains = 1 Taro
30 Tari = 1 Ounce
12 Tari = 1 Scudo or crown;
Thus 5 Crowns = 2 Ounces.

Quotation explained.

Palermo gives to	Uncertain prices.		Certain prices.
Amfterdam	$5\frac{1}{2}$ Tari	for	1 Florin
Genoa	40 Grains	—	1 Lira fuori banco
Leghorn	$12\frac{1}{2}$ Tari	—	1 Pezza of 8 reals
Lifbon	$6\frac{1}{4}$ Tari	—	1 Old crufade
London	60 Tari	—	1 Pound fterling
Paris	50 Grains	—	1 Livre
Rome	$12\frac{1}{2}$ Tari	—	1 Roman crown
Spain	$8\frac{1}{2}$ Tari	—	1 Dollar of plate.
receives from			
Naples	120 Grains	—	1 Sicilian crown.

PARIS.

Monies of Exchange.

Exchanges are computed in francs and centimes; or in livres, fous, and deniers tournois.

100 Centimes

100 Centimes	=	1 Franc
12 Deniers	=	1 Sou or ſol
20 Sous	=	1 Livre
80 Francs	=	81 Livres
3 Livres or 3 francs	=	1 Ecu of exchange.

The 5 franc piece is alſo ſometimes divided into 100 ſous, which are diſtinguiſhed by ſaying, 100, or ſo many ſous in francs.

Quotation explained.

Paris gives to	Uncertain prices.		Certain prices.
London	24 Francs	for	1 Pound ſterling
Hamburgh	185 Francs	—	100 Marks
Genoa	465 Centimes	—	1 Pezza of $5\frac{3}{4}$ lire
Leghorn	504 Centimes	—	1 Pezza of 8 reals
Spain	15 Francs 40 cent.	—	1 Dobloon of plate
Geneva	162 Francs	—	100 Livres current
Baſil	101 Livres	—	100 Livres
Augſburg	249 Centimes	—	1 Florin current
Vienna	160 Centimes	—	1 Florin
Naples	4 Francs 20 cent.	—	1 Ducat regno
receives from			
Amſterdam	54 Grotes Flemiſh	—	3 Francs
Frankfort	75 Rixdollars cur.	—	300 Ditto
Liſbon	460 Rees	—	3 Ditto
Milan	8 Livres 6 ſoldi	—	6 Ditto.

PETERSBURGH.

Monies of Exchange.

Exchanges are computed in rubles and copecks.

100 Copecks = 1 Ruble.

Quotation explained.

Peterſburgh gives to	Uncertain prices.		Certain prices.
Conſtantinople	50 Copecks	for	1 Piaſtre.
receives from			
London	28 Pence ſterling	—	1 Ruble
Amſterdam	25 Stivers	—	1 Ditto
Vienna	125 Creutzers	—	1 Ditto
Leipſic	17 Groſchen	—	1 Ditto
Paris	270 Centimes	—	1 Ditto

ROME.

Monies of Exchange.

Exchanges are computed in ſcudi moneta, and bajocchi; or in ſcudi di ſtampa d'oro, ſoldi and denari d'oro; quattrini and mezzi quattrini are alſo ſometimes reckoned.

2 Mezzi quattrini	=	1 Quattrino
5 Quattrini	=	1 Bajocco or Bolognino
100 Bajocchi	=	1 Scudo moneta, or Roman crown
1523 Mezzi quattrini, or $152\frac{3}{10}$ bajocchi	=	1 Scudo di ſtampa d'oro, or gold crown
12 Denari d'oro	=	1 Soldo d'oro
20 Soldi d'oro	=	1 Gold crown.

Quotation explained.

Rome gives to	Uncertain prices.		Certain prices.
Florence	84 Gold crowns	for	100 Gold crowns
Milan	81 Roman crowns	—	100 Scudi imperiali
Ancona	99 Ditto	—	100 Crowns
Bologna	98 Ditto	—	100 Ditto
Leghorn	98 Bajocchi	—	1 Pezza of 8 reals
Amſterdam	44 Ditto	—	1 Florin

Rome receives from	Certain prices.		Uncertain prices.
Naples	122 Ducats regno	for	100 Roman crowns
Venice	11 Lire 10 ſoldi piccoli	—	1 Ditto
Genoa	124 Soldi fuori banco	—	1 Ditto
Paris	105 Sous in francs	—	1 Ditto
London	51 Pence ſterling	—	1 Ditto

ROTTERDAM.

Monies of Exchange. See AMSTERDAM.

Quotation on London explained.

Rotterdam gives to	Uncertain price.		Certain price.
London	11 Florence current	for	1 Pound ſterling.

For the other exchanges of Rotterdam, ſee AMSTERDAM.

STOCKHOLM.

Monies of Exchange.

Exchanges are computed in rixdollars, ſkillings, and fenings.

12 Fenings or Oers	=	1 Skilling
48 Skillings	=	1 Rixdollar.

Quotation explained.

Stockholm gives to	Uncertain prices.		Certain prices.
Amſterdam	44 Skillings	for	1 Rixdollar
Copenhagen	36 Ditto	—	1 Ditto
Dantzic	$9\frac{1}{2}$ Ditto	—	1 Florin
Hamburgh	47 Ditto	—	1 Rixdollar
Leghorn	40 Ditto	—	1 Pezza of 8 reals
London	$4\frac{1}{2}$ Rixdollars	—	1 Pound ſterling
Paris	24 Skillings	—	1 Ecu of 3 livres
Spain	42 Ditto	—	1 Ducat of exch.

TRIESTE. See VIENNA.

TURIN.

Monies of Exchange.

Exchanges are computed in lire, ſoldi, and denari.

12 Denari	=	1 Soldo
20 Soldi	=	1 Lira

Quotation explained.

Turin gives to	Uncertain prices.		Certain prices.
Amſterdam	37 Soldi	for	1 Florin
Augſburg	42 Ditto	—	1 Ditto
Geneva	82 Ditto	—	3 Livres
Genoa	9 Lire 8 ſoldi	—	1 Sequin
Leghorn	86 Soldi	—	1 Pezza of 8 reals
London	19 Lire 10 ſoldi	—	1 Pound ſterling
Milan	92 Soldi	—	$7\frac{1}{2}$ Lire correnti
Paris	20 Lire	—	24 Francs
Rome	87 Soldi	—	1 Roman crown
Venice	94 Ditto	—	1 Ducat current.

VENICE.

Monies of Exchange.

Exchanges are computed in lire, ſoldi, and denari, moneta piccola; and alſo in ducats.

12 Denari	=	1 Soldo
20 Soldi	=	1 Lira
6 Lire 4 ſoldi	=	1 Ducat current, or of account
8 Lire	=	1 Ducat effective

Quotation

Quotation explained.

Venice gives to	Uncertain prices.		Certain prices.
London	56 Lire piccole	for	1 Pound ſterling
Amſterdam	4 Lire 18 ſoldi ditto	—	1 Florin
Augſburg	4 Lire 16 ſoldi ditto	—	1 Ditto
Conſtantinople	3 Lire 6 ſoldi	—	1 Piaſtre
Paris	2 Lire 5 ſoldi	—	1 Franc
Genoa	38 Soldi	—	1 Lira fuori banco
Hamburgh	4 Lire 6 ſoldi	—	1 Mark
Leghorn	11 Lire 18 ſoldi	—	1 Pezza
Milan	34 Soldi	—	1 Lira corrente
Naples	9 Lire 18 ſoldi	—	1 Ducat regno
Vienna	4 Lire 8 ſoldi	—	1 Florin
Rome	12 Lire 10 ſoldi	—	1 Roman crown.

VIENNA.

Monies of Exchange.

Exchanges are computed in florins and creutzers, or in rixdollars and creutzers; pfenings are ſometimes uſed.

4 Pfenings	=	1 Creutzer
60 Creutzers	=	1 Florin
90 Creutzers, or $1\frac{1}{2}$ florin	=	1 Rixdollar of account.

Quotation explained.

Vienna gives to	Uncertain prices.		Certain prices.
Amſterdam	286 Rixdollars	for	100 Rixdollars current
Augſburg	$202\frac{1}{2}$ Ditto	—	100 Ditto
Hamburgh	300 Ditto	—	100 Ditto banco
London	19 Florins	—	1 Pound ſterling
Paris	47 Creutzers	—	1 Franc
Conſtantinople	112 Florins	—	1 Piaſtre
Venice	184 Ditto	—	500 Lire piccole
Prague	$99\frac{1}{2}$ Ditto	—	100 Florins
receives from			
Genoa	30 Soldi fuori banco	for	1 Florin
Leghorn	28 Soldi moneta buona	—	1 Ditto
Milan	33 Soldi correnti	—	1 Ditto.

AMERICA.

Monies of Exchange.

Exchanges are computed in dollars, dimes, and cents; and in ſome places in pounds, ſhillings, and pence currency.

10 Cents	=	1 Dime
10 Dimes, or 100 cents	=	1 Dollar,
12 Pence currency	=	1 Shilling ditto
20 Shillings currency	=	1 Pound ditto.

American Quotations explained.

New York gives to	Uncertain prices.		Certain prices.
London	177 Pounds currency	for	1 Pound ſterling
Amſterdam	42 Cents	—	1 Guilder
Hamburgh	35 Cents	—	1 Mark
Bremen	78 Cents	—	1 Rixdollar
receives from			
Paris	5 Francs 30 cent.	—	1 Dollar.

Philadelphia gives to	Uncertain prices.		Certain prices.
Amſterdam	43 Cents	for	1 Guilder
Hamburgh	35 Cents	—	1 Mark
receives from			
London	4*s*. 6*d*. ſterling *at par*	—	1 Dollar

Baltimore gives to	Uncertain prices.		Certain prices.
Amſterdam	40 Cents	for	1 Guilder
Hamburgh	33 Cents	—	1 Mark
London	101 Cents	—	4*s*. 6*d*. ſterling.

Theſe American quotations have been copied from a New York paper of March 1809. All the other quotations may be likewiſe relied on, having been taken from genuine and recent authorities.

LONDON.

Monies of Exchange.

Exchanges are computed in pounds, ſhillings, and pence ſterling; and farthings are ſometimes reckoned.

4 Farthings	=	1 Penny
12 Pence	=	1 Shilling
20 Shillings	=	1 Pound.

Lloyd's Liſt explained.

London gives to	Uncertain prices.		Certain prices.
Madrid	42 Pence ſterling	for	1 Dollar of plate
Genoa	$47\frac{1}{2}$ Ditto	—	1 Pezza of $5\frac{3}{4}$ lire
Leghorn	$51\frac{1}{2}$ Ditto	—	1 Pezza of 8 reals
Liſbon	68 Ditto	—	1 Milree
Naples	42 Ditto	—	1 Ducat regno
Palermo	90 Ditto	—	1 Ounce
receives from			
Amſterdam	34 Shillings Flem.	—	1 Pound ſterling
Rotterdam	11 Florins current	—	1 Ditto
Hamburgh	33 Shillings Flem.	—	1 Ditto
Paris	23 Livres 10 ſous	—	1 Ditto
Venice	52 Lire piccole	—	1 Ditto
Dublin	10 per cent, that is, 110*l*. Iriſh	—	100 Ditto.

Examples for calculating the exchanges of London with the above places are here given; whence the method of computing the exchanges of other places one with another may be eaſily comprehended, as all operations of this kind may be performed by the Rule of Three Direct.

LONDON and AMSTERDAM.

Engliſh money is reduced to Dutch by ſaying; as 1*l*. ſterling is to the rate of exchange, ſo is the given ſum to the ſum ſought.

Reduce 782*l*. 12*s*. 6*d*. ſterling to Dutch money, exchange at 34 ſhillings and 8 pence Flemiſh *per* pound ſterling.

```
      £.      s. d.                £.  s. d.      Flor. Stiv.
As    1   :   34 8 Flem.   ::     782 12 6   :   8139  6
              12                       20
             ----                    -----
              416                    15652
                8                       12
             ----                    ------
             3328 Pennings           187830
                                       3328
                                    -------
                                    1502640
                                    375660
                                   563490
                                  563490        16
                             24,0)625098240(2604576 Pennings
                                  48
                                  --       2,0)16278,6 Stivers
                                  145, &c.     ------------
                                               8139 Flor. 6 Stiv.
```

Dutch money is reduced to Englifh by reverfing the foregoing operation; thus,

	s. d.		£.		Flor. Stiv.		£. s. d.
As	34 8 Flem.	:	1	::	8139 6	:	782 12 6

LONDON and HAMBURGH.

Englifh money is reduced to that of Hamburgh by an operation fimilar to the foregoing.

Reduce 106*l.* 17*s.* 6. fterling to Hamburgh money; exchange at 35 fhillings 4 grotes Flemifh *per* pound fterling.

	£.		s. d.		£. s. d.		M. Sc. Pf.
As	1	:	35 4 Flem.	:	106 17 6	:	1416 1 6

12   20
424   2137
6   12
2544 Pfenings   25650
2544
102600
102600
128250
51300   12
24,0)6525360,0(271890 Pfenings
48
16)22657 Schill. 6 Pfen.
172, &c.
1416 M. 1 Sc. 6 Pf.

Hamburgh money is reduced to Englifh by reverfing the foregoing operation; thus,

	s. d.		£.		M. Sc. Pf.		£. s. d.
As	35 4 Flem.	:	1	::	1416 1 6	:	106 17 6

LONDON and PARIS.

Englifh money is reduced to French by faying; as 1*l.* is to the rate of exchange, fo is the given fum to the fum fought.

Reduce 728*l.* 15*s.* fterling to French money, exchange at 23 livres 10 fous *per* pound fterling.

	£.		Liv. So.		£. s.		Liv. So. Den.
As	1	:	23 10	::	728 15	:	17125 12 6

20   ×20×470
470   2,0)685025,0
2,0)34251,2½ Sous
17125 Liv. 12 Sous, 6 Den.

But if the anfwer be required in francs, the livres muft be multiplied by 80 and divided by 81; thus,

					Liv. So. Den.		Francs. Cen.
As	81	:	80	::	17125 12 6	:	16914 19

French money is reduced to Englifh by reverfing the foregoing operation; thus,

					Francs. Cen.		Liv. So. Den.
As	80	:	81	::	16914 19	:	17125 12 6
	Liv. So.		£.		Liv. So. Den.		£. s.
And as	23 10	:	1	::	17125 12 6	:	728 15

The exchange of Paris on London is, however, generally expreffed in francs, and then the reduction may be performed by a fingle analogy; thus,

Reduce 4305 francs 95 centimes to fterling; exchange at 24 francs 25 centimes *per* pound fterling.

	Fr. Cen.		£.		Fr. Cen.		£. s. d.
As	24 25	:	1	::	4305 95	:	177 11 3½

LONDON and SPAIN.

Englifh money is reduced to Spanifh by faying; as the rate of exchange is to 1 dollar, fo is the given fum to the fum fought.

Reduce 391*l.* 1*s.* 3*d.* fterling to Spanifh money, exchange at 35½ fterling *per* dollar of plate.

	d.		Doll.		£. s. d.		Doll. R. M.
As	35½	:	1	::	391 1 3	:	2643 6 14

2   8   ×20×12×2
71   8   187710
34   ×272
272 Ma. 71)51057120(719114 Maravedis.
34
8)21150 Reals 14 Mar.
2643 Doll. 6 R. 14 M.

But if the anfwer be required in vellon, the reals of plate fhould be multiplied by 32 and divided by 17; thus,

					Reals. Mar. plate.		Reals. Mar. vel.
As	17	:	32	::	21150 14	:	39812 18

Spanifh money is reduced to Englifh by reverfing the foregoing operation: thus,

	Doll.		d.		Doll. R. Mar.		£. s. d.
As	1	:	35½	::	2643 6 14	:	391 1 3

LONDON and LEGHORN.

Englifh money is reduced to that of Leghorn by faying; as the rate of exchange is to 1 pezza, fo is the given fum to the fum fought.

Reduce 392*l.* 18*s.* 4¼*d.* fterling to money of Leghorn; exchange at 50¼*d.* *per* pezza of 8 reals.

	d.		Pezza.		£. s. d.		Pezze Sol. De.
As	50¼	:	1	::	392 18 4¼	:	1876 12 5

4   ×20×12×4
201   201)377201(1876 Pez. 12 Sol. 5 Den.
201
&c.

Money of Leghorn is reduced to Englifh by reverfing the foregoing operation; thus,

	Pezza		d.		Pezze Sol. Den.		£. s. d.
As	1	:	50¼	::	1876 12 5	:	392 18 4¼

LONDON and GENOA.

Englifh money is reduced to money of Genoa by an analogy fimilar to the foregoing.

Reduce 239*l.* 11*s.* 3*d.* to money of Genoa; exchange at 45*d.* fterling *per* pezza of 5¾ lire fuori banco.

	d.		Pezza		£. s. d.		Pezza Sol. Den.
As	45	:	1	::	239 11 3	:	1277 13 4

×20×12
45)57495(1277 Pezze 13 Soldi 4 Den.
45
124, &c.

But

But if the anſwer be required in lire, the ſum thus found ſhould be multiplied by 23, and divided by 4; thus,

	Pez.	Sol.	D. di Pez.		Lire	Sol.	D. di Lira
As 4 : 23 ::	1277	13	4	:	7346	11	8

Money of Genoa is reduced to Engliſh by reverſing the foregoing operation; thus

	Lire	Sol.	D. di Lira		Pez.	Sol.	D. di Pez.
As 23 : 4 ::	7346	11	8	:	1277	13	4

	Pezza		d.		Pezze Sol. Den.		£. s. d.
And as	1	:	$50\frac{1}{4}$	::	1277 13 4	:	239 11 3

London and Lisbon.

Engliſh money is reduced to Portugueſe by ſaying: as the rate of exchange is to 1 milree, ſo is the given ſum to the ſum ſought.

Reduce 218*l.* 8*s.* $5\frac{1}{4}$*d.* to Portugal money; exchange at $63\frac{3}{8}$*d.* ſterling *per* milree.

```
     d.      Milree      £.  s.  d.       Mil. Rees
As  63⅜   :   1    ::   218  8  5¼    :   827  160
     8               ×20×12×8
    ---             ------------
    507         507)419370(827,160
    ---             4056
                    ----   &c.
```

Portugal money is reduced to Engliſh by reverſing the foregoing operation; thus,

	Milree		d.		Mil. Rees		£. s. d.
As	1	:	$63\frac{3}{8}$	::	827 160	:	218 8 $5\frac{1}{4}$

London and Naples.

Engliſh money is reduced to that of Naples by ſaying; as the rate of exchange is to 1 ducat, ſo is the given ſum to the ſum ſought.

Reduce 158*l.* 9*s.* 3*d.* to money of Naples; exchange at $37\frac{1}{2}$*d.* ſterling *per* ducat regno.

```
     d.     Ducat       £.  s. d.       Ducats  Grains
As  37½  :   1    ::   158  9  3    :   1014     16
     2              × 20 × 12 × 2
    ---             -------------
    75           75)76062(1014,16
    ---              75
                     ---   &c.
```

Money of Naples is reduced to ſterling by reverſing the foregoing operation; thus,

	Ducat		d.		Ducats Grains		£. s. d.
As	1	:	$37\frac{1}{2}$	::	1014 16	:	158 9 3

London and Palermo.

Engliſh money is reduced to Sicilian by ſaying; as the rate of exchange is to 1 ounce, ſo is the given ſum to the ſum ſought.

Reduce 565*l.* 10*s.* 9*d.* ſterling to Sicilian money; exchange at 89*d.* ſterling *per* ounce.

```
     d.    Oz.       £.  s. d.        Oz.  Taro Grs.
As  89  :   1   ::  565 10  9   :   1525    1    7
                    × 20 × 12
                   -----------
              89)135729(1525 Oz.   1 taro 7 grains.
                 89
                 ---    &c.
```

Remainder 4 oz. × 30 × 20 ÷ 89 gives 1 taro 7 grains.

Sicilian money is reduced to Engliſh by reverſing the foregoing operation; thus:

	Oz.		d.		Oz. Taro Grs.		£. s. d.
As	1	:	89	::	1525 1 7	:	565 10 9

London and Venice.

Engliſh money is reduced to Venetian by ſaying; as 1*l.* is to the rate of exchange, ſo is the given ſum to the ſum ſought.

Reduce 250*l.* 11*s.* 3*d.* to Venetian money; exchange at 59 lire piccole *per* pound ſterling.

```
     £.    Lire        £.  s. d.       Lire  Sol. Den.
As   1  :   59   ::   250 11  3    :  14783   3    9
                  × 20 × 12 × 59
                  --------------
          24,0)354796,5(14783 Lire 3 Soldi 9 Denari.
               24
               ---  &c.
```

Venetian money is reduced to Engliſh by reverſing the foregoing operation; thus,

	Lire		£.		Lire Sol. Den.		£. s. d.
As	59	:	1	::	14783 3 9	:	250 11 3

London and Rotterdam.

Engliſh money is reduced to Dutch currency by ſaying; as 1*l.* is to the rate of exchange, ſo is the given ſum to the ſum ſought.

Reduce 196*l.* 17*s.* 6*d.* ſterling to Dutch currency in Rotterdam; exchange at 12 florins 4 ſtivers *per* pound ſterling.

```
     £.  Fl. St.        £.  s. d.        Fl.  St. Pen.
As   1 :  12  4   ::   196 17  6    :   2401  17   8
          20        × 20 × 12 × 244
         ---        ---------------
         244               20
        24,0)1152900,0(4803,7½ Stivers.
             96        2401  Florins 17½ Stivers.
             ---  &c.
```

Dutch currency is reduced to Engliſh money by reverſing the foregoing operation; thus.

	Fl. St.		£.		Flor. St. Pen.		£. s. d.
As	12 4	:	1	::	2401 17 8	:	196 17 6

London and Dublin.

Engliſh money is reduced to Iriſh by ſaying; as 100 is to 100 more the rate of exchange, ſo is the given ſum to the ſum ſought.

Reduce 787*l.* 15*s.* Engliſh to Iriſh money; exchange at $11\frac{5}{8}$.

```
                          £.  s.             £.  s. d.
As 100  :  111⅝   ::    787  15 Eng.   :   879  6  6 Ir.
     8      8          × 893
   ---    ---         ----------
   800    893   8,00)7034,60l. 15s.
   ---    ---          879
                Rem.   2,60
                         20
                      ------
                8,00)52,15(6,51
                             12
                            ---
                           6,12
                            ---
```


Or

Or thus:

```
           787  15
                11⅝
           --------
          8665   5
4/8 = 1/2 = 393  17   6
1/8 = 1/4 =  98   9   4½
         ----------------
         91,57  12  10½
            20
         -----
         11,52
            12
         -----
          6,35        £787 15s. 0d.
         -----           91 11  6
                      -----------
                        879  6  6
```

Irifh money is reduced to Englifh by reverfing the foregoing analogy; thus,

			£.	s.	d.		£.	s.
As $111\frac{5}{8}$	:	100 ::	879	6	6 Ir	:	787	15 Eng.

When the exchange between the two countries is at par, Englifh money is turned to Irifh by adding $\frac{1}{12}$, and Irifh to Englifh by fubtracting $\frac{1}{13}$.

Thus reduce 787*l.* 15*s.* Englifh to Irifh money at par.

```
12)787  15   0  Englifh
    55  12  11
   -----------
13)853   7  11  Irifh
    65  12  11
   -----------
   787  15   0  Englifh.
```

Arbitration of Exchange.

Arbitration of exchange is a comparifon between the courfes of exchange of feveral places in order to afcertain the moft advantageous method of drawing or remitting bills. It is diftinguifhed into fimple and compound arbitration; the former comprehends the exchanges of three places only, and the latter of more than three places.

Simple Arbitration

Is a comparifon between the exchanges of two places with refpect to a third; that is to fay, it is a method of finding fuch a rate of exchange between two places, as fhall be in proportion with the rates quoted between each of them and a third place. The exchange thus determined, is called the *arbitrated price*, and alfo *proportional exchange*; and the *proportional par*.

If, for example, the courfe between London and Paris be 24 francs for 1*l.* fterling, and between Paris and Amfterdam 54*d.* Flemifh for 3 francs, (that is, 36*s.* Flemifh for 24 francs,) the arbitrated price between London and Amfterdam, through Paris, is evidently 36*s.* Flemifh for 1*l.* fterling: for as 3 fr. : 54*d.* Flem. :: 24 fr. : 36*s.* Flem.

Now when the actual direct price (as feen by a quotation or otherwife advifed,) is found to differ from the arbitrated price, advantage may be made by drawing or remitting indirectly, that is, by drawing on one place through another, as on Amfterdam through Paris; which may be performed in three different ways.

1ft. London may draw on Paris, and order his correfpondent there to draw on Amfterdam.

2d. London may draw on Paris, and order his correfpondent in Amfterdam to remit the fame fum to Paris.

3d. London may order his correfpondent at Paris to draw on Amfterdam, and to remit the value to London.

The operation of remitting indirectly, or of remitting to one place through another, may be likewife performed in three different ways:

1ft. London may remit to Paris, and order his correfpondent there to remit the fum to Amfterdam.

2d. London may remit to Paris, and order his correfpondent in Amfterdam to draw on Paris.

3d. London may take bills on Paris, and remit them to Amfterdam, there to be negociated.

To exemplify this by familiar illuftrations, fuppofe the arbitrated price between London and Amfterdam to be as before ftated, 36*s.* Flemifh for 1*l.* fterling; and fuppofe the direct courfe, as given in Lloyd's lift, to be 37*s.* Flemifh, then London, by drawing directly on Amfterdam, muft give 37*s.* Flemifh for 1*l.* fterling; whereas, by drawing through Paris, he will give only 36*s.* Flemifh for 1*l.* fterling: it is therefore the intereft of London to draw indirectly on Amfterdam through Paris.

On the contrary, if London remits directly to Amfterdam, he will receive 37*s.* Flemifh for 1*l.* fterling; whereas, by remitting through Paris, he will receive only 36*s.* Flemifh: it is the intereft of London therefore to remit directly to Amfterdam.

Example 2.—Suppofe the exchange of London on Lifbon to be at 68*d.* *per* milree, and that of Lifbon on Madrid 500 rees *per* dollar, the arbitrated price between London and Madrid is 34*d.* ft. *per* dollar; for as 1000 rees : 68*d.* :: 500 rees : 34*d.* But if the direct exchange of London on Madrid be 35*d.* fterling *per* dollar, then London, by remitting directly to Madrid, muft pay 35*d.* for every dollar; whereas by remitting through Lifbon he will pay only 34*d.*: it is therefore the intereft of London to remit indirectly to Madrid through Lifbon.

On the contrary, if London draws directly on Madrid, he will receive 35*d.* fterling *per* dollar; whereas, by drawing indirectly through Lifbon, he would receive only 34*d.*: it is therefore the intereft of London to draw directly on Madrid.

From thefe examples, the two following rules are manifeft.

Rule 1.—Where London gives the certain price, draw through that place which gives the loweft arbitrated price, and remit through that which produces the higheft.

Rule 2.—Where London gives the uncertain price, draw through that place which produces the higheft arbitrated price, and remit through that which gives the loweft.

What is faid here of London will equally apply to any other place from whence the operation is made.

Suppofe the exchange of London on Amfterdam to be 34.6; on Genoa, 47; on Leghorn, 52; and the exchange of Amfterdam on Genoa, 86; on Leghorn, 93; what is the moft advantageous method for London to remit to, or draw on Amfterdam?

1ft.—Becaufe 47*d.* ft. give 1 pezza in Genoa, and this pezza in Amfterdam gives 86*d.* Flemifh, fay, as 47*d.* ft. : 86*d.* Flemifh :: 240*d.* ft. : 439*d.* Flemifh, or 36*s.* 7*d.* Flemifh, which is the arbitrated price through Genoa.

2d.—Becaufe 52*d.* ft. give 1 pezza in Leghorn, and this pezza in Amfterdam gives 93*d.* Flemifh, fay, as 52*d.* ft. : 93*d.* Flemifh :: 240*d.* ft. : 429*d.* Flemifh, or 35*s.* 9*d.* Flemifh, which is the arbitrated price through Leghorn.

Hence, according to the firft rule, the intereft of London is *to draw* directly on Amfterdam, inftead of drawing through Genoa or Leghorn; and *to remit* through Genoa, inftead of remitting directly to Amfterdam, or indirectly through Leghorn.

And according to the fecond rule, the intereft of Amfterdam would be *to remit* directly to London, and *to draw* on London through Genoa.

Compound

Compound Arbitration

Is a compariſon between the exchanges of more than three places in order to find how much a remittance paſſing through them all will amount to at the laſt place, or to find the arbitrated price between the firſt place and the laſt, and thus to determine on the moſt advantageous mode of negociating bills.

Compound arbitration is therefore a repetition of ſimple arbitration, and may be ſolved by a continuation of ſeveral ſtatings in the Rule of Three; but all ſuch operations are beſt performed by conjoint proportion; commonly called the "Chain rule," which ſhall be here explained and demonſtrated, after giving an example of compound arbitration by the Rule of Three.

Suppoſe the exchange between London and Amſterdam to be 35 ſhillings Flemiſh for 1 *l.* ſterling; between Amſterdam and Liſbon, 42 pence Flemiſh for 1 old cruſade; and between Liſbon and Paris, 480 rees for three francs, what is the arbitrated exchange between London and Paris?

1ſt. As 35*s.* Flem. : 1*l.* :: 42*d.* Flem., or 3½*s.* Flem. : 2*s.* ſt. = 1 old cruſade.

2dly. As 1 old cruſade, or 400 rees : 2*s.* ſt. :: 480 rees : 2*s.* 4$\frac{4}{5}$*d.* ſt. = 3 francs.

3dly. As 2*s.* 4$\frac{4}{5}$*d.* ſt. : 3 francs :: 240*d.* ſt. : 25 francs.

Hence the arbitrated price is 25 francs for 1 *l.* ſterling.

The Chain Rule explained and demonſtrated.

Diſtinguiſh the ſeveral courſes of exchange into antecedents and conſequents, and place them in two columns, the antecedents to the left and the conſequents to the right, by way of equation.

The firſt antecedent muſt be of the ſame denomination as the quantity of which the value is required.

The firſt conſequent muſt be of the ſame denomination as the ſecond antecedent, and the ſecond conſequent as the third antecedent; and ſo on throughout.

The laſt conſequent muſt be of that denomination in which the anſwer is required.

The terms being thus arranged, the antecedents muſt be multiplied continually for a diviſor, and the conſequents for a dividend; and the quotient will be the anſwer.

The calculation may be abridged by expunging ſuch antecedents and conſequents as are alike, and reducing ſuch their loweſt terms as admit of a common diviſor.

Example from the foregoing Queſtion.

1 *l.* Sterling	=	35 Shillings Flemiſh.
3½ Shillings Flemiſh	=	400 Rees
480 Rees	=	3 Francs.

How many francs will 1*l.* ſterling give?

$$\frac{3 \times 400 \times 35}{1 \times 480 \times 3\frac{1}{2}} = \frac{42000}{1680} = 25 \text{ francs.}$$

In this example, 480 and 400 have the common diviſors 8 and 10, and they may therefore be reduced to 5 and 6; again the antecedent 6 may be reduced to 2, by ſtriking out the firſt conſequent 3; the fraction is therefore reduced to $\frac{5 \times 35}{2 \times 3\frac{1}{2}} = \frac{175}{7} = 25$, as before.

Demonſtration of the Chain Rule.

Let A, B, C, D, &c. be ſeveral denominations of money, and *m*, *n*, *p*, *q*, &c. the numbers or quantities of thoſe denominations, and let them ſtand thus:

Antecedents.		*Conſequents.*
m A	=	n B
p B	=	q C
r C	=	s D
t D	=	v E

Now to find what number of the laſt denomination (E) is equal to a given number of the firſt denomination (A) let z times the laſt term = y times the firſt, that is, let $z\,E = y\,A$.

Multiply all theſe equations together, the antecedents by the antecedents, and the conſequents by the conſequents, which will give $m\,A \times p\,B \times r\,C \times t\,D \times z\,E = n\,B \times q\,C \times s\,D \times v\,E \times y\,A$, and this equation reduced is $mprtz = nqsvy$.

Now if the number of the laſt denomination be required, $z = \frac{nqsvy}{mprt}$; but if the number of the firſt denomination be required, $y = \frac{mprtz}{nqsv}$. *Q. E. D.*

Example 2.—If London remit 1000*l.* ſterling to Cadiz by way of Holland at 35 *s.* Flemiſh *per* pound ſterling; thence to France at 58 *d.* Flemiſh *per* ecu of 3 francs; and thence to Cadiz at 15½ francs *per* doubloon of 4 dollars, what is the price between London and Cadiz reſulting from the operation? and how many dollars will the 1000*l.* amount to in Spain?

1 Pound ſterling	=	35 Shillings Flemiſh
1 Shilling Flemiſh	=	12 Pence Flemiſh
58 Pence Flemiſh	=	3 Francs
15½ Francs	=	1 Doubloon
1 Doubloon	=	4 Dollars

How many dollars are equal to 1000*l.* ſterling?

$$\frac{35 \times 12 \times 3 \times 4 \times 1000}{58 \times 15\frac{1}{2}} = \frac{5040000}{899} = 5606 \text{ dollars, 1 real,}$$

28 mar. which gives the exchange at 42¾ *d.* nearly.

The indirect courſe of exchange between London and Cadiz may be alſo found by an inverſe operation, called the *Doctrine of Contraries*: thus,

4 Dollars	=	1 Doubloon
1 Doubloon	=	15½ Francs
3 Francs	=	58 Pence Flemiſh
12 Pence Flemiſh	=	1 Shilling Flemiſh
35 Shillings Flemiſh	=	240 Pence ſterling.

How many pence ſterling equal 1 dollar?

$$\frac{240 \times 58 \times 15\frac{1}{2}}{4 \times 3 \times 12 \times 35} = \frac{58 \times 15\frac{1}{2}}{3 \times 7} = \frac{899}{21} = 42\tfrac{17}{21}d.$$

Now if the direct courſe of exchange was above the indirect, the circular remittance would be moſt advantageous; but if under, the direct operation would be preferable.

In computing the profits or loſſes of exchange operations, allowance ſhould be made for the expences, commiſſion, and intereſt of money, all of which may be compriſed in the ſtatement by the Chain Rule; that is, by deducting them from thoſe terms of the conſequents to which they may relate; thus, in the following example, the *per centage* is ſubtracted from 100 in the laſt place of the conſequents.

Example 3.—London takes bills on Madrid at 33½*d. per* dollar of exchange, remits them to Amſterdam, with orders to negociate at 90¼ grotes *per* ducat of exchange, and make the returns in bills on Paris at 51⅜ grotes *per* ecu of 3 francs: what does London gain or loſe *per cent.* by this operation, ſuppoſing the bills on Paris are negociated at 25 livres 18 ſous *per* pound ſterling; and that all the charges, including intereſt for the time that London is out of its money, amount to 1⅛ *per cent.*?

33½ Pence ſterling	=	272 Maravedis
125 375 Maravedis	=	90¼ Grotes

51⅜

	$51\frac{3}{8}$ Grotes	=	$\cancel{4}$	Francs
4	$\cancel{80}$ Francs	=	81	Livres
	1 Livre	=	$\cancel{20}$	Sous
259	$\cancel{518}$ Sous	=	$\cancel{240}$	Pence sterling 120
	$\cancel{100}$ Pence sterling	=	$98\frac{7}{8}$	On account of charges.

How much does $\cancel{100}$ *l.* sterling give?

$$\frac{272 \times 90\frac{1}{4} \times 81 \times 98\frac{7}{8}}{33\frac{1}{2} \times 125 \times 51\frac{3}{8} \times 4 \times 259 \times 100} = 105,853, \text{ anfwer.}$$

The profit is therefore 5*l.* 17*s.* $0\frac{3}{4}$*d.* *per* 100*l.* fterling.

Operations in compound arbitration may be greatly facilitated by the help of logarithms: thus, "from the fum of the logarithms of the confequents, fubtract the fum of the logarithms of the antecedents; the difference will be the logarithm of the anfwer."

In this cafe, however, the reduction of the numbers as above is fuperfluous, as it is as eafy to find the logarithm of a large as of a fmall number; but when equal terms are on both fides they fhould be ftruck out; and if a common divifor can be found which will reduce any term to unity, it will likewife fhorten the operation.

In queftions of this kind much time and labour may be fometimes faved by making ufe of *fixed numbers*; thus, where feveral terms are unchangeable in both the antecedents and confequents they can be reduced to one; and the conftant logarithm of this number may be ufed with thofe that vary; fuch as the logarithms of the rate of exchange, the amount of the charges, &c.

Befides the foregoing rules for facilitating the arbitration of exchange, various other methods have been propofed for fhortening and illuftrating the fubject; even triangles and other diagrams have been conftructed for this purpofe; (fee Poftlethwait's Commercial Dictionary, vol. i. p. 94.) but geometrical projections do not feem well adapted to elucidate this rule.

A graphic operation, however, of a very ufeful and ingenious defcription, has been lately executed in London, in which fcales of the monies of exchange of the principal places in Lloyd's lift are fo graduated and arranged, that the arbitrated price between any two of them, with refpect to a third place, may be immediately found by the application of a right line. The invention is by William Wollafton, M.D. S. and F.R.S.

We fhall conclude this article by giving rules for calculating the intrinfic par of exchange, and alfo tables of the fame in gold and filver according both to mint regulations, and to affays.

The intrinfic par of exchange may be calculated by the rules laid down for computing the value of coins. (See Coin.) But the operation may be performed with greater precifion by the Chain rule, as in the following examples.

Example 1.—What is the intrinfic par between London and Lifbon, in *gold*, when taken from the Johanefe of 6400 rees, which, according to the mint regulations of Portugal, contains $221\frac{2}{5}$ grains of Englifh ftandard gold?

6400 Rees	=	$221\frac{2}{5}$ Grains of ftandard gold
480 Grains ftandard gold	=	$934\frac{1}{2}$ Pence fterling.

How many pence fterling will 1000 rees give?

Striking out the common divifor 1000, $\dfrac{221\frac{2}{5} \times 934\frac{1}{2}}{64 \times 48} =$ 67,35*d.* fterling for the milree.

Example 2.—What is the intrinfic par between London and Madrid, in *filver*, the weight of the dollar being 17 dwt. 8 gr. Troy, and its finenefs 8 dwt. worfe than Englifh ftandard, according to average affays lately made at his majefty's mint at the Tower of London.

85 Dollars of exchange	=	64 Hard dollars
1 Hard Dollar	=	416 Grains Troy
222 Grains in dollars	=	214 Grains ftandard
480 Grains ftandard	=	62 Pence fterling.

How many pence fterling does 1 dollar of exchange give?

Striking out the common divifor 64, $\dfrac{416 \times 214 \times 62}{85 \times 111 \times 15} =$ 39*d.* fterling for the dollar of exchange.

Example 3.—What is the intrinfic par between London and Amfterdam, in *filver*, when taken from the rixdollar current, which weighs 18 dwt. Troy, and is (according to affays) 16 dwt. worfe than Englifh ftandard, taking the agio of banco on currency at 4 *per cent.*

62 Pence fterling	=	20 Dwt. ftandard filver
202 Dwt. ftandard	=	222 Dwt. in rixdollars
18 Dwt. or 1 rixdollar	=	50 Stivers currency
1 Stiver	=	2 Grotes
12 Grotes	=	1 Shilling Flemifh
104 Shillings Flemifh currency	=	100 Shillings Flemifh banco.

Howmany fhillings Flemifh banco do 240 pence fterling give?

Brought down and reduced.

31	$\cancel{62}$	$\cancel{20}$	5
103	$\cancel{206}$	$\cancel{222}$	37
3	$\cancel{18}$	50	50
	$\cancel{12}$	$\cancel{2}$	
13	$\cancel{104}$	$\cancel{100}$	25
		$\cancel{240}$	20

$$\frac{5 \times 37 \times 50 \times 25 \times 20}{31 \times 103 \times 3 \times 13} = 37s.\ 2d. \text{ Flemifh for the pound fterling.}$$

Table of the intrinfic par of exchange between London and the principal places in Lloyd's lift, gold againft gold, and filver againft filver, calculated according to the mint regulations of each place refpectively.

	In Gold.	In Silver.
	f. d. Flem.	f. d. Flem.
Amfterdam, currency	37 4.9	38 1
———, banco (agio 4 *per cent.*)	35 11.6	36 7.5
	flor. ftiv.	flor. ftiv.
Rotterdam, currency	11 4.5	11 8.5
	f. d. Flem.	f. d. Flem.
Hamburgh, banco	34 3.5	35 1
	liv. f. den.	liv. f. den.
Paris in the old coins	25 9 11	25 1 9
—— in the new coins	25 10 6	25 0 $9\frac{1}{2}$
	fr. cents.	fr. cents.
	or 25 21	or 24 73
	d. fter.	d. fter.
Genoa - -	45.52	46
Leghorn - -	49.09	46.67
Naples - -	42.57	43.5
Lifbon - -	67.4	69.4
Madrid, Cadiz - -	37.3	39.22
	lire	lire
Venice - -	46.28	47.5

Table

Table of the intrinſic par of exchange between London and the principal places in Lloyd's Liſt, gold againſt gold, and ſilver againſt ſilver, calculated from aſſays lately made both in London and Paris.

	In Gold.	In Silver.
	ſ. d. Flem.	ſ. d. Flem.
Amſterdam, currency	37 4	38 $7\frac{1}{2}$
——, banco (agio 4 *per cent.*)	35 10.8	37 1.7
	flor. ſtiv.	flor. ſtiv.
Rotterdam, currency	11 4	11 14
	ſ. d. Flem.	ſ. d. Flem.
Hamburgh, banco	34 2.4	35 1
	liv. ſ. den.	liv. ſ. den.
Paris, in the old coins	25 9 9	25 9 9
——, in the new coins	25 11 6.2	25 3 $7\frac{1}{2}$
	fr. cents.	fr. cents.
	or 25 26	or 24 87
	d. ſter.	d. ſter.
Genoa - -	45.52	45.82
Leghorn - -	49.05	46.57
Naples - -	42	41.25
Liſbon - -	66.5	68.4
Madrid, Cadiz - -	36.05	39
	lire	lire
Venice - -	46.38	48.9

From the two foregoing tables it appears, that the par in gold generally varies from that in ſilver, and in ſome places very conſiderably.

It alſo appears that the aſſays do not differ eſſentially from the mint regulations; but where any difference is found to exiſt, it is moſtly in deficiency.

The intrinſic par of exchange between any other places, beſides the above, may be determined by the foregoing rules, and from the money tables in the preſent article, with thoſe given in the article Coin.

It ſhould be obſerved, that in the calculation of the par for Amſterdam, the ducat is reckoned at 5 florins 5 ſtivers currency, but this price is ſubject to alteration, and therefore no permanent par in gold can be eſtabliſhed with Holland, even if the agio were fixed. It ſhould be alſo remarked, that in computing the par with Hamburgh the ducat is reckoned at 6 marks Hamburgh banco, and the Cologne mark of fine ſilver at $27\frac{5}{8}$ marks banco, which are the common, but not conſtant prices, and therefore no permanent par can be eſtabliſhed with Hamburgh, any more than with Amſterdam.

Authors on exchange are very numerous, though few can be mentioned that have produced full and accurate ſyſtems: the principal are, Kruſe of Hamburgh; Ricard of Amſterdam; Gerhardt of Berlin; Marien of Spain; Senebier of Geneva; Giraudeau, Ruelle, Reiſhammer, and Corbaux of France; and Duboſt of London. Among the productions of thoſe writers Kruſe's Hamburgh Contoriſt has been the moſt univerſally approved; an Engliſh tranſlation of this ſyſtem of exchanges, monies, weights and meaſures, with conſiderable additions and alterations, is now nearly printed, and will be ſhortly publiſhed, under the title of the "Univerſal Cambiſt;" from which the preſent article has been chiefly extracted.

Exchange alſo denotes a public place, in moſt conſiderable cities, wherein the merchants, negociants, agents, bankers, brokers, interpreters, and other perſons concerned in commerce, meet, on certain days, and certain times thereof, to confer, and treat together of matters relating to exchanges, remittances, payments, adventures, aſſurances, freightments, and other mercantile negociations both by land and ſea.

In Flanders, Holland, and ſeveral cities of France, theſe places are called *bourſes;* at Paris and Lyons, *places de change;* and in the Hanſe towns, *colleges of merchants.*

Theſe aſſemblies are held with ſo much exactneſs, and merchants and negociants are ſo indiſpenſably required to attend at them, that a perſon's abſence alone makes him be ſuſpected of a failure or bankruptcy.

The moſt conſiderable exchanges in Europe are that of Amſterdam, and that of London, called the Royal Exchange. For an account of the latter, ſee Royal *Exchange.*

The former is a large building, 230 feet long and 130 broad, round which runs a periſtyle or portico, 20 feet wide. The columns of the periſtyle, amounting to 46, are numbered, for the convenience of finding perſons.

That of Antwerp was little inferior to either of them, till a variety of circumſtances concurred to effect its ruin, and to transfer its trade to Amſterdam; the era of this important event in commercial hiſtory is about the year 1585.

Even in the time of the ancient Romans there were places for the merchants to meet, in moſt of the conſiderable cities of the empire. That ſaid by ſome to have been built at Rome in the year of the city 259, 493 years before our Saviour, under the conſulate of Appius Claudius and Publius Servilius, was called *collegium mercatorum;* whereof it is pretended there are ſtill ſome remains, called by the modern Romans *loggia*, the lodge; and now, uſually the "Place of St. George."

This notion of a Roman exchange is ſuppoſed to be founded on the authority of Livy, whoſe words are as follow; *viz.* "Certamen conſulibus inciderat, uter dedicaret Mercurii ædem. Senatus a ſe rem ad populum rejecit utri eorum dedicatio juſſu populi data eſſet, eum præeſſe annonæ, mercatorium collegium inſtituere juſſit." Liv. lib. ii. But it muſt be here remarked, that *collegium* never ſignified a building for a ſociety in the purer ages of the Latin tongue; ſo that "collegium mercatorum inſtituere" muſt not be rendered to build an exchange for the merchants, but to incorporate the merchants into a company. As Mercury was the god of traffic, this ædes Mercurii ſeems to have been chiefly deſigned for the devotions of this company or corporation.

Exchange, in *Law*, is a mutual grant of equal intereſts in lands or tenements, the one in conſideration of the other; and in our common law it more particularly denotes the compenſation which the warrantor muſt make the warrantee, value for value, if the land warranted be recovered from the warrantee. Bracton, lib. ii.

The word "exchange," is ſo individually requiſite and appropriated by law to the caſe now ſtated, that it cannot be ſupplied by any other word, or expreſſed by any circumlocution. (Co. Litt. 50, 51.) The eſtates exchanged muſt be equal in quantity (Litt. § 64, 65.), not of *value*, for that is immaterial, but of *intereſt;* as fee-ſimple for fee-ſimple, a leaſe for 20 years for a leaſe of 20 years, and the like. And the exchange may be of things that lie either in grant or in livery. (Co. Litt. 51.) But no livery of ſeiſin, even in exchanges of freehold, is neceſſary to perfect the conveyance (Litt. § 62.); for each party ſtands in place of the other and occupies his right, and each of them hath already had corporal poſſeſſion of his own land. But entry muſt be made on both ſides; for, if either party die before entry, the exchange is void for want of ſufficient notoriety. (Co. Litt. 50.) And ſo alſo, if two parſons, by conſent of patron and ordinary, exchange their preferments; and the one is preſented, inſtituted, and inducted, and the other is preſented, and inſtituted, but dies before induction; the former ſhall not keep his new benefice, becauſe the exchange was not completed; and therefore he ſhall return back to his own. (Park, § 288.) For if, after an exchange of lands or other hereditaments, either party be evicted of thoſe, which were taken by him in exchange, through defect of the other's title, he ſhall return back to the poſſeſſion of his own, by virtue of the implied warranty contained in all exchanges. Blackſt. Comm. book ii. See WARRANTY.

EXCHANGE *of goods and chattels*. See SALE.

EXCHANGE, *the king's*, is the place appointed by the king for exchange of plate, or bullion for the king's coin. Theſe places have formerly been diverſe: but now there is only one, *viz.* that of the Tower of London, joined with the Mint.

EXCHANGE, *bill of*. See BILL *of Exchange*.

What we call re-exchange, is the due, or premium of a ſecond exchange, when a bill is proteſted. See RE-EXCHANGE.

EXCHANGE *brokers*. See *Exchange* BROKERS.

EXCHANGE *of Priſoners*. This meaſure, which is dictated both by humanity, and, in general, by mutual intereſt, is frequently adopted by two hoſtile nations, for the purpoſe of eaſing themſelves from the great charge incurred by the retention of priſoners of war in priſons, depots, &c. Sometimes an exchange becomes a conſideration while drawing up the articles of a capitulation; eſpecially where the beſiegers conſider it a matter of policy to get poſſeſſion of a fortreſs, without being too ſtrict in the conditions of ſurrender.

Thus we frequently obſerve, that a garriſon is allowed to retire, under the expreſs ſtipulation, that "no part thereof ſhall ſerve again until regularly exchanged." In ſuch caſe, an immediate liberation of an equal number of thoſe confined in the enemy's priſons ought inſtantly to take effect, and the perſons thus diſcharged ſhould be forwarded to their country; but if, as ſometimes occurs at the very commencement of a war, when one party has been extenſively ſucceſsful, the other may not have the means of equalization in regard to the liberation of priſoners, it may occur, that months, or even years, may elapſe, before ſuch reſtriction may be removed.

This, indeed, is not the only point on which the matter may reſt: it may ſometimes happen, that a prince may feel it to be his intereſt not to carry an exchange into effect; and this he may juſtify under the ordinary circumſtances attendant upon capitulation. Say, that an army ſurrenders ſimply under this condition; "that it ſhall not ſerve until duly exchanged." Here we ſee no obligation on the part of its ſuperiors to make any exchange: therefore, when policy dictates ſuch forbearance, we cannot affix any imputation on the prince, power, &c., if no exchange takes place.

If, indeed, the garriſon are allowed to return to their country, or to retire unmoleſted, on condition that "they *ſhall* be exchanged," then, we naturally expect, that no time will be loſt in liberating an equal number; adverting to the ſeveral claſſes of thoſe allowed to retire, and pairing them off in a correct manner.

We have heard of evaſions contrived for the expreſs purpoſe of detaining ſome individual, who, by his prowcſs, or abilities, may have become highly obnoxious to the enemy. This, however, can only take place where there is no perſon of correſponding rank, againſt whom he can be paired off; then the exchange neceſſarily becomes in a degree arbitrary; though it is a matter of courteſy, to form ſome equivalent, in ſuch manner as may ſuit the wiſhes of his own government.

With a view to facilitate the exchanges occaſionally ordered, as well as to obviate the million of frivolous complaints which would elſe be made, it is cuſtomary for powers at war either to receive agents, or to appoint ſupervisors, whoſe duty is confined ſolely to ſuch matters as relate to the due ſubſiſtence of the priſoners, and to conducting whatever may relate to exchanges. Through this medium a government may always avail itſelf of the means of releaſing any particular perſons, confined as priſoners of war in the enemy's country; but, to effect this, at leaſt to be able to command it, there muſt be in its power ſome equivalent: for it would be unreaſonable to expect that a general officer ſhould be given up, when only a colonel could be offered in exchange; but a general may be liberated by any government, for the purpoſe of liberating any officer of inferior rank then in the power of the enemy: and ſo throughout.

EXCHANGERS are thoſe who return money beyond ſea, by bills of exchange, &c. called anciently alſo *excambiators*, and ſince *remitters*.

EXCHEQUER, or ſimply *Chequer*, originally denotes a cheſs-board; or a frame divided into ſixty-four ſquares, of two colours, whereon to play at draughts, cheſs, &c. See CHESS, &c.

The word is formed from the French *eſchequier*, which ſignifies the ſame. Hence, trees are ſaid to be planted chequer-wiſe, *in quincuncem*, when diſpoſed ſo as to form diverſe ſquares repreſenting a chequer.

EXCHEQUER is more particularly uſed for a chamber, or apartment, in Weſtminſter-hall, conſiſting of two parts; the court of exchequer and the lower exchequer. See COURT *of Exchequer*, and COURT *of Exchequer-chamber*.

EXCHEQUER-*bills* are a ſpecies of paper firſt eſtabliſhed by Mr. Montague, in 1696, as a more convenient kind of ſecurity than the tallies and orders for repayment then in uſe, and alſo to ſupply the want of circulating caſh, during the re-coinage at that period. They were then taken at the exchequer for all payments of the revenue, and, when re-iſſued, they were allowed 7*l.* 12*s. per cent.* intereſt. They have ſince been iſſued yearly for anticipating the produce of particular taxes; and they have almoſt conſtantly formed the principal article of that part of the public debt called the unfunded debt. Of late years the total amount of outſtanding exchequer bills (excluſive of thoſe charged on ſpecific branches of the revenue) has uſually been about 12 millions. The bank of England, ever ſince the year 1706, have been the contractors for their circulation, at a certain premium. The commiſſioners of the treaſury are empowered, by various ſtatutes, to borrow money, within a ſpecific ſum, limited by thoſe ſtatutes, by iſſuing exchequer bills on the credit of certain duties; which bills, by 12 Anne, cap. 11. and 12 Geo. I. cap. 11. bear an intereſt of 2*d.* a day *per cent.* payable to the bearers. But the intereſt payable on them has differed according to the current rate of intereſt at the time when they have been iſſued. Thoſe now in circulation bear intereſt at the rate of 3½*d.* a day *per cent.* They are often made for 100*l.* each, but of late years they have been chiefly for 1000*l.* each, and ſometimes for larger ſums. Theſe bills are numbered arithmetically,

cally, and regiſtered accordingly, ſo that the principal ſums may be paid off in courſe, the time of which is notified by public advertiſement. The ſaid exchequer bills ſhall be current to all receivers and collectors of the cuſtoms, exciſe, or any revenue, and at the receipt of the exchequer; and as any of them are paid or lent into the exchequer, the officers there ſhall cauſe tallies to be levied and delivered to the payers or lenders, as if they had made ſuch payments or loans in ſpecie. The inſtalments on loans are paid into the receipt of the exchequer in exchequer bills, which are received again by the bank as caſh, either for the amount of dividends due, or in repayment of advances. When theſe bills are ſold at a conſiderable diſcount, or any other circumſtance indicates that too many of them are in circulation, it is uſual to fund a part of them, that is, to convert them into a permanent debt by offering the holders of them ſtock in lieu of their bills. This of late has been frequently done. The total amount of exchequer bills iſſued for the public ſervice between the 5th of January 1808 and the 5th of January 1809, and not redeemed within that period, was 39,735,200*l.* The unfunded debt in exchequer bills, outſtanding on the 5th of January 1809, was 40,093,200*l.* The amount of exchequer bills iſſued for the public ſervice in Ireland, between the 5th of January 1808 and the 5th of January 1809, and not redeemed within that period, was 541,666*l.* 13*s.* 4*d.* If any exchequer bills be loſt, upon affidavit before a baron of the exchequer, and certificate from him, and ſecurity given to pay the ſame if found, duplicates are to be made out; and when bills are defaced new ones ſhall be delivered. Forging of theſe bills, or of the indorſements on them, is felony.

Exchequer, *meſſenger of the.* See Messenger.

Exchequer, *Black Book of the*, is a book under the keeping of the two chamberlains of the exchequer; ſaid to have been compoſed in 1175, by Gervaiſe of Tilbury, nephew of king Henry II. and divided into ſeveral chapters.

Herein is contained a deſcription of the court of England, as it then ſtood, its officers, their ranks, privileges, wages, perquiſites, powers, and juriſdiction; and the revenues of the crown, both in money, grain, and cattle. Here we find, that for one ſhilling, as much bread might be bought as would ſerve a hundred men a whole day; that the price for a fat bullock was only twelve ſhillings, and a ſheep four, &c. Larrey, p. i. p. 394. See alſo Domesday.

EXCISE, an inland duty, or impoſition, charged on commodities of general conſumption, and paid ſometimes upon the conſumption of the commodity, or frequently upon the retail ſale, which is the laſt ſtage before the conſumption. This mode of taxation was adopted among the Romans; for Auguſtus, after the civil wars, introduced an exciſe, which, though very moderate, was general. It ſeldom exceeded one *per cent.* but it comprehended whatever was ſold in the markets or by public auction, from the moſt conſiderable purchaſes of lands and houſes, to thoſe minute objects which can only derive a value from their infinite multitude and daily conſumption. Such a tax, however, as it affects the body of the people, has ever been the occaſion of clamour and diſcontent. Auguſtus was obliged to declare by a public edict, that the ſupport of the army depended in a great meaſure on the produce of the exciſe; and Tiberius diminiſhed the exciſe to one-half, though the relief was of very ſhort duration. It has been adopted, in more modern times, as the moſt economical mode of taxing the ſubject; the charges of laying, collecting, and managing the exciſe duties being conſiderably leſs in proportion than in other branches of the revenue. Beſides, it renders the commodity cheaper to the conſumer than charging it with cuſtoms to the ſame amount would do, becauſe this tax is generally paid in a much later ſtage of it. Nevertheleſs, the rigour and arbitrary proceedings of exciſe-laws ſeem hardly compatible with the temper of a free nation. For the frauds that might be committed in this branch of the revenue, unleſs a ſtrict watch is kept, makes it neceſſary, wherever it is eſtabliſhed, to give the officers a power of entering and ſearching the houſes of ſuch as deal in exciſeable commodities, at any hour of the day, and, in many caſes, of the night likewiſe. And the proceedings in caſe of tranſgreſſions are ſo ſummary and ſudden, that a man may be convicted in two days' time in the penalty of many thouſand pounds by two commiſſioners or juſtices of the peace; to the total excluſion of the trial by jury, and diſregard of the common law. Obnoxious as the exciſe duty has always been, it was firſt ſuggeſted by the earl of Bedford, lord treaſurer to king Charles I., but never actually introduced in that prince's reign. Its original eſtabliſhment took place in the year 1643, when it was introduced, on the model of the Dutch prototype, by the long parliament after its rupture with the crown; and its progreſs has been gradual. It was at firſt laid upon thoſe perſons and commodities, where it was ſuppoſed the hardſhip would be leaſt perceivable, *viz.* the makers and venders of beer, ale, cyder, and perry; and though it originated with the long parliament, the royaliſts at Oxford ſoon followed the example of their brethren at Weſtminſter, by impoſing a ſimilar duty; both parties, however, proteſting that it ſhould be continued no longer than to the end of the war, and then be utterly aboliſhed. But the parliament at Weſtminſter ſoon after impoſed it on fleſh, wine, tobacco, ſugar, and ſuch a multitude of other commodities, that it might be fairly denominated general. This was done in purſuance of the plan laid down by Mr. Pymme, who had been intended for chancellor of the exchequer under the earl of Bedford, and who ſeems to have been the father of the exciſe. In his letter to ſir John Hotham (30 May, 1643) he intimates, "that they had proceeded in the exciſe to many particulars, and intended to go on farther; but that it would be neceſſary to uſe the people to it by little and little." Having accuſtomed the people to it for ſome years, the ſucceeding champions of liberty boldly and openly declared (Ord. 14th Auguſt, 1649, ch. 50.) "the impoſt of exciſe to be the moſt eaſy, and indifferent levy that could be laid upon the people;" and accordingly it was continued during the whole uſurpation. Upon the reſtoration of king Charles II., as it had been long eſtabliſhed, and its produce was well known, ſome part of it was given to the crown, in 12 Car. II., by way of purchaſe for the feodal tenures and other oppreſſive parts of the hereditary revenue. (See Revenue.) Notwithſtanding its general unpopularity, it has been impoſed on abundance of other commodities in the reigns of king William III. and of every ſucceeding prince, towards ſupporting the enormous expences occaſioned by our wars on the continent. In the year 1732, the groſs produce of the exciſe-duty amounted to 2,964,617*l.* About this time ſir Robert Walpole, being of opinion, that taxes on conſumable commodities, to which every citizen contributes in proportion to his conſumption, and which, being included in the price of the commodity, are inſenſibly paid, conſtituted the moſt eligible mode of raiſing the revenue neceſſary for the public ſervice, formed a project for the gradual abolition, not only of the taxes on land, houſes, and windows, but alſo of the cuſtoms, by the ſubſtitution of productive exciſe duties. Fully apprized of the abuſes and frauds to which the collection of the cuſtoms was ſubject, and which he had no hope of remedying, he thought that the ſcheme of converting the greater part of the cuftoms into duties of excife, would be equally advantageous to government and to the fair trader; and that the excife laws might be fo ameliorated, that, notwithftanding the odium generally attached to them as arbitrary and oppreffive, no juft ground of complaint fhould remain. With a view to the execution of this plan, he obtained a revival of the falt-duties, which had been repealed fome years before; but upon propofing, in the following year, to transfer the duties on wine and tobacco to the excife, "faction," fays Dr. Smith (Wealth of Nations, vol. iii. p. 358.) "combined with the intereft of fmuggling merchants, raifed fo violent, though unjuft a clamour againft that bill, that the minifter thought proper to drop it." The defeat of this fcheme was celebrated by general rejoicings, as a deliverance from the greateft political danger.

The feveral commodities now fubject to excife duties are ale, beer, cyder, perry, mum, metheglin, and mead; things fold by auction; bricks and tiles; candles; coaches and coachmakers; coffee, tea, chocolate, and cocoa-nuts; glafs; hops; leather; linen cloths, filks, cottons, and callicoes; malt; paper; plate; falt; foap; fpirituous liquors; ftarch, hair-powder, and ftone-blue; fweets; tobacco and fnuff; vinegar and verjuice; wine; and wire. See each of thefe articles.

In the year 1787 the various rates of duty which had been impofed at different times were confolidated; and other regulations were alfo adopted, by which the produce of the revenue was augmented, and the expence of collecting it materially reduced.

By 24 Geo. II. c. 40, all fines, penalties, and forfeitures, impofed by this or any other act relating to the duties of excife, fhall be fued for, levied, recovered, or mitigated by fuch ways and means as any fine, penalty, or forfeiture is or may be recovered or mitigated by any law or laws of excife, or in the courts at Weftminfter, and fhall be half to the king and half to him that fhall inform or fue:—that is to fay, if within the limits of the chief office in London, the offence fhall be determined by the commiffioners (or any three of them, 1 Geo. II. ft. 2. c. 16.) or, in cafe of appeals, by the commiffioners of appeals; in all other places they fhall be heard and determined by any two or more juftices of the peace, refiding near the place where the offence was committed, or forfeiture incurred; and in cafe of neglect or refufal of fuch juftices, for the fpace of fourteen days next after complaint made, and notice thereof given to the offender; then the fub-commiffioners may hear and determine the fame; and if the party find himfelf aggrieved by the judgment given by the faid fub-commiffioners, he may appeal to the next quarter-feffions, whofe judgment therein fhall be final. The faid commiffioners for appeals, and chief commiffioners for excife, and all juftices of the peace and fub-commiffioners aforefaid, are required, upon any complaint or information exhibited of any fuch forfeiture made or offence committed, to fummon the party accufed, and upon his appearance or contempt to proceed to the examination of the fact, and on due proof thereof either by the voluntary confeffion of the party, or by the oath of one credible witnefs, to give judgment or fentence, and to iffue warrants under their hands, for levying the fame on the goods and chattels of the offender, and to caufe fale to be made thereof, if not redeemed in (not lefs than four, nor more than eight days, 27 Geo. II. c. 20.); and for want of fufficient diftrefs, to imprifon the party offending till fatisfaction be made. The juftices, commiffioners, or fub-commiffioners, refpectively, where they fhall fee caufe, may mitigate, compound, or leffen, the forfeiture, penalty, or fine; fo as the fame be not made lefs than double the value of the duty of excife which ought to have been paid, befides the reafonable cofts and charges of fuch officers, or others as were employed therein, to be to them allowed by the faid juftices. (12 C. II. c. 24.) No appeal in any caufe of excife fhall be admitted, till the appellant hath depofited the fingle duty with the commiffioners or fub-commiffioners, and given fecurity to the commiffioners of appeal, or juftices of the peace, where the caufe is to be finally adjudged, for fuch forfeiture as was adjudged againft him. (15 C. II. c. 13.) By the fame ftatute all differences and appeals about the excife fhall be heard in the proper county, and not elfewhere, and appeals within London and its limits, fhall be within two months after judgment, and notice given or left at the dwelling houfe of the party, in all other places in four months and not otherwife.

By 43 Geo. III. c. 69, after fifth of July 1803, all duties, allowances, bounties and drawbacks of excife, and other duties under the management of the commiffioners, granted by any act of parliament then in force, fhall ceafe; except in cafes relating to the recovery of arrears, or of any fine, &c. previoufly incurred. Provided that the act fhall not extend to alter the duties upon malt, mum, cyder, and perry, granted by 43 Geo. III. c. 3. or upon malt, tobacco, and fnuff, continued by 43 Geo. III. c. 4; (except as to the duties on tobacco licences, and on tobacco of Spain and Portugal): nor fhall the act extend to the countervailing duties on importation from Ireland, or the drawbacks payable on exportation thither, according to the "Act of the Union;" (except thofe in refpect of beer, ale, and wines, bricks and tyles, cyder and perry, hops, mead or metheglin, fpirits, vellum and parchment, gilt and filver wire, and gold and filver thread, lace or fringe.) And in lieu thereof fhall be raifed and collected upon the feveral goods, wares, merchandize, and commodities, defcribed in fchedules annexed to the faid act, and for the fales by auction, and upon licences mentioned in one of thefe fchedules, the feveral fums and duties refpectively fet forth in the faid fchedules; and that there be allowed in refpect of goods, &c. for which any duty of excife is impofed, the feveral drawbacks of excife as fet forth in another fchedule, and alfo all allowances directed to be made by any act in force on the faid 1ft of July 1803, except as herein altered. And by 43 Geo. III. c. 81. certain additional duties inferted in an annexed fchedule are directed to be paid, and the drawbacks in another fchedule fhall be allowed; to commence from July 5, 1803, where no date is inferted in the act, and the amount of the additional duties may be added to the price of articles contracted for prior to the act. And the faid new duties fhall be raifed, levied, collected, confumed, paid, recovered, adjudged, mitigated, and allowed, (except where altered by thefe acts or either of them) in the like manner, and by fuch means, ways, and methods as the former duties. And all conditions, regulations, rules, reftrictions, and forfeitures; and every pain, penalty, fine, or forfeiture of any nature or kind whatfoever, for any offence againft any act of parliament then in force; and the feveral claufes, powers, and directions therein contained, (unlefs altered hereby,) fhall extend to and be applied in the execution of thefe acts, in as full and ample manner as if the fame were repeated and re-enacted in the body of thefe acts, 43 Geo. III. c. 69. § 4. c. 81. § 3. And in all cafes where duties are impofed or drawbacks allowed by thefe acts on any fpecific quantity of goods, the fame fhall apply after the fame rate to any lefs quantity. Id.

The excife duties of England are under the management of nine commiffioners, who fit in the general "Excife office," having falaries of 1200*l.* a-year each, and they are obliged, by oath, to take no fee or reward, but from the king only. From thefe commiffioners there lies an appeal to five others, called "Commiffioners of Appeal." The commiffioners

commiffioners of excife in Scotland are five in number, and have falaries of 600*l.* *per annum* each.

The number of officers employed in this branch of the revenue is very great. Befide the commiffioners above-mentioned, and their fubordinate officers, as regifters, meffengers, &c. there is an auditor of the excife, and an auditor of hides, with their clerks, &c. A comptroller of cafh, and another of accompts, with their clerks; a regifter; fecretary; folicitor; receiver-general, with his clerks; clerk of fecurities; ftore-keeper; houfe-keeper; door-keepers; general accomptants, with their affiftants; accomptant for fines, and two accomptants for the London brewery; clerk of the bills of exchange; examiners; clerk for fupervifors diaries; five general furveyors; general furveyors of diftillery; and brandy; examiners of the diftillery, of the brewery, and of foap and candles; furveyors of glafs, of coaches, and plate licences; infpector of fpirituous liquors, licences, and coaches; infpectors general of coffee, tea, &c. and of brewery through England and Wales. Befide which, there are in England and Wales, exclufive of the bills of mortality, within which is the principal head office of excife, to which all other offices in the kingdom are fubordinate and accountable, about fifty collectors, who go their refpective rounds once in fix weeks: the province of a collector comprehends feveral diftricts, within each of which there is a fupervifor, under the infpection of the collector; and each diftrict is parcelled out into out-rides and foot-walks, within each of which there is an inferior officer, conftituted under the hands and feals of the commiffioners, or fub-commiffioners, in their refpective divifions, as neceffity requires, and called gauger, or exciseman, under the infpection of the fupervifor, who every fix weeks draws out a diary of every day's bufinefs, with remarks, and tranfmits it to the chief officer. Every perfon, previous to his appointment to the office of gauger, muft procure a certificate of his age, which muft be between 21 and 30; he muft underftand the four firft rules of arithmetic, ftate what bufinefs he hath followed, and that he is not encumbered with debts, be of the communion of the church of England, and, if married, not have more than two children; he muft nominate two able perfons to be his fureties; and the certificate, containing thefe particulars, and written by himfelf, muft be figned by the fupervifor of the diftrict where he lives, and accompanied with an affidavit, that he has ufed no bribes for obtaining this office. He is then ordered for inftruction, under the care of an experienced officer, and to wait, under the denomination of an "expectant," till a vacancy happens. Upon admiffion of officers of every kind relating to the excife, the oaths of allegiance and fupremacy, and an oath of faithfulnefs in the execution of the particular office, muft be taken, and the declaration againft tranfubftantiation muft be fubfcribed. The officers of excife are appointed, and may be difmiffed, replaced, or altered by the commiffioners under their hands and feals; their falaries are allowed and eftablifhed by the treafury: and by 1 William and Mary, c. 24. § 15. if it be proved by two witneffes that any officer has demanded or taken any money, or other reward whatever, except of the king, fuch offender fhall forfeit his office. Officers of excife, taking a bribe, are liable to a forfeiture of 10*l.* 15 Car. II. cap. 11: and a perfon liable to excife duties offering them a bribe, &c. fhall forfeit 500*l.* 11 Geo. cap. 30. Officers meddling in elections are fubject to a penalty of 100*l.* and an incapacity of holding any office under the king, 5 W. cap. 20. And an officer, either of the excife or cuftoms, dealing in excifeable liquors, fhall forfeit 50*l.* and be incapable of any office in the revenue, 12 Geo. cap. 28. The concealment of excifeable goods is fubject to a forfeiture of thofe goods, and treble value, 11 Geo. cap. 30. Any perfon obftructing an officer in the execution of his duty, fhall forfeit 10*l.* 6 Geo. cap. 21. Actions of affault upon any officer may be tried in any county, 9 Geo. II. c. 35. And if any perfon fhall difturb or oppofe any excife officer in the execution of the powers and authorities by this act granted, or any or either of them, except where other penalties are by the act provided, he fhall forfeit 200*l.* 42 Geo. III. c. 38. And the fame penalty is inflicted by 43 Geo. III. c. 81, in relation to that act. Officers of excife are empowered to fearch at all times of the day, enter warehoufes, &c. And if officers fufpect that excifeable goods are concealed in any place within the limits of the chief office of excife in London, upon oath by fuch officers before the commiffioners, or any two or more of them; or if fuch place be in any other part of Great Britain, on oath before one or more juftices of the county, &c. or fufpected place, fetting forth the ground of fufpicion, the faid commiffioners, or the faid juftice or juftices may, by fpecial warrant, authorife fuch officers by day or night (but if in the night, in prefence of a conftable or other peace officer) to enter into fuch place and to feize all fuch goods; and if any perfon fhall obftruct any fuch officers fo authorifed, or any one acting in the execution of fuch warrant, he fhall forfeit 100*l.* 42 Geo. III. c. 93. The officers, in their permits for removing excifeable goods, fhall exprefs as well the time for which they fhall be in force for removing fuch goods, as the time within which they fhall be received into ftock by the perfon to whom they are fent; and if not removed within the time limited (unavoidable accidents excepted), or, in default of fuch removing, if the permit fhall not be returned to the officer who granted the fame, the perfon procuring the permit fhall forfeit treble value of the goods: and if not received into ftock, within the time limited, by the perfon to whom they were permitted to be fent, they fhall be deemed goods removed without a permit. 21 Geo. III. c. 55. No writ fhall be fued out againft any officer of excife, or his affiftant, for any thing done in the execution of his office, until one calendar month's notice fhall have been delivered to him, or left at his ufual place of abode, clearly and explicitly containing the caufe of action, the name and place of abode of the perfon who is to bring fuch action, and the name and place of abode of his attorney or agent: and the officer may at any time within fuch month tender amends, and plead fuch tender in bar of the action; and if, upon iffue joined, the jury fhall find the tender to have been fufficient, they fhall give a verdict for the defendant; but if the jury find that no amends, or fuch as were not fufficient, were tendered, they fhall give a verdict for the plaintiff, and fuch damages as they fhall think proper with cofts of fuit. 23 Geo. III. c. 70. If any action fhall be brought againft an officer, &c. it fhall be brought within three months after the caufe of action fhall arife, and not afterwards, and fhall be laid in the proper county; and if the plaintiff fhall be nonfuited, or difcontinue, or if upon a verdict or demurrer judgment fhall be given againft him, the defendant fhall recover treble cofts.

The additional duties, which the progrefs of the public expenditure has rendered it neceffary to impofe, have greatly increafed the produce of the excife, and rendered it the moft important branch of the public revenue. The duties which it comprehends are divided into the permanent confolidated duties, the temporary war taxes, and the annual duties; the latter confift of the old annual malt duty, and of an additional malt duty, which, with fome duties on tobacco and fnuff, and fome cuftom duties, have, fince the project for felling the land-tax, been granted annually in lieu thereof.

An Account of the Grofs Actual Receipt in Money, Charges of Management, and Taxes repaid to Officers, Exports, Temporary War Taxes, and Malts and Tobacco, Annual in England, for the Year ended Exchequer, on each Article;—together with the Balance in the Hands of the

Articles.	Grofs Actual Receipt in Money.			Charges of Management.			Rewards to Officers and Charges on Seized Spirits, 45th and 47th Geo. III.			Taxes.			Exports.			Allowances.			Bounties.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
Auctions - - - -	281,795	10	11¼	1,624	8	10	-	-	-	108	3	9	-	-	-	-	-	-	-	-	-
Beer - - - - -	2,958,224	3	11½	202,052	16	2¼	-	-	-	11,140	2	6½	43,355	12	1	-	-	-	-	-	-
Bricks and Tiles - -	291,243	11	0¼	2,649	16	9	-	-	-	119	6	3	1,917	9	11¼	-	-	-	-	-	-
Candles - - -	302,888	5	10	43,248	7	6¼	-	-	-	2,631	1	6	5,503	17	0	-	-	-	-	-	-
Cocoa Nuts and Coffee -	139,888	0	1	7,134	15	3	-	-	-	51	17	6	78	15	0	-	-	-	-	-	-
Cyder and Perry - -	54,272	2	8	962	17	9	-	-	-	45	3	6	5,248	4	8¾	-	-	-	-	-	-
Glafs - - -	428,307	19	5¾	10,901	0	7	-	-	-	474	19	4	81,303	14	11½	-	-	-	-	-	-
Hides and Skins - -	311,005	8	8	23,247	8	1	-	-	-	1,579	15	0	7,416	7	5¾	-	-	-	-	-	-
Hops - - - -	172,103	5	0¼	5,206	12	11	-	-	-	72	1	9	22,468	19	8½	-	-	-	-	-	-
Licences - - -	313,471	10	2½	3,898	12	2¼	-	-	-	291	13	6	-	-	-	-	-	-	-	-	-
Malt - - - -	1,147,672	2	2¾	326	11	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metheglin or Mead -	1	11	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paper - - -	403,129	13	5¾	7,742	16	9	-	-	-	705	12	10	18,198	15	10	4,315	10	6	-	-	-
Printed Goods - -	712,245	1	5¾	19,029	7	7¾	-	-	-	640	19	6½	401,889	11	0	-	-	-	-	-	-
Salt - - - -	1,449,200	11	0½	23,526	11	2½	-	-	-	1,445	2	9	42,943	8	0¼	22,747	13	5	8,019	2	2¾
Soap - - - -	592,688	2	10¾	26,111	8	2	-	-	-	1,289	3	9½	12,761	17	9¾	26,154	11	10¼	-	-	-
Spirits British - -	1,346,962	14	8½	12,710	6	11	-	-	-	687	1	0	-	-	-	-	-	-	-	-	-
Spirits Foreign -	1,849,330	5	11	55,982	0	6¾	38,462	15	0½	953	1	0¾	-	-	-	-	-	-	-	-	-
Starch - - -	52,626	5	6½	4,892	14	11½	-	-	-	229	17	6	2,097	5	0½	521	12	11¼	-	-	-
Sweets - - -	27,420	7	5½	157	2	4	-	-	-	5	10	3	-	-	-	-	-	-	-	-	-
Tea - - - -	2,003,479	7	11½	31,372	1	0	-	-	-	823	2	6	36,758	18	6¾	-	-	-	-	-	-
Tobacco and Snuff -	194,436	3	6¾	-	-	-	-	-	-	-	-	-	1,412	0	0½	-	-	-	-	-	-
Verjuice - - -	63	16	9¼	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vinegar - - -	41,013	2	10¾	390	8	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wine - - - -	1,222,946	9	4½	40,221	13	3	-	-	-	960	4	7½	52,192	18	4	26,645	5	2¼	-	-	-
Wire - - -	14,016	17	9¾	328	9	0	-	-	-	0	13	2½	1,749	3	10½	-	-	-	-	-	-
Total confolidated Duties.	16,310,432	12	5¾	523,718	8	4¼	38,462	15	0½	24,254	13	8¼	737,296	19	5	80,384	13	10¾	8,019	2	2¾
Temporary War Taxes.																					
Malt, per Act 43 Geo. III. ch. 81. - - -	2,251,761	0	11	639	16	3½	-	-	-	-	-	-	15,275	10	5¼	-	-	-	-	-	-
Spirits British - do. -	665,956	7	2¼	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spirits Foreign do. -	914,245	15	6	10	10	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sweets - - - do. -	4,471	1	7½	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tea - - - do. -	2,005,370	18	2¼	-	-	-	-	-	-	-	-	-	36,758	18	6¾	-	-	-	-	-	-
Tobacco and Snuff, per Act 46 Geo. III. ch. 39.	291,454	5	6	-	-	-	-	-	-	-	-	-	2,111	2	6¾	-	-	-	-	-	-
Brandy, &c. per Act 47 Geo. III. ch. 27. -	266,352	8	10¾	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total temporary war taxes £.	6,399,611	17	9¾	650	6	3½	-	-	-	-	-	-	54,145	11	6¾	-	-	-	-	-	-
Annual Duties.																					
Tobacco and Snuff, commenced 26th March -	437,774	0	7½	22,703	13	1	-	-	-	770	10	3¼	3,288	19	9¼	-	-	-	-	-	-
Malt, additional - do. -	911,993	6	8½	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malt, Old, commenced 24th June - -	554,975	9	9¼	100,957	0	7¼	-	-	-	6,618	10	3½	-	-	-	-	-	-	-	-	-
Total Annual Duties - £.	1,904,742	17	1¼	123,660	13	8¼	-	-	-	7,389	0	6¾	3,288	19	9¼	-	-	-	-	-	-
Totals Collected:																					
Confolidated Duties -	16,310,432	12	5¾	523,718	8	4¼	38,462	15	0½	24,254	13	8¼	737,296	19	5	80,384	13	10¾	8,019	2	2¾
Temporary War Taxes -	6,399,611	17	9¾	650	6	3½	-	-	-	-	-	-	54,145	11	6¾	-	-	-	-	-	-
Annual Duties - -	1,904,742	17	1¼	123,660	13	8¼	-	-	-	7,389	0	6¾	3,288	19	9¼	-	-	-	-	-	-
Grand Total - £.	24,614,787	7	4¾	648,029	8	4	38,462	15	0½	31,643	14	3	794,731	10	9	80,384	13	10¾	8,019	2	2¾

Allowances, Bounties, Penſions, Net Produce, and Payments into the Exchequer, of the Exciſe Conſolidated Duties, 5th January 1809; diſtinguiſhing the Groſs Receipt, Net Produce, and Net Payments into the Receiver-General, at the Commencement and Termination of the Year.

Overcharges, Overpayments, Repayments per Treaſury, Warrant, &c.	Annual Payments to Officers of the late Wine Licence Office, and of the late Salt Duties.	Penſions	Net Produce of each Article.	Net Payments into the Exchequer.	Exchequer Payments leſs than Net Produce.	Reſting on the 5th January 1808.	Exchequer Payments more than Net Produce.	Reſting on the 5th January 1809.	Impreſts.
£ s. d	£. s. d	£.	£. s. d.	£. s. d.	£. s d.	£. s. d.	£. s. d.	£. s. d	£. s. d.
2,975 5 6¼	- - -	- -	277,087 12 10	277,088 0 0	- - -	0 15 2	0 7 2	0 8 0	—
1,535 15 11½	- - -	14,000	2,686,139 17 2¼	2,671,140 0 0	14,999 17 2¼	0 4 6¼	- - -	15,000 1 8½	—
61 14 1½	- - -	- -	286,495 3 11½	286,495 0 0	0 3 11½	0 5 1	- - -	0 9 0½	—
- - -	- - -	- -	251,504 19 9¾	251,505 0 0	- - -	0 4 2¾	0 0 2¼	0 4 0½	—
5 6 1	- - -	- -	132,617 6 3	132,618 0 0	- - -	0 16 6½	0 13 9	0 2 9½	—
- - -	- - -	- -	48,015 16 6¼	48,045 0 0	- - -	30 2 10¾	29 3 3¾	0 19 7	—
12,814 12 11	- - -	- -	322,813 11 8¼	322,814 0 0	- - -	0 16 3½	0 8 3¾	0 7 11¾	—
51 12 0	- - -	- -	278,710 6 1¼	278,711 0 0	- - -	0 17 9¼	0 13 10¾	0 3 10½	—
73 1 0	- - -	- -	144,282 9 7¾	144,282 0 0	0 9 7¾	0 9 10¾	- - -	0 19 6½	—
- - -	480 0 0	- -	308,801 4 6¼	308,802 0 0	- - -	0 17 11	0 15 5¾	0 2 5¼	—
366 8 4	- - -	- -	1,146,979 2 3¾	1,146,979 0 0	0 2 3¾	0 15 5¼	- - -	0 17 9	—
- - -	- - -	- -	1 11 6	- - -	1 11 6	42 7 1½	- - -	43 18 7½	—
- - -	- - -	- -	372,166 17 6¾	372,167 0 0	- - -	0 15 9	0 2 5¼	0 13 3¾	—
149 16 2½	- - -	- -	290,535 7 1	290,536 0 0	- - -	0 18 9¼	0 12 11	0 5 10¼	—
22,192 15 5½	7,911 3 7¼	- -	1,320,414 14 4¼	1,320,415 0 0	- - -	0 7 10½	0 5 7¾	0 2 2¾	—
19 13 9	- - -	- -	526,351 7 6½	526,323 0 0	28 7 6¼	0 1 4¾	- - -	28 8 11	—
- - -	- - -	- -	1,333,565 6 9½	1,333,565 0 0	0 6 9½	0 7 5	- - -	0 14 2½	Impreſt repaid
163 1 11¾	- - -	- -	1,753,769 7 3¼	1,753,812 0 0	- - -	0 1 9¼	42 12 8¾	0 8 11½	42 19 11
- - -	- - -	- -	44,884 15 1¼	44,885 0 0	- - -	0 15 11	0 4 10¾	0 11 0¼	—
- - -	- - -	- -	27,257 14 10½	27,253 0 0	4 14 10½	0 15 8½	- - -	5 10 7	—
- - -	- - -	- -	1,934,525 5 10¾	1,934,464 2 6	61 3 4¾	0 9 10	- - -	61 13 2¾	—
19 5 0	- - -	- -	193,004 18 6¼	193,004 0 0	0 18 6¼	0 0 1¾	- - -	0 18 8	—
- - -	- - -	- -	63 16 9¼	- - -	63 16 9¼	31 12 6	- - -	95 9 3¼	—
28 3 9½	- - -	- -	40,594 10 2¼	40,595 0 0	- - -	0 14 11¼	0 9 9¾	0 5 1½	—
354 0 2½	- - -	- -	1,102,572 7 9¼	1,102,572 0 0	0 7 9¼	0 3 5½	- - -	0 11 2¾	—
- - -	- - -	- -	11,938 11 8¾	11,939 0 0	- - -	0 9 6¼	0 8 3¼	0 1 3	—
40,810 12 3¾	8,391 3 7¼	14,000	14,835,094 3 11¼	14,820,009 2 6	15,162 0 3	116 7 10½	76 18 9¾	15,244 9 2¾	42 19 11
817 17 6¾	- - -	- -	2,235,027 16 7½	2,235,028 0 0	- - -	0 16 7½	0 3 4½	0 13 3	—
- - -	- - -	- -	665,956 7 2¼	665,957 0 0	- - -	0 12 11	0 12 9¾	0 0 1¾	—
- - -	- - -	- -	914,235 5 6	914,235 0 0	0 5 6	0 12 1	- - -	0 17 7	—
- - -	- - -	- -	4,471 1 7½	4,458 0 0	13 1 7½	10 18 3¾	- - -	23 19 11¼	—
- - -	- - -	- -	1,968,611 19 7½	1,968,611 2 6	0 17 1½	0 2 6½	- - -	0 19 8	—
28 17 6	- - -	- -	289,314 5 5½	289,314 0 0	0 5 5¼	0 11 1½	- - -	0 16 6¾	—
278 19 0	- - -	- -	266,073 9 10¾	266,073 0 0	0 9 10¾	0 2 0¾	- - -	0 11 11½	—
1,125 14 0¾	- - -	- -	6,343,690 5 10¾	6,343,676 2 6	14 19 7	13 15 8	0 16 2¼	27 19 0¾	—
- - -	- - -	- -	411,010 17 6	411,011 0 0	- - -	0 9 7	0 2 6	0 7 1	—
239 7 1	- - -	- -	911,753 19 7½	911,738 0 0	15 19 7½	7 1 5¾	- - -	23 1 1¼	—
180 8 9¾	- - -	- -	447,219 10 0¾	447,278 0 0	- - -	84 5 7	58 9 11¼	25 15 7¾	—
419 15 10¾	- - -	- -	1,769,984 7 2¼	1,770,027 0 0	15 19 7½	91 16 7¾	58 12 5¼	49 3 10	—
40,810 12 3¾	8,391 3 7¼	14,000	14,835,094 3 11¼	14,820,009 2 6	15,162 0 3	116 7 10½	76 18 9¾	15,244 9 2¾	42 19 11
1,125 14 0¾	- - -	- -	6,343,690 5 10¾	6,343,676 2 6	14 19 7	13 15 8	0 16 2¼	27 19 0¾	—
419 15 12¾	- - -	- -	1,769,984 7 2¼	1,770,027 0 0	15 19 7½	91 16 7¾	58 12 5¼	49 3 10	—
42,356 2 3¼	8,391 3 7¼	14,000	22,948,768 17 0¼	22,933,712 5 0	15,192 19 5½	222 0 2¼	136 7 5¼	15,321 12 1¼	42 19 11

The produce, &c. of the exciſe duties in Scotland for the period above ſtated appears from the following abſtract:

	£.	s.	d.
Caſh reſting to be accounted for at 5th of January, 1808 - - - -	38,653	1	$2\frac{1}{4}$
Groſs receipt from 5th January, 1808, to 5th January 1809 - - -	2,086,283	19	$3\frac{3}{4}$
	2,124,937	0	6

	£.	s.	d.
Charges of management, exports, and allowances - - - - - -	325,768	0	$10\frac{1}{2}$
Diſburſements out of the net produce - - - - - - - - - -	88,012	12	$3\frac{1}{2}$
Remitted to London - - - -	1,628,000	0	0
Reſting to be accounted for at 5th January, 1809 - - - - - - -	83,156	7	4
	2,124,937	0	6

The total payments out of the revenue of exciſe, under the authority of warrants from the barons of exchequer, to the receiver-general of crown rents and caſualties in Scotland, from January 5, 1808, to January 5, 1809, are as follow:

	£.	s.	d.
Salaries to the judges and officers of the three courts of ſeſſion, juſticiary, and exchequer, and of the admiralty and commiſſary courts - - - - - - - -	50,340	12	$10\frac{1}{4}$
Paid to thoſe on his majeſty's civil liſt eſtabliſhment, not belonging to the three courts - - - - - - - - - - -	22,727	10	$10\frac{1}{2}$
To Francis lord Napier, commiſſioner to the general aſſembly of the church of Scotland - - - - - - - - - - -	2,000	0	0
To John Connel, procurator for the church of Scotland, to be diſtributed by him among itinerant preachers - -	1,000	0	0
To A. Mundell, without account	1,208	17	6
Total - -	77,277	1	$3\frac{1}{4}$

The total revenue of inland exciſe and licences, together with other fees received by revenue exciſe collectors in Ireland, for one year, ending the 5th of January, 1809, amounted to 1,659,838*l.* 8*s.* $9\frac{1}{4}$*d.* and the total payments for management, militia, bounties, &c. out of the groſs and net revenue of exciſe, during the ſame period, amounted to 531,910*l.* 9*s.* 5*d.* If we add to the above ſum 1,659,838*l.* 8*s.* $9\frac{1}{4}$*d.* the amount of the inland duties, *viz.* 429,824*l.* 11*s.* $0\frac{5}{8}$*d.* the groſs produce will amount to 2,089,662*l.* 19*s.* $9\frac{5}{8}$*d.* and the amount of the net produce was 1,772,615*l.* 16*s.* $2\frac{3}{8}$*d.*

EXCISION, in *Surgery*, is a word often uſed to ſignify the operation of cutting any tumour, or any foreign ſubſtance, off, or out of, a part of the body.

EXCITABILITY, in Dr. John Brown's hypotheſis, or the *Brunonian* hypotheſis, as it has been called, is nearly ſynonymous with the *vital principle* of medical writers in general, and ſignifies that quality or property of living beings, on which the phenomena of life depend.

Life itſelf is, in the opinion of Brown, a *forced ſtate*, ariſing altogether from the action of certain agents, which he denominates *exciting* powers, upon the *excitability*; for death enſues equally, whether the exciting powers are withdrawn, or the excitability is loſt. The exciting powers conſiſt of heat, air, food, drink, and other ſubſtances taken into the ſtomach, the blood, and the fluids ſecreted from it; as well as of certain functions of the ſyſtem itſelf, ſuch as muſcular exertion, ſenſation, thought, and paſſion or emotion. The effect of the exciting powers acting upon the excitability, is denominated *excitement.*

This word "excitability" is to be conſidered as a general term, expreſſive of the facts aſcertained by obſervation, but of the eſſential nature of which we muſt remain ignorant; as in the caſe of gravitation, &c. "We know not what excitability is," ſays Dr. Brown, "or in what manner it is affected by the exciting powers. But whatever it be, whether a quality or a ſubſtance, a certain portion is aſſigned to every being upon the commencement of its living ſtate." He obſerves, however, that ſuch expreſſions as a determinate portion of excitability in each living being, the exhauſtion, or the accumulation of excitability, are neceſſarily borrowed from the qualities of material ſubſtances, in conſequence of the poverty of language; and are not to be received in a ſtrict and literal ſenſe.

Every power, then, that acts on the living frame, according to this doctrine, is ſtimulant, or produces excitement by expending excitability; whence "it follows, that the whole phenomena of life, every ſtate and degree of health and diſeaſe, are alſo owing to ſtimulus, and no other cauſe." By too great ſtimulation weakneſs is induced, becauſe the excitability becomes defective; this is ſaid to conſtitute a ſtate of *indirect debility*; when the exciting powers or ſtimulants are withheld or diminiſhed, weakneſs is likewiſe induced, the excitability being accumulated, or in exceſs; and this is denominated a ſtate of *direct debility*. (See Debility.) For "this mutual relation obtains betwixt excitability and excitement; that the more weakly the powers have acted, or the leſs the ſtimulus has been, the more abundant the excitability becomes;—the more powerful the ſtimulus, the excitability becomes the more exhauſted." It is only then, when a mean degree of ſtimulus operates upon excitability at a medium, that perfect health is produced: in illuſtration of which a ſcale was drawn by Brown, (See Elements of Medicine, chap. iii. § 39. *note*) divided into 80 degrees of excitability oppoſed inverſely to 80 degrees of exciting power, at each end of which is *death*; there being, in the one caſe, 80 degrees of excitability, and no exciting power; and in the other, 80 degrees of ſtimulus and no excitability; whereas *perfect health* holds the middle ſtation, where there are 40 degrees of ſtimulus and of excitability reſpectively. Good health, however, may be conſidered to exiſt within a range of 30 or 40 degrees (15 or 20 on each ſide of the mean) in conſequence of the conſtant variation of ſtimulus, to which man is expoſed, in his food, drink, paſſions of the mind, &c.; but every departure from the mean of perfect health conſtitutes a pre-diſpoſition to diſeaſes of direct or indirect debility. As life is entirely regulated by excitement, and the exciting powers have a ſtimulating effect only, Dr. Brown affirms, that "the notion of health and diſeaſe being different ſtates is diſproved;" the operation of the powers producing or removing each ſtate being perfectly identical: and efficacious remedies being ſuch as oppoſe deficient ſtimulus to exceſſive excitement, and exceſſive ſtimulus to deficient excitement. In a word, there are but *two* forms of diſeaſes; and both are always preceded by pre-diſpoſition; thoſe which ariſe from exceſſive excitement are called *ſthenic* (from σθένος, *ſtrength*,) and thoſe which originate from a deficient excitement, *aſthenic*. The direct tendency of this hypotheſis, therefore, was to reduce the art of medicine to the ſimple regulation of ſtimuli, or of the exciting powers; it required

us

us only to increafe the quantity of ftimulation on the one hand, or to withdraw, or rather diminifh, the ftimuli on the other; as the excitement happened to be too great or too little, above or below the medium of the fcale of health.

As this concife ftatement of a medical hypothefis, which has excited great attention and much controverfy, may, perhaps, be obfcure to thofe who are unaccuftomed to the ftudy of the phenomena of animal life, we fhall cite an illuftration of Brown's fyftem, drawn up by one of his pupils from a familiar operation, by which a conception of his fundamental principles may be facilitated.

"Suppofe a fire to be made in a grate filled with a kind of fuel not very combuftible, and which could only be kept burning by means of a machine, containing feveral tubes, placed before it, and conftantly pouring ftreams of air into it. Suppofe alfo a pipe to be fixed in the back of the chimney, through which a conftant fupply of frefh fuel was gradually let down into the grate, to repair the wafte occafioned by the flame, kept up by the air-machine.

The grate will reprefent the human frame; the *fuel* in it the *matter of life* (the *excitability* of Brown, and the *fenforial power* of Darwin): the tube behind, fupplying frefh fuel, will denote the power of all living fyftems conftantly to regenerate or reproduce excitability; while the air-machine, of feveral tubes, denotes the various *ftimuli*, or exciting powers, applied to the excitability of the body; and the flame, drawn forth in confequence of that application, reprefents *life*, the product of the exciting powers acting upon excitability.

As Dr. Brown has defined *life* to be "a forced ftate," it is fitly reprefented by a flame, *forcibly* drawn forth, from fuel little difpofed to combuftion, by the conftant application of ftreams of air poured into it from the different tubes of a machine. If fome of thefe tubes are fuppofed to convey pure, or *oxygenous* air, they will denote the higheft clafs of exciting powers, fuch as opium, mufk, camphor, fpirits, wine, &c. (the diffufible ftimuli of Dr. Brown) which bring forth for a time a greater quantity of life than ufual, as the blowing in of pure air into a fire will temporarily draw forth an uncommon quantity of flame. If others of the tubes be fuppofed to convey common or atmofpheric air, they will reprefent the ordinary exciting powers, or ftimuli, applied to the human frame, fuch as heat, light, air, food, drink &c.; while fuch as convey impure airs may be ufed to denote what have formerly been termed fedative powers, fuch as poifons, contagious miafmata, foul air, &c. (Sedatives are deemed by Brown ftimulants of a minor force.)

The reader will now be at no lofs to underftand the feeming paradox of the Brunonian fyftem, that food, drink, and all the exciting powers applied to the body, though they *fupport* life, yet they *confume* it; for he will fee, that the application of thefe powers, though it brings forth *life*, yet at the fame time it waftes the excitability, or *matter of life*; juft as air blown into the fire brings forth more *flame*, but wafts the *fuel*, or *matter of fire*. This is conformable to the common faying, "the more a fpark is blown, the brighter it burns, and the fooner it is fpent." A Roman poet has given us an excellent illuftration of the Brunonian fyftem, when he fays,

> "Balneæ, vina, Venus, confumunt corpora noftra;
> Sed vitam faciunt balnea, vina, Venus."
>
> "Wine, warmth, and love our vigour drain;
> Yet wine, warmth, love our life fuftain."

It will be equally eafy to illuftrate the two kinds of *debility*, termed *direct* and *indirect*, which, according to Brown, are the caufes of all difeafes; if the quantity of ftimulus, or exciting power, is proportioned to the quantity of excitability; that is, if no more excitement is drawn forth, than is equal to the quantity of excitability produced, the human frame will be in a ftate of health; juft as the fire will be in a vigorous ftate, when no more air is blown in, than is fufficient to confume the frefh fupply of fuel, conftantly poured down by the tube behind. If a fufficient quantity of ftimulus is not applied, or air not blown in, the excitability in the man, and the fuel in the fire, will accumulate, producing *direct debility*; for the man will become *weak*, and the fire *low*. This, carried to a certain degree, will occafion death to the firft, and extinction to the laft. If again, an over proportion of ftimulus be applied, or too much air blown in, the excitability will foon be wafted, and the matter of fuel almoft fpent: hence will arife *indirect debility*, producing the fame weaknefs in man, and lownefs in the fire as before, and equally terminating, when carried to a certain degree, in death and extinction."

The fimplicity of this doctrine, contrafted with the complicated hypothefes of preceding phyficians, and its happy illuftration of fome of the phenomena of life, (which we have noticed under the word Debility,) fpeedily obtained for it a number of profelytes, in the fchools of medicine, wherever it was introduced. A generalization fo fweeping was, indeed, well calculated to arreft the attention, and gratify the ardour of young minds; and accordingly it was efpoufed with enthufiafm by the moft fanguine and fpeculative ftudents, and was debated and defended with a vehemence and intolerance of oppofition, almoft unknown in fcientific difcuffions; and this not only at Edinburgh, where the doctrine originated, but fucceffively in the different univerfities of the continent to which it was carried. To learn that there were but two forms of difeafe, and therefore but two indications of cure, and two fets of remedies, was particularly gratifying to thofe who preferred indolent hypothefis to the labour of obfervation. It fuperfeded at once the practice and maxims of the Hippocratic fchool of experience and unremitting inveftigation, and reduced the art of medicine within the compafs of a nut-fhell.

But, true as this doctrine of excitement may be, in its application to many of the phenomena of life, it is by no means adequate to the explanation of the whole, and efpecially of the caufes and remedies of numerous difeafes: it is, moreover, inconfiftent with itfelf in fome points, and its advocates are not agreed in the interpretation of thefe difficulties.

There is one inconfiftency fo grofs and obvious, in the Brunonian doctrine, that it is inconceivable how the author could have been infenfible of it, or have perfevered in maintaining it. In the illuftration above quoted, a tube or chimney is provided, by which the fuel, or excitability, is fuppofed to be conftantly replenifhed: but no fuch provifion is mentioned by Brown. He affirms that "a certain portion of excitability is affigned to every being at the commencement of its exiftence, that the action of ftimuli neceffarily exhaufts it, and that life confifts in the inceffant action of ftimuli upon this excitability;" *i. e.* in the inceffant exhauftion of it. With this ftatement the notion of accumulated excitability (which is faid to conftitute *direct* debility) is altogether incompatible: non-confumption, or rather diminifhed confumption, might preferve the excitability, but furely could never increafe it: though fomewhat might be faved, nothing could be gained, by the abftraction of ftimuli; and on the re-application of the difcontinued ftimuli, the excitability fhould never be found increafed or accumulated, but fhould be ftationary at the point of interruption; or, more correctly fpeaking, it muft always be found

found fomewhat wafted, fince, while life remains, it muft be acted upon in fome degree; while, on the other hand, every violent ftimulation fhould, upon the fame principle, rapidly wafte, and haften the irrecoverable exhauftion of the powers of life. The propofition, then, that a determinate portion of excitability is affigned to every individual, being equally inconfiftent with the fubfequent theorems of the fyftem, and with matter of fact, has been either given up, or explained away, by the pfeudo-Brunonians of the prefent day. They admit that the excitability may be partially reftored or renewed by reft and food. But to make the hypothefis confiftent with common fenfe, it requires that the procefs of *generating* excitability be conftantly going; for even during the moft profound fleep, ftimuli, or, in other words, exhaufting powers, are inceffantly applied, the ceffation of all excitement being fynonymous with death.

Another inconfiftence in the hypothefis, fcarcely lefs palpable, is the ftatement, that *indirect* debility, which confifts in exhauftion of the excitability from exceffive ftimulation, is to be cured, *i. e.* the excitability is to be reftored, by a continuance of ftrong ftimuli; namely, by ftimuli "*little fhort* of thofe which produced the over-excitement." But, however managed, it is obvious from the hypothefis, that they muft exhauft excitability, if they act at all; they muft, therefore, wear out what remains of the excitability more and more, and ultimately exhauft the power. No attempts to explain away this incongruity of language can be confidered fuccefsful; the alleged lofs of power in the ftimuli, in confequence of repetition, will only account for the lefs rapidity of the complete exhauftion; but exhauftion of excitability cannot be feparated from the notion of ftimulation.

In its application to the practice of medicine, as well as to the explanation of the action of many caufes of difeafe, the Brunonian fyftem is marked by a grofs neglect or defiance of obfervation and experience. The connections and dependencies of the different functions, the local derangements which take place in the different organs, and the curative indications deduced from thefe, are altogether overlooked; and the variety of phenomena which refult from the fpecific operation of various agents on the animal economy, is equally neglected. The affertion that all powers, which influence the animal body, whether productive or curative of difeafe, are *ftimulant*, is an abufe of language not often equalled by the framers of theories. There is not only not an identity in their action;—there is fcarcely any thing in common. "With regard to contagions," to ufe the words of an intelligent critic, "when we confider the regular and progreffive feries of actions, induced by thefe on the fyftem; when we have obferved that each contagion gives rife to a train of peculiar and characteriftic phenomena, defining the difeafe whence the contagion originated, and terminating often in the formation and feparation of a quantity of morbid matter, alone capable of propagating the fame difeafe in others, we cannot acknowledge that identity in the operation of the exciting powers, which the Brunonians contend for. In difeafes induced by contagions, in the fmall-pox, for example, or in lues venerea, we perceive fomething more than fimple excitement and unvaried ftimulation. Individuals of every defcription, whether predifpofed to fthenia or afthenia, whether labouring under direct or indirect debility, may be infected; and when the difeafe has taken place, it runs its courfe under every poffible modification of the excitability, &c." (See Edinburgh Med. and Surg. Journal, vol. i. p. 369.) And again, with refpect to the agents of the Materia Medica, befides their action upon the excitability, or the degree of excitement and exhauftion which they produce, there are various other peculiarities in their mode of operation. "They differ in the fucceffion of phenomena to which they give occafion; the intoxication produced by wine, opium, and fome other narcotics, cannot be imitated by aromatics, by the preparations of antimony or of mercury; nor the effects of thefe by narcotics: they differ in their power of fpecifically affecting particular organs and functions, as the ftomach, inteftines, kidnies, fkin, falivary glands, abforbent or vafcular fyftem, by emetics, purgatives, diuretics, fudorifics, mercury, digitalis, &c. They differ in their power of oppofing and inducing particular organic changes and morbid affections of the fyftem; as fyphilis and biliary difeafes are cured by mercurials, fcurvy by vegetable acids, and uric difeafes by alkalis: they differ in the durability of effect or change produced; as is obvious by comparing the momentary and fleeting effects of the diffufible ftimuli, with the permanent excitement and vigour produced by tonics, as by cinchona and preparations of iron, by wholefome food and pure air." Loc. cit.

In fhort, it is obvious that the word ftimulant, as applied to all thefe various actions upon the living fyftem, no longer retains any definite meaning; but produces a jargon which may be interpreted by each individual according to his own notions. In this refpect, the theory poffeffes an univerfal fitnefs, like Bayes' prologue, and will do for any practice that may be found moft expedient. Thus mercury will be confidered as the proper *ftimulant* for fyphilis, cinchona and arfenic for intermittents, citric acid for fcurvy, and fo on; for fortunately mankind have ftill good fenfe enough to accommodate their hypothefes to the refults of experience: hence we do not apprehend, that many of the moft implicit believers in this jargon would endanger their patients by applying the fame remedies to typhus, gout, and dropfy, becaufe they ftand in the fame numerical portion of the fcale; or by treating phthifis, apoplexy, and the plague alike, becaufe they are claffed together in the fame way!

Notwithftanding its many inconfiftencies and defects, however, the Brunonian doctrine has had fome beneficial influence on medical fcience, by inducing a particular attention to the degree of excitement, which accompanies many difeafes, although it cannot be confidered as the caufe or effence of them. The regulation of the excitement often conftitutes the moft ufeful means of conducting thefe difeafes through their courfe to a fafe termination, by moderating fymptoms, and keeping action within due bounds on the one hand, or fupporting the languid forces of the fyftem on the other. This is efpecially true with regard to contagious febrile difeafes.

The doctrines of Brown are contained in the "Elementa Medicinæ," which were firft publifhed in Latin, and afterwards tranflated by himfelf. After his death a revifed edition of this tranflation was publifhed by Dr. Beddoes, in 2 vols. 8vo. 1795; and another by the author's fon, Dr. William Cullen Brown, in 3 vols. 8vo. in 1804. See Brown.

EXCITATION, (from the Latin *excito*, I excite,) denotes the act of awakening, of roufing, or of producing fome power or action; thus we hear of the excitation of motion, excitation of heat, excitation of paffions, &c. In natural philofophy this word is principally ufed in the fubjects of electricity and of heat; and of thefe two kinds of excitation the particulars are as follows.

When a piece of amber, or of glafs, or of fulphur, or in fhort, of any other folid, called *electric*, or *non-conductor*, is obferved in common, it does not appear to have any particular power; but if it be rubbed with a dry hand, or with fomething elfe, then after a few ftrokes it will be found that

that it has acquired the electric virtue, ſo that now it will attract ſmall bodies that are preſented to it, and it will alſo exhibit other electrical phenomena (for which ſee the article ELECTRICITY.) In this caſe the electric power in the amber, or glaſs, or ſulphur, is ſaid to have been *excited* by the friction of the hand or other body, which therefore is called the *rubber;* for, previous to the friction, the amber, or ſulphur, &c. ſhewed no ſigns of electricity, that power being, as it were, dormant in it.

Rubbing is the moſt general, and upon the whole, the moſt effectual method of exciting electrics, but there are ſeveral other modes of excitation, and indeed hardly any action, or any motion, takes place among natural bodies, which is not attended with the excitation of electricity. In general, however, the electricity is not produced in quantity ſufficient to affect our ſenſes, without the aid of proper inſtruments, and of courſe it paſſes unnoticed. The principal cauſes of the excitation of electricity are rubbing or friction, heating and cooling, melting or coagulating, evaporation and condenſation, expanſion and contraction, the mere juxtapoſition or contact of certain bodies, ſolution and efferveſcence, and laſtly ſome unknown action of the body in certain aquatic animals. But theſe methods are not indiſcriminately applicable to all ſubſtances. They are confined within certain limits of application as well as of effect; and of theſe particulars we ſhall now give a regular account.

Rubbing, or *friction*.—In the ſcience of electricity the various bodies of the earth are diſtinguiſhed into electric and conductors (ſee ELECTRICS and CONDUCTORS;) and whenever two bodies are rubbed againſt each other, unleſs they be both very good conductors, ſome electricity is always produced; that is, one of the bodies acquires the poſitive or vitreous, and the other acquires the negative or reſinous electricity; for by this means one kind of electricity cannot be produced without the other. The circumſtance which, in the ſuperficial manner of performing the experiment, makes it appear as if one kind only of electricity were produced, is that the beſt conductor of the two bodies concerned, being not inſulated, loſes its electricity as ſoon as it receives it; but when both bodies are inſulated, each of them will become electrified by the friction, one of them acquiring the poſitive, and the other the negative electricity. Even two inſulated perfect conductors, by the leaſt contact or friction againſt each other, acquire a ſlight degree of electricity; but of this hereafter. The friction which is required for this excitation of electricity is not that which can ſcrape off or injure the ſurface, but a gentle preſſure progreſſively applied with a pretty quick motion. The former hard kind of friction generates heat, but little or no electricity.

The very ſame body, by changing the rubber, may be cauſed to acquire either the poſitive or the negative kind of electricity; and the change is often produced by a remarkably ſlight alteration of circumſtances, ſuch as altering the direction of the friction, increaſing or diminiſhing the temperature by a few degrees, and ſo forth. The following table exhibits the principal caſes of this kind of change, *viz.* it ſhews what kind of rubber is required for exciting a given body poſitively, and what kind for exciting it negatively. Thus it appears that ſealing-wax acquires the poſitive electricity when rubbed with a metallic body, and that it acquires the negative electricity when rubbed with furs, leather, woollen cloth, &c. Thus alſo it ſhews that baked wood is excited poſitively by ſilk, and negatively by flannel.

Subſtance rubbed.	*Electricity.*	*Rubber.*
The fur on the back of a cat.	Poſitive	Every ſubſtance with which it has hitherto been rubbed.
Smooth glaſs.	Poſitive	Every ſubſtance hitherto tried, excepting
	Negative	The fur on the back of a cat.
Rough glaſs.	Poſitive	Dry oiled ſilk, ſulphur, metals.
	Negative	Woollen cloth, quills, wood, paper, ſealing-wax, white-wax, the human hand.
Tourmalin.	Poſitive	Amber, air, *viz.* by blowing with the bellows upon it.
	Negative	Diamond, the human hand.
Hare's ſkin.	Poſitive	Metals, ſilk, loadſtone, leather, hand, paper, baked wood.
	Negative	Other finer furs.
White ſilk.	Poſitive	Black ſilk, metals, black cloth.
	Negative	Paper, hand, hairs, weaſel's ſkin.
Black ſilk.	Poſitive	Sealing-wax.
	Negative	Hare's, weaſel's, and ferret's ſkin, the load ſtone, braſs, ſilver, iron, the human hand.
Sealing-wax.	Poſitive	Metals.
	Negative	Hare's, weaſel's, and ferret's ſkin, the hand, leather, woollen cloth, paper.
Baked wood.	Poſitive	Silk.
	Negative	Flannel.

When two electric ſubſtances, equal in every reſpect, are rubbed againſt each other, that ſubſtance which ſuffers the greater degree of friction acquires the *negative*, and the other acquires the *poſitive* electricity. Thus, if a piece of ſilk, A, be drawn acroſs another piece of ſilk, B, in every reſpect equal to A, ſo that the ſurface of the whole piece, A, (*viz.* of one ſide of it,) be ſucceſſively drawn over one part of the piece B, then A will acquire the *poſitive*, and B the *negative* electricity. The reaſon of this probably is the greater degree of heat which the rubbed part of B acquires by the friction, it having been obſerved by Bergman, that heat rather diſpoſes bodies to acquire the negative electricity.

Glaſs, when warmed a little, as about the temperature of 110° of Fahrenheit's ſcale, may be excited more eaſily and more powerfully than at a lower temperature. A great part of this effect probably depends upon the glaſs being leſs apt to attract moiſture in that elevated temperature.

Mr. Henly inſulated ſeveral bodies, and in that ſtate rubbed them, one by one, againſt his woollen garments, or againſt ſilk, by which means they became electrified; but he obſerved very great irregularities in the effects which were produced by fubftances much allied to each other, or of the fame clafs. Thus, a guinea, a fix-pence, and a piece of tin, became negative; a piece of copper, a fteel button, and a filver button, pofitive, at leaft when the cloth was warm; animal fubftances, excepting fhells, generally acquired the pofitive electricity; vegetables became almoft always negative; but the fmooth fkins of bears became pofitive; common pebbles, marble, coal, and jet, acquired the negative electricity; gems and cryftals, the pofitive; glazed wares and writing paper, the pofitive; tobacco pipe, elaftic gum, a tallow candle, oiled filk, Indian ink, and blue vitriol, (*viz.* fulphate of copper,) acquired the negative electricity. Other perfons have extended the lift confiderably farther, but it is ufelefs to fpecify the particulars.

The principal requifite in the fubject of electricity, is to determine the proper conftruction of the rubber, and the method of employing it, fo as to excite the greateft poffible power in a given electric.

The beft rubber for a tube of fmooth glafs, Mr. Cavallo fays, (Treatife on Electr.) is the rough fide of black oiled filk, efpecially when a little amalgam has been rubbed upon it; but the beft rubber for a rough glafs tube, a ftick of baked wood, fealing-wax, or fulphur, is foft new flannel. The rubbers of common electrical machines, wherein a glafs globe, or cylinder, or circular plate is revolved, has been varied and improved progreffively. The more common conftruction confifts of nothing more than a filk cufhion ftuffed with hair, over which is placed a piece of leather, and upon this leather fome amalgam, (fee AMALGAM *for electrical purpofes,*) is fpread fo as to adhere pretty faft to it. Some time ago it was cuftomary, (and the practice even at prefent is not entirely laid afide,) to make the rubber of red bafil fkin ftuffed with hair; but the abovementioned filk one, which was contrived by Dr. Nooth, is much preferable. If this filk cufhion, on account of adapting it to the furface of the glafs, is to be fixed upon a metallic plate, then care fhould be taken to render the plate free from fharp points, edges or corners, and it fhould be concealed or covered over with the filk. In fhort, to conftruct the rubber properly, it muft be made fo, that the fide of it which the furface of the glafs enters in whirling, may be as perfect a conductor as can be made, in order to furnifh an ample and ready fupply of electricity, and the oppofite part fhould be as much a non-conductor as poffible, in order that none of the electricity that has been accumulated upon the glafs may go back to the rubber. A piece of filk is generally fixed to the extremity of the leather which ftands againft the furface of the glafs. The rubber of Mr. Nairne's electrical machine (fee ELECTRICAL *Machine,*) confifts of filk only put over the leather cufhion, the piece of filk projecting a confiderable way beyond the cufhion, and very little amalgam is ufed with it: in truth no amalgam at all is put upon the rubber of this machine; but whilft the clean rubber is on, and the cylinder is turning, a piece of leather, with fome amalgam fpread upon it, is applied for a few feconds to the under part of the cylinder, by which means a fufficient number of particles of amalgam will fly along the furface of the glafs, from the leather to the rubber.

The rubber fhould be fupported by a fpring, by which means it may eafily adapt itfelf to the inequalities of the furface of the glafs, which, with cylinders, often are very confiderable. It fhould likewife be infulated in whatever manner it may be moft convenient; for whenever infulation is not wanted, a chain or wire may be occafionally hung upon it, by which means it will communicate with the ground, or with any other body at pleafure: when there is no poffibility of infulating the rubber, feveral of the moft interefting experiments in electricity cannot be performed with the machine.

Mr. Nicholfon made a great variety of experiments refpecting this mode of excitation, which are defcribed at large in the Philofophical Tranfactions for the year 1789, and from thofe experiments he deduces the following inferences.

"Thofe experiments," he fays, "fhew that the office of the filk is not merely to prevent the return of electricity from the cylinder to the cufhion, but that it is the chief agent in the excitation, while the cufhion ferves only to fupply the electricity, and perhaps increafe the preffure at the entering part. There likewife feems to be little reafon to doubt but that the difpofition of the electricity to efcape from the furface of the cylinder, is not prevented by the interpofition of the filk, but by a compenfation after the manner of a charge, the filk being then as ftrongly negative as the cylinder is pofitive; and, laftly, that the line of light between the filk and the cufhion in weak excitations, does not confift of returning electricity, but of electricity which paffes to the cylinder, in confequence of its not having been fufficiently fupplied, during its contact with the rubbing furface.

"When the excitation was very ftrong in a cylinder newly mounted, flafhes of light were feen to fly acrofs its infide, from the receiving furface to the furface in contact with the cufhion, as indicated by the brufh figure. Thefe made the cylinder ring as if ftruck with a bundle of fmall twigs: they feem to have arifen from part of the electricity of the cylinder taking the form of a charge. This appearance was obferved in a nine-inch, and a twelve-inch cylinder, and the property went off in a few weeks. Whence it appears to have been chiefly occafioned by the rarity of the internal air produced by handling, and probably reftored by gradual leaking of the cement."

In order to determine what takes place in the infide of the cylinder, Mr. Nicholfon undertook a feries of experiments with a plate machine, (fee ELECTRICAL *Machine,*) and from their refult it appears, "that no advantage is gained by rubbing both furfaces, but that a well-managed friction on one furface will accumulate as much electricity as the prefent methods of excitation feem capable of collecting; but that when the excitation is weak, on account of the electric matter not paffing with fufficient facility to the rubbed furface, the friction enables the oppofite furface to attract or receive it, and if it be fupplied, both furfaces will pafs off in the pofitive ftate, and either furface will give out more electricity than is really induced upon it, becaufe the electricity of the oppofite furface forms a charge. It may be neceffary to obferve, that I am fpeaking of the facts or effects produced by friction; but how the rubbing furfaces act upon each other to produce them, whether by attraction or otherwife, I do not here enquire."

From farther experiments with the cylinder, Mr. Nicholfon deduced the following conclufions; "the line, he fays, of light on a cylinder departing from a fimple cufhion, confifts of returning electricity. 2. The projecting part of the cufhion compenfates the electricity upon the cylinder, and by diminifhing its intenfity prevents its ftriking back in fuch large quantities as it would otherwife do. 3. That if there were no fuch compenfation, very little of the excited electricity would be carried off; and, 4. That the compen-

compenſation is diminiſhed, or the intenſity increaſed, in an higher ratio than that of the diſtance of the compenſating ſubſtance; becauſe if it were not, the electricity which has been carried off from an indefinitely ſmall diſtance, would never fly back from a greater diſtance, and from the edge of light.

"I hope the conſiderable intenſity I ſhall ſpeak of will be an apology for deſcribing the manner in which I produce it. I wiſh the theory of this very obſcure proceſs were better known; but no conjecture of mine is worth mentioning. The method is as follows:

"Clean the cylinder and wipe the ſilk.

"Greaſe the cylinder by turning it againſt a greaſed leather till it is uniformly obſcured. I uſe the tallow of a candle.

"Turn the cylinder till the ſilk flap has wiped off ſo much of the greaſe as to render it ſemi-tranſparent.

"Put ſome amalgam on a piece of leather, and ſpread it well, ſo that it may be uniformly bright. Apply this againſt the turning cylinder. The friction will immediately increaſe, and the leather muſt not be removed until it ceaſes to become greater.

"Remove the leather, and the action of the machine will be very ſtrong.

"My rubber conſiſts of the ſilk flap paſted to a leather, and the cuſhion is preſſed againſt the ſilk by a ſlender ſpiral ſpring in the middle of its back. The cuſhion is looſely retained in a groove, and reſts againſt the ſpring only in ſuch a manner, that by a ſort of libration upon it as a fulcrum, it adapts itſelf to all the irregularities of the cylinder, and never fails to touch in its whole length. There is no adjuſtment to vary the preſſure, becauſe the preſſure cannot be too ſmall when the excitation is properly made. Indeed, the actual withdrawing of the cuſhion to the diſtance of one-tenth of an inch from the ſilk, will not materially affect a good excitation.

"The amalgam is that of Dr. Higgins, compoſed of zinc and mercury. If a little mercury be added to melted zinc, it renders it eaſily pulverable, and more mercury may be added to the powder to make a very ſoft amalgam. It is apt to cryſtallize by repoſe, which ſeems in ſome meaſure to be prevented by triturating it with a ſmall proportion of greaſe: and it is always of advantage to triturate it before uſing."

The following curious fact may, perhaps, be referred to the action of friction.—If a ſtick of ſealing-wax be broken into two pieces, the fractured parts, that is, thoſe extremities of the pieces which were contiguous to each other, will be found electrified, one of them poſitively, and the other negatively.

Heating and cooling.—The property of exhibiting electrical phenomena by means of heating and cooling, was firſt obſerved in a hard ſemi-pellucid foſſil, known under the name of tourmalin (called *aſchentrickker* by the Dutch, from its property of attracting aſhes, &c. when laid near the fire. Linnæus, in his Flora Zeylonica, calls it *lapis electricus.*) This ſtone, which generally is of a deep red or purple colour, and ſeldom exceeds the ſize of a ſmall walnut, is common in ſeveral parts of the Eaſt Indies, and eſpecially in the iſland of Ceylon. Tourmalins are alſo found in a great many other parts of the world, and often in pretty large maſſes, but they are moſtly opaque, and then they hardly ever ſhew any peculiar electric properties. (See its mineralogical characters under the article TOURMALIN.) The tourmalin's properties with reſpect to electricity are as follows.

1. The tourmalin, while kept in the ſame degree of heat, ſhews no ſigns of electricity; but it will become electrical by increaſing or diminiſhing its heat, and ſtronger in the latter than in the former circumſtance. An exceedingly ſmall variation of temperature is often ſufficient to render it ſenſibly electrical.

2. The electricity of the tourmalin does not appear all over its ſurface, but only on two oppoſite ſides, which may be called its *poles*, and they are always in one right line with the centre of the ſtone, and in the direction of its ſtrata; in which direction the ſtone is abſolutely opaque, though on the other ſemi-tranſparent.

3. Whilſt the tourmalin is heating, one of its ſides (diſtinguiſhed by A) is electrified plus, or poſitively, and the other ſide B, minus; but when it is cooling A is minus, and B is plus.

4. If it be heated and ſuffered to cool without either of its ſides being touched, then A will appear poſitive, and B negative, all the time of its heating or cooling.

5. If this ſtone be excited by friction, like any other electric, then each of its ſides, or both at once, may be made poſitive.

6. If the tourmalin be heated or cooled upon ſome other inſulated body, that body will be found electrified as well as the ſtone; and will be found poſſeſſed of the electricity contrary to that which is acquired by that ſide of the ſtone which was laid upon it.

7. The electricity of each ſide, or of both, may be reverſed by heating or cooling the tourmalin in contact with various ſubſtances; thus if it be cooled, or heated, in contact with the palm of the hand, that ſide of it, which would have been poſitive if cooled in the open air, is now negative; and that which would have been negative is now poſitive.

8. If a tourmalin be cut into ſeveral parts, each piece will have its poſitive and negative poles, correſponding to the poſitive and negative ſides of the ſtone from which it was cut.

9. Theſe properties of the tourmalin are alſo obſervable in vacuo, but not ſo ſtrongly as in the open air.

10. If this ſtone be covered all over with ſome electric ſubſtance, as ſealing-wax, oil, &c. it will in general ſhew the ſame appearances with this coating as without it.

11. Mr. W. Canton obſerved a very vivid light upon the tourmalin while heating in the dark; and this is ſufficient to point out which end of the ſtone is become poſitive, and which negative. Alſo, when the ſtone is ſtrongly excited, it emits very ſtrong flaſhes from the poſitive to the negative end, in the dark. That ſtone which is commonly called the "Braſilian emerald" from its colour, but which in fact is a tourmalin, alſo emits the abovementioned electrical light.

12. Laſtly, it is to be remarked that the power of the tourmalin is ſometimes injured by the action of a ſtrong fire, at other times it is improved, and frequently it is not at all affected by it. The laws, however, of ſuch uncertain effects, have not yet been inveſtigated.

Moſt of the above-mentioned properties, which were firſt obſerved in the tourmalin, have been found to belong to ſome other bodies; *i. e.* there are ſome other ſubſtances which have the electric virtue excited in them by heating and cooling. It is to be obſerved that ſuch bodies are generally, if not always, in a cryſtallized ſtate; alſo it has been remarked that the parts which exhibit the different ſtates of electricity differ from each other with reſpect to their form, although they are ſimilarly ſituated: while in thoſe cryſtals that are not electric, the ſimilarly ſituated parts correſpond alſo in form. If a cryſtal, for inſtance, conſiſt of a priſm terminated at each extremity by a pyramid,

mid, and these pyramids differ as to the kind of electricity they are capable of acquiring, it will be found that they also differ in their form ; one consisting of a greater number of surfaces than the other ; and the part which has the greater number of faces acquires the positive electricity ; the other the negative. Kidd's Outlines of Miner. vol. i.

The Abbé Haüy says, that the electricity which is produced by heat has been observed in six species of minerals, *viz.* the tourmalin, the borated magnesia or boracite, the topaz, whether from Brazil, from Saxony, or from Siberia, the mesotype of Haüy, or zeolite, the prehnite, and the oxydated zinc, or electrical calamine. See the nature of these minerals under the articles of their peculiar names. We are informed, however, that lately a gentleman, highly versed in electrical experiments, examined a vast number of specimens of the above-mentioned six minerals, and among them, (independent of the tourmalin,) he found two only that became electrical by heating and cooling ; namely, the boracite and the oxydated zinc ; with respect to a specimen of the latter, which had a pyramid at one end, and was truncated at the other end, he particularly observed that whilst cooling, the pyramid became negative, and the truncated side positive ; but whilst heating, the pyramid became positive, though slightly so, and the truncated side did not manifest any sensible degree of electricity.

Melting or coagulating.—Melting or pouring a melted electric substance into another, excites electricity in various instances, and with peculiar phenomena.

If sulphur be melted in an earthen vessel, and be left to cool upon conductors ; then if taken out of the vessel, when cold, it will be found strongly electrical ; but not at all so, if it be left to cool upon electrics.

If sulphur be melted in glass vessels, and afterwards left to cool, they will both acquire a strong electricity, the sulphur negative, and the glass positive, whether they be left to cool upon electrics or upon conductors ; however, they always acquire a stronger power in the former case than in the latter ; and a stronger still, if the glass vessel is coated with metal. It is to be remarked, that the sulphur acquires no electricity till it begins to cool ; its power increases in proportion as it contracts, and is the strongest when in the state of greatest contraction ; but then the electricity of the glass vessel is at the same time the weakest.

If melted sulphur be poured into a vessel of baked wood, it acquires the negative electricity, and the wood the positive ; but if it be poured into sulphur, or rough glass, it does not acquire any sensible degree of electricity.

Melted sulphur poured into a metal cup, and there left to cool, shews no signs of electricity whilst remaining in the cup ; but if separated, they will then appear strongly electrified, the sulphur positively, and the cup negatively. If the sulphur is replaced in the cup, every sign of electricity will vanish, but, if whilst they are separate the electricity of either of them is taken off, then, on being replaced, they will both appear possessed of that kind of electricity which had not been taken off.

Melted wax, poured into glass or wood, acquires the negative electricity, and leaves the glass or wood positive. But sealing-wax poured into sulphur acquires the positive electricity, and leaves the sulphur negative. The wax-chandlers, in making their candles, often find it extremely difficult to prevent the attraction and adhesion of dust and other light bodies, in consequence of the electrified state of the wax.

Chocolate fresh from the mill, as it cools in the pans in which it is received, becomes strongly electrical. When turned out of the pans, it retains for some time this property, but soon loses it by handling. Mr. Henly, who made these observations upon chocolate, found that by melting it again in an iron ladle, and pouring it into the tin pans as at first, would for once or twice more renew its power ; but when the mass became very dry and powdery in the ladle, the electricity could no longer be revived by simple melting. However, he found that if in that state a little olive oil be added and mixed well with the chocolate in the ladle, then on pouring it into the tin pan as at first, the electric power will be found to be completely recovered.

Evaporation and *condensation.*—It was Mr. Volta who first discovered that the evaporation of water, and of most other bodies either solid or fluid that can be converted into smoke or vapour produced electricity, and not long after it was discovered that the condensation of vapour also produced electricity, but of the contrary kind. Thus when water is evaporated from an insulated vessel, that vessel remains electrified negatively, and if the vapour be received and condensed upon an insulated surface, that surface will acquire the positive electricity. These discoveries, besides their affording an easy explanation of the origin of the electricity in the clouds, fogs, &c. seem to point out a general law of nature ; namely, that the capacity of water or other fluids for holding the electric fluid, is increased by the expansion of those bodies into the form of vapour ; and is diminished by the contrary operation, *viz.* by the contraction of the vapour into the form of water. Therefore, in the first case, by imbibing an additional quantity of electric fluid the vapour would leave the bodies from which it departed in a negative state ; and in the second case, *viz.* in the conversion of vapour into water by giving out a quantity of electric fluid, would leave the bodies that touched it in a positive state. And this is analogous to what takes place with respect to caloric and vapour.

The easiest way of shewing the production of negative electricity by evaporation is, to place a metallic cup upon a delicate electrometer, and to put a red-hot coal in it ; then on pouring a few drops of water upon the coal, a sudden evaporation takes place, and the electrometer opens with negative electricity. In order to shew the positive electricity which is produced by the condensation of vapour, let a pretty long wire (*viz.* about a foot long) proceed from the top of the electrometer, and fix some pieces of paper to the farther end of the wire, then if the steam of water which issues out of the spout of a boiling kettle be directed towards the paper, the steam will be condensed upon it, and the electrometer will open with positive electricity.

The production of electricity by evaporation is not, however, always proportional to the quantity of evaporation ; for instance, when water is evaporated from certain substances it produces a considerable quantity of negative electricity, but when evaporated from certain other substances, it produces little of it or none at all. Thus the slaking of quicklime produces a copious evaporation, but no electricity ; and such is likewise the case with a few other substances.

All the experiments that were made, during some years subsequent to the original discovery, shewed, that if evaporation produced any electricity at all, this was of the negative kind ; but at last two remarkable exceptions from this general rule were discovered, *viz.* one by a learned professor of the academy of Mantua, and the other by Mr. Cavallo, and these exceptions seem to point out a more intimate connection between the electric fluid and other bodies.

The first of the above-mentioned gentlemen found that when water is evaporated by being poured over a red-hot piece of very *rusty* iron, it would leave the iron and vessel upon which

which it ſtood electrified poſitively; and the ſame would be the caſe if the red-hot piece of ruſty iron was thrown into the water: ſuppoſing that the latter is contained in an inſulated veſſel. If the iron be clean and free from ruſt, the electricity will be negative; if very ruſty, the electricity will be poſitive, and if partially ruſty, it will acquire little or no electricity; for in this laſt caſe the negative electricity which ariſes from the evaporation of water from over the clean part of the iron, is balanced by the poſitive electricity, which is produced by the evaporation from over the ruſty part. In conſequence of this, a ruſty piece of iron will not ſerve for more than one or two experiments, for, by rendering it red-hot, part of the ruſt is ſhaken off, and at laſt it will act like a piece of clean iron. Gardenii Diſſert. de Electrici Ignis Natura. § 84, 85, 86.

The other exception (which was diſcovered by Mr. Cavallo, and is publiſhed in the 4th edit. of his Treat. on El.) is ſhewn by means of red-hot glaſs. "The various degrees," Mr. C. ſays, "of electric powers that are produced by the evaporation of water from different ſubſtances induced me to diverſify the experiments as much as I could, in order to diſcover, if poſſible, the reaſon why thoſe different effects took place when the evaporation ſeemed to be equally quick and copious. Amongſt other ſubſtances I tried glaſs, and found that it generally produced little or no electricity. The water was ſometimes poured upon the hot glaſs, but in general the hot glaſs was dropped into the inſulated water which was contained in a tin cup. However, the difference of effect was found not to be occaſioned by thoſe two different modes of proceeding. Having repeated this experiment a great many times, I at laſt found that the effect depended upon the different nature of the glaſs. If white and clean flint glaſs be made red-hot, and in that ſtate be dropped into the veſſel of water, a quick evaporation will enſue, and the veſſel is electrified poſitively. If the flint glaſs be not very clear, there will not be any electricity generated by the evaporation. And, laſtly, if the experiment be tried with glaſs more impure, as that of which wine bottles are made, then the negative electricity will be produced.

"In performing this experiment, it is neceſſary to take care that no pieces of coal adhere to the glaſs, which will frequently happen when a piece of glaſs is heated in a common fire; for in that caſe negative electricity will be produced by the evaporation, though the beſt flint glaſs be uſed."

Expanſion and *contraction.*—The mere expanſion of parts produces electricity in various inſtances; ſuch as the diſperſion of powders by projection or blowing; and the electrometer is affected by the ſame. It is owing to this electrified ſtate of the powders, that ſeveral curious phenomena are exhibited by them, which could not otherwiſe be explained. Thus the configurations which are produced by projecting powders upon an electrophorus, or upon any electrified ſurface, are owing, in great meaſure, to this cauſe; thus alſo the duſt upon the roads when properly attended to is often found to expand itſelf more than it apparently ſhould, and to aſſume peculiar movements, in conſequence of its actual electrified ſtate, which may be eaſily diſcovered by means of a very delicate electrometer. For further particulars reſpecting this kind of excitation, ſee the article ELECTRICAL *Experiments*, and the deſcription of Mr. Bennet's gold-leaf electrometer, under the article ELECTROMETER. Mr. Cavallo, in his Treatiſe on Electricity, gives the following directions for exciting powders. "Inſulate," he ſays, "a metal plate upon an electric ſtand, and connect with it a cork-ball electrometer; then the powder which is required to be tried, being held in a ſpoon, or other thing, at about ſix inches above the plate, is to be let fall gradually upon it. In this manner the electricity acquired by the powder, being communicated to the metal plate, and to the electrometer, is rendered manifeſt by the divergency of the threads; and its quality may be aſcertained in the uſual manner."

"It muſt be obſerved, that if the powder is of a conducting nature, like the amalgam of metals, or ſand, &c. it muſt be held in ſome electric ſubſtance, as a glaſs phial, a plate of ſealing-wax, or the like. Sometimes the ſpoon that holds the powder may be inſulated; in which caſe, after the experiment, the ſpoon will be found poſſeſſed of the electricity contrary to that of the powder."

It is, however, proper to remark with reſpect to this kind of excitation, that the production of the electricity is in ſome meaſure due to the friction; for in the act of pouring any ſubſtance in powder from a plate, a veſſel, &c. a degree of friction between the latter and the former muſt neceſſarily take place.

Contact, or *juxtapoſition.*—That the mere contact of two perfect conductors would generate, or excite electricity, is a diſcovery of a very late date. Mr. Cavallo ſeems to have been the firſt who proved that by dropping a piece of metal upon another, a ſlight degree of electricity was thereby produced. (See the 4th edition of his Treatiſe on Electricity, publiſhed in 1795, third vol. Experiments on Metallic Subſtances.) Mr. Bennet alſo, independent of Mr. Cavallo's experiments, ſeems to have a claim to this diſcovery. The electricity thus produced was ſo very ſlight, that it could only be diſcovered by the niceſt methods; but it was the forerunner of a moſt aſtoniſhing diſcovery. In ſhort Mr. Volta, by repeating the contact of metallic ſubſtances, and at the ſame time expoſing them to the action of a ſaline ſubſtance, produced a moſt powerful electrical inſtrument, which has opened a new field of ample and promiſing aſpect, and has furniſhed the chemical philoſopher with the moſt active engine of decompoſition.

This, and the other modes of excitation that have been mentioned ſubſequent to it, *viz.* by means of ſolution, or efferveſcence, and by the action of the animal body, cannot be well explained, nor thoroughly underſtood, without a full, hiſtorical, and circumſtantial account of that new and admirable branch of electricity, which is now commonly called *Galvaniſm;* but which in juſtice ought rather to be called *Voltaiſm;* and as it would be uſeleſs to fill this Cyclopædia with repetitions, we muſt refer our readers to the articles of the two laſt mentioned denominations, wherein thoſe other modes of excitation are particularly deſcribed.

EXCITATION *of Heat.*—The temperature of bodies is raiſed either by the approach of a body hotter than themſelves, or by the extrication of heat from the bodies themſelves, occaſioned by ſome particular action or diſpoſition. The former of theſe methods of elevating the temperature is a mere communication of heat; for that principle continually tends to diſperſe itſelf amongſt ſurrounding bodies, until they all acquire the ſame degree of temperature. The latter is called the *excitation* of heat, ſince an elevation of temperature takes place amongſt bodies which were not hotter than the ſurrounding bodies a ſhort time before. Thus, when a perſon ſtands before a common fire, heat is ſaid to be communicated to him, but with reſpect to the fire itſelf, the heat is ſaid to be excited, or produced by that particular decompoſition of fuel which is called combuſtion. Thus alſo heat is excited by friction, by the mixture of water with ſulphuric acid, and by a great many others.

other means; but it is communicated by the rays of the fun.

The means by which various degrees of fenfible heat are produced and communicated, are not more than eight; *viz.* 1. Animal heat, or that power in animals which keeps them warm, and enables them to communicate heat to other bodies. 2. Compreffion. 3. Friction, or percuffion of hard bodies. 4. Electricity. 5. Mixture. 6. Fermentation, or putrefaction. 7. The fun's rays; and, 8. The inflammation of fuel. However, by excluding the confideration of the fun's rays for reafons already affigned; by comprehending animal heat, fermentation, and inflammation under the general denomination of decompofition; and by referring the action of electricity to friction; the various modes of exciting heat, which demand our confideration in the prefent article, may be reduced to four; namely, compreffion, friction, mixture, and decompofition, and even this number may be diminifhed by two, fince, as it will appear in the fequel, both friction and mixture may be comprehended under the head of compreffion; for in thefe two cafes the excitation of heat feems to be occafioned by the compreffion or concentration of the integrant parts. We fhall, however, for the fake of perfpicuity, treat diftinctly of the above-mentioned four modes.

The flattening or ftretching of metallic fubftances, whether it be effected by means of the hammer, or fcrew preffes, or flattening mills, or wire drawing, or any other fuch like means, is conftantly attended with an excitation of heat, and a compreffion of the metallic fubftance. The former of thefe effects is perceived by the feel, or, more accurately, by the thermometer; the latter by an increafe of fpecific gravity in the fubftance that has been operated upon. Not only the metals, but all other fubftances that are fufceptible of compreffion, fuch as wood, cotton, the aerial fluids, &c. are likewife heated by the fame means. On the other hand, water, hard ftones, and all fuch bodies as cannot be condenfed into a fmaller fpace, at leaft not in any confiderable degree, will not be heated by the above-mentioned means.

The heat, which is thus excited, differs in degree according to the nature of the fubftance, the violence of the preffure, and the quicknefs of the operation; thus a metallic fubftance, powerfully and quickly compreffed, becomes hotter than a piece of wood fimilarly treated, and hotter than if it were preffed gently or flowly; for with a gentle preffure little heat is excited, and when the preffure is applied flowly, the heat is diffipated nearly as faft as it is excited.

A dexterous blackfmith, by giving a dozen or twenty fmart ftrokes with a hammer, to the extremity of a flender iron rod upon an anvil, will render that extremity of the rod vifibly red-hot, even in the day light; and this is the way by which feveral blackfmiths light the fire of their forges when they go to work in the morning. With refpect to this operation, Dr. Black, in his Lectures, remarks, that the fame extremity of the iron rod cannot be rendered red-hot a fecond time by hammering, unlefs it be firft annealed, or foftened in the fire. "On account," he fays, "of this and other facts, I began to fufpect that malleability and ductility of metals depend on a certain quantity of latent heat exifting in them, which being extricated by hammering, the metals remain rigid, and require to be placed in the fire or annealed, in order to recover that latent heat."

A mixture of oxygen and hydrogen gafes, if compreffed, takes fire, and explodes with great violence. The mechanical condenfation of vapour, and of all the aerial fluids, is attended with a confiderable elevation of temperature. The condenfation of common air excites a confiderable degree of heat, and, when quickly performed, it fires a variety of combuftibles, fuch as cotton, charcoal previoufly warmed, tinder, &c.; and upon this principle a curious inftrument has of late been contrived, by which a candle or fire may be lighted. It is nothing more than a fmall fyringe, or little condenfer, about fix inches long, and not much above a quarter of an inch in diameter, (meaning the diameter of its cylindrical cavity.) It has a pifton, the rod of which comes out at one end, and a ftop-cock at the other end; this ftop-cock is not perforated quite through, but only little more than half way, fo that its cavity may either be expofed to the external air, or it may be turned towards the cylindrical cavity of the fyringe. The operation is performed in the following manner: the pifton is firft drawn out as far as the extremity of the fyringe, a little bit of *amadue*, (more commonly known by the name of German tinder,) is placed into the cavity of the ftop-cock, which is afterwards turned towards the cylindrical cavity of the fyringe; this done, the pifton is pufhed in quickly and forcibly, with one fmart ftroke, by which means the fudden condenfation of the air excites a degree of heat fufficient to fet fire to the tinder; and in fact if the ftop-cock be turned outwardly immediately, after having pufhed the pifton in, the tinder will be found burning, and a match may be lighted by it.

From a general confideration of the effects of compreffion, it appears that the caloric, or that principle to which the effects of heat are attributed, is contained within the pores of other bodies, fomewhat like water in the cavities of a fponge, and that by compreffing the body, part of that caloric is difengaged, and becomes fenfible heat. Thus when a mixture of oxygen and hydrogen gafes is quickly and forcibly condenfed, that operation forces the gafes to abandon a quantity of caloric, which becomes fenfible heat, and as it cannot be diffipated immediately, raifes their temperature to a degree fufficient for their inflammation. This explanation is corroborated by the converfe of the above operation, *viz.* by expanfion; for when gafes are expanded, they abforb an additional quantity of heat, which does not raife their temperature.

Friction is well known to excite heat, the degree of which differs in proportion to the nature of the bodies concerned, and the force which is employed. This effect of friction is fo commonly experienced, and fo generally ufed, as to require but little illuftration. Rubbing the hands againft each other, or againft any part of the body in order to excite heat, is a general practice. Filing, turning, grinding, ftriking a piece of fteel againft a flint, the motion of the axles of wheels in their holes, &c. are common and well-known inftances of friction, which excite heat. In thefe cafes the confideration of two remarkable circumftances forcibly lead us to conclude, that the heat is excited by the compreffion of the parts of the bodies concerned. One of the circumftances alluded to is, that compreffion is the neceffary confequence of friction; the other is, that fuch fubftances as are not compreffible, or the compreffibility of which is next to nothing, cannot be heated by means of friction.

Thus Dr. Irvine fays, in his Lectures, "The moft violent agitation of fimple fluids, fuch as water or mercury, will not fenfibly affect the thermometer. Heat is produced by agitation on thofe fluids which are compound, and whofe ftate of exiftence is changed by the agitation; fuch as milk, and the folution of certain falts in water."

It is afferted in Nicholfon's Journal for June 1808, that Dr.

Dr. Joseph Read found that by agitating water in a tin veffel, or in a glafs one for a few minutes, the temperature of that fluid was raifed about eight degrees, as it appeared from a thermometer left in it all that time. We are, however, ftrongly inclined to fufpect that this apparent refult was owing to fome fallacy in the mode of conducting the experiment.

It feems, therefore, moft probable, that friction produces a compreffion, and that the caloric is expelled from the bodies concerned, fo as to become fenfible heat, in confequence of that compreffion.

The greateft opponent to this hypothefis is count Rumford, who inftituted fome capital experiments, which are defcribed at large in the Philofophical Tranfactions, and in which he fucceeded to fet a quantity of water actually a boiling by the friction of metal againft metal. In fhort, the metal fubmitted to friction was encompaffed by water, and air was carefully excluded from the furfaces in motion; yet the water became hot, and was kept boiling a confiderable time. In this experiment the only obvious fource of caloric, from without, as the count imagines, was through the borer employed to produce the friction; if it be true, that the water could not at the fame inftant be in the act of giving out and receiving heat. Mr. Wm. Henry (Tranf. of the Manchefter Society, vol. v. p. 2.) reafoning upon this experiment of count Rumford, fays, "I cannot admit that the argument is demonftrative in proving the evolved caloric not to be derived from external fubftances; for no abfurdity is implied in fuppofing that a body may be receiving caloric in one ftate, and giving it out in another." Thus thefe gentlemen feem to exclude the action of the compreffion between the metallic bodies, which is occafioned by the friction, and upon which the whole effect feems moft probably to depend.

With refpect to this excitation of heat by means of friction, two ufeful practical confiderations naturally occur; *viz.* to determine which kinds of friction are capable of producing the greateft degree of heat, and in what manner the heat which arifes from the friction of the parts of machinery in general, may be prevented.

The production of heat, and of actual fire, by the friction of wood againft wood, feems to be the firft that occurs to the human being, fince the materials neceffary for it are to be met with every where, and do not require any previous preparation, excepting a trifling adaptation of fhape. In fact all rude nations that have any notion of fire, light their fires by this means. For this purpofe, a piece of wood is laid flat nearly in an horizontal fituation, and another flender piece of wood is rubbed with one extremity backward and forward over the furface of the former, until it excites heat enough to fet fire to the duft that has been abraded from the wood itfelf by the friction. Otherwife a blunt pointed piece of wood is held perpendicularly over an horizontal piece, with its point in a little cavity on the furface of the latter, and is worked therein, like a drill, by rolling it between the hands of the operator, after the manner of a chocolate mill. Though this operation may at firft fight appear to be eafy and fimple, and though it be readily performed by the individuals of rude nations; yet certain it is that the practice of it is not eafily acquired; and in fact there are very few perfons in Europe who are able to fucceed in it. Profeffor Bartholdi fays, that the beft kinds of wood for this purpofe are, box-wood rubbed againft mulberry, or laurel againft poplar, or againft ivy. But the ufe of this mode of exciting heat amongft all civilized nations is fuperfeded by the incomparably eafier, and much more effectual method, of ftriking a piece of fteel againft the edge of a filiceous ftone. In this operation fmall particles of the fteel are violently compreffed and fcraped off in an ignited ftate, fo as to fire tinder, gun-powder, &c. The very common and general ufe of this method, for domeftic conveniency, for gun-locks, &c. renders any farther defcriptions of it perfectly ufelefs.

We have ventured to refer the excitation of heat by electricity, to friction, in confideration that electricity does not excite any heat, unlefs it is actually paffing through bodies, which in fome meafure obftruct its free paffage. But we muft refer the reader for the farther confideration of this matter to the articles which relate to electricity.

It is a matter of great importance in mechanics to prevent, or, at leaft, to diminifh the heat which is excited by the friction of the parts of machinery in general; and for this purpofe the common practice is to interpofe fomething of a lubricating quality between the contiguous parts of machines, *viz.* fomething which may hinder the too intimate contact of the parts, and whofe particles are eafily feparated from each other. On various confiderations olive oil has been found fuperior to any thing elfe in metallic machinery, and efpecially in watch or clock-work, when fteel works in metal or in hard ftone. Where wood and metals work againft each other, hog's lard, or mutton-fuet or fuch other fat or greafe, is moftly ufed; and when wood works againft wood, then the powder of black lead is found to be the moft ufeful.

The heat which is excited by the mixture of certain bodies, comes next under confideration: the inftances of this kind are very numerous, and different degrees of heat may be excited by this means, as far as actual inflammation. The following are felected. If fpirit of wine be mixed with water, the mixture will inftantly become hot enough to be perceived not only by means of the thermometer, but likewife by the mere application of the human hand. This heat will be gradually diffipated, fo that in a few minutes' time that mixture will be found to have acquired the temperature of the furrounding bodies. On mixing a quantity of the ftrongeft fulphuric acid with an equal quantity of water, a degree of heat is excited which exceeds that of boiling water. If a mixture of nitric and fulphuric acids be poured upon an inflammable effential oil, fuch as oil of cloves, oil of turpentine, &c.; the latter is thereby fo heated as to burft out in flames. Water mixed with quick-lime excites a confiderable degree of heat. There is a kind of earth found in Derbyfhire, which is called *black-wad.* If a quantity of this earth, as about half a pound or more of it, be fprinkled over with linfeed oil, and be then left undifturbed, and expofed to the air, about an hour after it will be found in a ftate of incandefcence, burning fomewhat like fmall coal.

In all the cafes of the excitation of heat by the mixture of fluids, two remarkable circumftances deferve particular confideration. One is that the heat will be excited only when the fluids have a chemical action upon each other, fuch as between acids and water, fpirituous liquors and water, &c.; whereas, if oil be mixed with water, or water with quickfilver, no heat will be excited, becaufe no real mixture will take place among thefe bodies. The other circumftance is, that whenever heat is excited by the mixture of fluids, an incorporation, or a concentration of the fubftances is obferved; for it is always attended with a diminution of bulk. Thus a pint of alcohol and a pint of water, mixed together, will meafure lefs than two pints. Thefe circumftances feem to indicate, that the affinity, or the mutual attraction of the particles of the bodies concerned, occa-

fions

ſions a kind of compreſſion, in conſequence of which a certain part of the caloric is forced out, and becomes ſenſible heat.

The fourth cauſe of the excitation of heat is decompoſition; and under this head we muſt comprehend the origin of animal heat, fermentation, putrefaction, combuſtion, and all other proceſſes in which the heat is manifeſtly excited in conſequence of the decompoſition of compound bodies. But as theſe proceſſes will be found treated at large under the articles of their peculiar denominations; we ſhall here only add a few remarks on the heat which is produced by decompoſitions in general. In ſhort it ſeems that the caloric, like ſeveral other principles, enters more or leſs into the formation of compound bodies, and that in the decompoſition of theſe bodies, where certain principles are ſet at liberty, and other new combinations enſue, the caloric alſo undergoes its changes; *viz.* it is expelled from certain bodies, and is either ſet entirely at liberty ſo as to become ſenſible heat, or is partially reabſorbed, in which latter caſe but little heat is manifeſted. This liberation of caloric is ſometimes effected ſlowly, as in the proceſs of animal life, in fermentations, &c. or it proceeds ſo quickly and abundantly, as to occaſion actual inflammation. By the concurrence of various favourable circumſtances it happens, not unfrequently, that decompoſitions and ſpontaneous inflammations take place among bodies, which, in general, are not capable of producing ſuch phenomena. Thus, vegetable ſubſtances that have undergone torrefaction, being kept in ſacks of cloth in contact with the ambient air, as coffee, the meal of grain, French beans, &c. have ſometimes been known to take fire. The like effect is alſo produced by the generation of ſulphurated and phoſphorated hydrogen gas. The cauſe of ſubterraneous fires and volcanoes has in great meaſure been attributed to the decompoſition of pyrites, or metallic ſulphurets, buried in the interior of the earth. Theſe maſſes of pyrites are decompoſed by the contact and concurrence of water and air; and the decompoſition is always accompanied by a great extrication of caloric, and a diſengagement of a very inflammable gas, called *ſulphurated hydrogen gas*. This gas is inflamed at an elevated temperature, and communicates the inflammation to other combuſtibles that may be at hand.

With reſpect to the heat which is produced in combuſtions, ſeveral queſtions of economical uſe may be aſked, ſuch as the determination of the cheapeſt and moſt economical mode of employing fuel, the method of preventing the diſſipation of heat, &c. but theſe particulars will be found under the articles Fire, Fuel, and Heat.

EXCITEMENT, in Dr. Browne's ſyſten of *Medicine*, nearly ſynonymous with life. See Excitability.

EXCLAMATION, or Ecphonesis, in *Rhetoric*, a figure, wherein, by raiſing the voice, and uſing an interjection either expreſsly or underſtood, we teſtify an uncommon ardour, commotion, and paſſion of mind; and expreſs the magnitude of the thing, or the importance of the occaſion.

Such is, " O heavens! O earth!" &c. ſuch alſo is that of Cicero againſt Cataline: " O times! O manners! this the ſenate knows, the conſul ſees—and yet he lives! Lives, ſaid I? nay, and comes into the ſenate!"

In Engliſh the interjections O! or oh! alas! or good God! are generally adjoined in an exclamation. In Latin they uſe O! heu! eheu! ah! vah! pro ſuperi! pro ſuperûm atque hominum fidem!" Sometimes, however, the interjection is underſtood, as, Woe is me! Miſerum me! hoccine ſæculum!

Cicero uſes this figure to expreſs a variety of paſſions. It often denotes reſentment or indignation. Thus, after his return from baniſhment, he exclaims, (Pro Sext. c. 12.) " O mournful day to the Senate and all good men; calamitous to the ſtate, afflictive to me and my family; but glorious in the view of poſterity!" At other times it is uſed to expreſs diſdain or contempt. Thus, ſpeaking of Pompey's houſe, which was bought by Mark Antony, he ſays, (Philipp. II. c. 12.) " O conſummate impudence! Dare you go within that houſe! Dare you enter the venerable threſhold, and ſhew your audacious countenance to the tutelar deities which reſide there?" It is no leſs adapted to expreſs grief. Thus, Cicero ſays of Milo, (Pro Milone, ſub fin.) " O that happy country, which ſhall receive this man! ungrateful this, if it baniſh him! miſerable, if it loſe him!" It alſo ſerves to expreſs admiration, as when Cicero, in compliment to Cæſar, ſays, (Pro Ligur. c. 2,) " O admirable clemency! worthy of the greateſt praiſe, the higheſt encomiums, and moſt laſting monuments!" It has its uſe alſo in ridicule and irony. Thus Cicero, in his oration for Balbus, deriding his accuſer, exclaims, " O excellent interpreter of the law! maſter of antiquity! corrector and amender of our conſtitution!" The ſacred writers ſometimes uſe it by way of intreaty or wiſh, Pſ. lv. 6., and at other times in exultation and triumph, ſo St. Paul exclaims, (1 Cor. xv. 25.) " O death, where is thy ſting! O grave, where is thy victory!" It is frequently joined, as in ſome of the preceding inſtances, with the figure " Interrogation." It generally follows the repreſentation of the thing which occaſions it; though it is ſometimes uſed to introduce it, and thus it ſerves to prepare the mind by exciting its attention.

EXCLUSION, the act whereby a perſon or thing is excluded, *i.e.* ſhut out or ſet aſide. A crown imports an excluſion from the papacy: he appointed a ſtranger his heir, in excluſion of his own relations.

Great efforts were made towards the cloſe of the reign of king Charles II. to procure a bill of excluſion, for ſetting aſide the duke of York, the king's brother, on account of his being a papiſt. See Crown.

Exclusions, in *Mathematics*. The method of excluſions, is a way of coming at the ſolution of problems (in numerical caſes) by previouſly ejecting, or excluding out of conſideration, ſuch numbers as are of no uſe in ſolving the queſtion; whereby, of conſequence, the proceſs may be regularly and judiciouſly abbreviated.

EXCLUSIVE, is ſometimes uſed adjectively, for the force or power of excluding; as, a patent carries with it an excluſive privilege.

Sometimes it is alſo uſed adverbially; as, he ſent him all the Gazettes, from N° 195, to N° 300 excluſive; *i.e.* all between thoſe two numbers, which themſelves were excepted.

Exclusive *Propoſitions*, are thoſe wherein the predicate ſo agrees with the ſubject, as to agree with no other. See Proposition. *E. gr.* Virtue alone makes nobility: nothing elſe renders a man truly noble.

EXCŒCARIA, in *Botany*, from *excæco, to deprive of ſight*, becauſe, according to Rumphius, the ſailors who firſt landed on the iſlands of the Eaſt Indies, where this tree grows, were greatly incommoded, and ſometimes even entirely blinded, by the acrid juice which ſpirted forth, as they felled the wood for burning. Linn. Gen. 515. Schreb. 677. Juſſ. 390. Gærtn. t. 108. Claſs and order, *Diœcia Triandria.* Nat. Ord. *Tricoccæ*, Linn. *Euphorbiæ*, Juſſ.

Gen. Ch. Male, *Cal.* Catkin cylindrical, covered with florets. *Cor.* none. *Stam.* Filaments three, thread-ſhaped; anthers roundiſh. Female, *Cal.* Catkin as in the male. *Cor.* none. *Piſt.* Germen ſuperior, roundiſh, ſomewhat triangular;

angular; ſtyles three; ſtigmas ſimple. *Peric.* Capſule three-lobed, ſmooth, of three valves, each marked with a furrow, and three cells. *Seeds* ſolitary, ſmooth.

Eſſ. Ch. Male, Catkin naked. Perianth none. Corolla none. Female as in the male. Styles three. Capſule three-lobed. Seeds ſolitary.

E. *Agallocha.* Linn. Sp. Pl. 1451. (Arbor excœcans; Rumph. Amb. v. 2. 237. t. 79, 80.) Native of rocky, dry, and ſandy places about the coaſt in Amboina and other Eaſt Indian iſlands, flowering in January and February, as well as occaſionally at other ſeaſons. It forms a crooked inelegant tree. The *leaves* are alternate, elliptical, bluntiſh, ſmooth, more or leſs waved or bluntly crenate. *Catkins* cylindrical, lateral. *Capſules* the ſize of a pea. The acrid milk with which the tree abounds, cauſes the inhabitants of the countries where it grows to hold it in abhorrence; but Rumphius ſays it is chiefly dangerous to the eyes. The bark, as well as the milk, are uſed in medicine, being powerfully purgative. There ſeems to be no propriety in applying the Greek name αγαλλοχον, from Dioſcorides, to this tree.

How far the Cammetti, Rheede Hort. Malab. v. 5. 89. t. 45, is a diſtinct ſpecies from the above, we have not materials to decide. Its *leaves* are more pointed and leſs diſtinctly waved. Koenig gathered it by the ſea ſide on the coaſt of Coromandel, in low ground, overflowed during the rainy ſeaſon, which does not agree with what Rumphius relates of the foregoing.

Loureiro deſcribes what is probably another ſpecies, by the name of E. *cochinchinenſis*, in p. 612. of his Flora Cochinch. This, he ſays, has beautiful ſhining *leaves*, red underneath, for the ſake of which it is cultivated as an ornamental ſhrub. Its qualities are aſtringent and glutinous, nor did he ever hear of its being hurtful to the eyes.

EXCOMMUNICATION, an anathema, or eccleſiaſtical cenſure, and puniſhment; whereby a heretic is cut off from the ſociety of the faithful, or an obſtinate ſinner from the communion of the church, and the participation of the ſacraments.

This cenſure of excommunication was originally inſtituted for preſerving the purity of the church; but ambitious eccleſiaſtics converted it by degrees into an engine for promoting their own power, and inflicted it on the moſt frivolous occaſions.

The power of excommunication properly belongs to the biſhop; but he may delegate it to any grave prieſt, with the chancellor.

Every excommunication ſhould be preceded by three public admonitions, two days at leaſt diſtant from each other; but this is to be underſtood of excommunications impoſed by the eccleſiaſtical judge; for thoſe impoſed by the law are incurred to all intents and purpoſes the moment the action is committed.

Theſe latter are called excommunications *by the canon*, or *latæ ſententiæ*; and are ſo very numerous, that it would be difficult even for the beſt canoniſts to give an exact liſt of them; there are fifty in the Clementines; twenty in the bull *Cœna Domini*, &c. Wilkins's Mag. Brit. Conc. vol. iv. p. 664. Rebuffe, on the Concordat, reckons up ſixty penalties accruing upon excommunication.

Excommunication is founded on a natural right which all ſocieties have, of excluding out of their body ſuch as violate the laws thereof.

Excommunication is either *major* or *minor*, i. e. *greater* or *leſs*; the firſt, which is that underſtood when we ſay, ſimply, excommunication ſeparates, or cuts off, the delinquent, not only from the ſacraments, but from all communion and fellowſhip with other Chriſtians. The ſecond, or leſſer, only excludes from the participation of the ſacraments.

The greater excommunication, called alſo *ab homine*, is when a prelate, or his deputy, excommunicates any man perſonally, and interdicts him all ſociety with the faithful, all uſe of ſacraments, &c.

In the ancient church, the ſentences of the greater excommunication were ſolemnly promulged four times in the year, with candles lighted, bells tolling, the croſs, and other ſolemnities.

The leſſer excommunication is incurred *pleno jure*, by having any communication with a perſon excommunicated in the greater excommunication. And this too imports a privation of communion, but not an interdiction from entering the church, or having commerce with the faithful.

Anciently, the excommunicated were obliged to procure abſolution from their biſhop, and make ſatisfaction to the church in forty days' time; otherwiſe they were compelled to it by the ſecular judge, by a ſeizure of their effects, impriſonment of their perſons, &c. (See EXCOMMUNICATO *Capiendo.*) In France they were allowed a whole year.

By an edict of St. Louis, in the year 1228, vaſſals, tenants, &c. were diſpenſed, or freed from the oath of fidelity, homage, &c. they had taken to their lords, or ſuperiors, when excommunicate, till they had made their ſubmiſſion.

In Spain, to this day, a perſon who is not abſolved from his excommunication in a year's time is deemed a heretic. There was a time, when the people were fully convinced, that the bodies of excommunicated perſons, unleſs they were firſt abſolved, would not rot, but remain entire for ſeveral ages, a horrible ſpectacle to poſterity! as is atteſted by Matthew Paris, and other writers. And the Greeks are ſtill of the opinion, and affirm, they have many proofs thereof, as is ſhewn by Du-Cange, from the teſtimony of a vaſt number of authors.

By the laws, an excommunicated perſon was not to be buried, but the body flung into a pit, or covered with a heap of ſtones; which were called *imblocare corpus*. And by the rubric, in the Book of Common Prayer, the burial office ſhall not be read for any that die excommunicated. See FUNERAL, &c.

In the ancient church, there were diverſe degrees of excommunication. In effect, excommunication did not always import an interdiction of the ſacraments; but frequently, a ſeparation, or kind of ſchiſm, between the ſeveral churches, or a ſuſpenſion of ſpiritual communication between the biſhops. But afterwards the occaſions of excommunications growing more frequent, they began to uſe it with leſs circumſpection and reſervedneſs.

In the ninth century the eccleſiaſtics were continually making uſe of this ſpiritual weapon, to repel any violences or affronts offered them; and time and familiarity rendering offenders more and more obdurate, they proceeded, by degrees, to rigours unknown to antiquity; as the excommunicating of whole families, or provinces; prohibiting the exerciſe of all religion therein; and even accompanying the excommunications with horrible ceremonies, and direful imprecations.

In the tenth and eleventh centuries, the ſeverity againſt the excommunicated was carried to its higheſt pitch: nobody might come near them, not even their own wives, children, or ſervants; they forfeited all their natural legal rights and privileges, and were excluded from all kinds of offices. Thus was an excommunicated king reduced to the condition of a private man. By thus ſtretching the power of the church to extravagance, they rendered it contemptible. Gregory VII. tempered it a little; exempting the wives and children of excommunicated perfons from incurring excommunication by holding converfation with their hufbands and parents.

To render the excommunicated ftill more odious, the prieft was obliged to ftop, and break off divine fervice, if an excommunicated perfon entered the church; nothing of which averfion is any where difcovered in the practice of the primitive church. At prefent we have but little of the terror or refpect of our forefathers for excommunication; and it is even judged, and proclaimed, an abufe, whenever impertinently employed.

The form of excommunication in the Romifh church, as related by Fevret, is to take lighted torches, throw them on the ground with curfes and anathemas, and trample them out under-foot to the ringing of the bells.

"Auctoritate Dei Patris omnipotentis, et Filii, et Spiritus Sancti, et beatæ Dei genetricis Mariæ, omniumque fanctorum, excommunicamus, anathematizamus, et a limitibus fanctæ matris ecclefiæ fequeftramus illos malefactores, N. confentaneos quoque et participes; et nifi refipuerint, et ad fatisfactionem venerint, fic extinguetur lucerna eorum ante viventem in fæcula fæculorum. Fiat: Amen: Amen: Amen." Ex Emendat. Leg. Will. Conquæft.

We have now none of this folly; the fentence is gravely read, and the perfon remains excommunicated without farther ceremony. See the form of excommunication of the Englifh church in Concilia M. Brit. et Hib. vol. iv. p. 663, &c.

Petrus Blefenfis affures us, that in England it was anciently the practice only to excommunicate fuch as had killed an ecclefiaftic; whereas they were put to death who had killed a layman. But the reafon was, they held excommunication a greater punifhment than death.

The caufes with us are contempt of the bifhop's court, herefy, neglect of coming to church, and of receiving the facrament, incontinency, adultery, fimony, &c.

But if the judge of any fpiritual court excommunicates a man for a caufe of which he hath not the legal cognizance, the party may have an action againft him at common law, and he is alfo liable to be indicted at the fuit of the king. (2 Inft. 623.) With us by the common law an excommunicated perfon is difabled to do any act, that is required to be done by one that is "probus et legalis homo." He cannot ferve on juries, cannot be a witnefs in any court, and cannot bring an action, either real or perfonal, to recover lands or money due to him. (Litt. § 200.) Befides, if, within 40 days after the fentence has been publifhed in the church, the offender does not fubmit and abide by the fentence of the fpiritual court, the bifhop may certify fuch contempt to the king in chancery; upon which there iffues out a writ *De* EXCOMMUNICATO *capiendo*; which fee.

We have inftances of bifhops, who have pronounced formal excommunications againft caterpillars, and other infects, after a formal juridical procefs againft them, wherein thofe animals were allowed an advocate, and proctor to defend their caufe. See EXORCISM.

Fevret relates divers inftances of fuch excommunications againft rats, mice, and other animals, for infefting a country. See the form of thefe excommunications in that author, Traité de l'Albus.

In the ancient church there were two different kinds of excommunications in ufe; the one called *medicinal,* whereby perfons convicted of a crime by their own confeffion, were removed from communion; the other, called *mortal,* was fulminated againft rebels, who perfifted obftinately in their errors and impieties.

The power of excommunicating was lodged in the whole church in general; that is, the bifhops and priefts had the adminiftration thereof by and with the confent of the people, which was practifed even in St. Cyprian's time. But afterwards they ceafed to confult the people about the matter; the bifhop and clergy arrogated the whole power to themfelves. Recourfe, however, might ftill be had to the fynod of the province, to judge of the validity of an excommunication.

EXCOMMUNICATION was alfo practifed among the Jews, who ufed to expel from their fynagogue fuch as had committed any grievous crime. See the Gofpel according to St. John, ix. 22. xii. 42. xvi. 2. And Jofeph. Antiq. Jud. lib. ix. cap. 22. and lib. xvi. cap. 2.

The Effeni, when excommunicated, durft not fo much as receive food at any perfon's hand, for fear of violating their oath, but contented themfelves to live on herbs; infomuch that they frequently perifhed and died for want. See Jofeph. de Bell. lib. ii. cap. 12.

Godwyn, in his Mofes and Aaron, diftinguifhes three degrees, or kinds, of excommunication among the Jews. The firft he finds intimated in St. John ix. 22. The fecond in St. Paul Epift. 1 Cor. v. 5. And the third, in the 1ft Ep. to Corinth. xvi. 22. See NIDDUI.

The rule of the Benedictines gives the name excommunication to the being excluded from the oratory, and the common table of the houfe in our inns of court called *difcommoning.* This was the punifhment of fuch monks as came too late.

EXCOMMUNICATION, or a being fecluded, or cut off from a participation in the myfteries of religion, was alfo in ufe under paganifm.

Such as were thus excommunicated were forbidden to affift or attend at the facrifices, or to enter within the temples; and were afterwards delivered over to the dæmons and furies of hell, with certain imprecations; which was called among the Romans, *diris devovere.* See EXECRATION.

The Druids, among the ancient Britons and Gauls, likewife made ufe of excommunication againft rebels; and interdicted the communion of their myfteries to fuch as refufed to acquiefce in their decifions. See DRUIDS.

That this is the true origin of the extenfive and horrid influence of the European and papal excommunication, will appear evident by the following paffage of Cæfar, De Bello Gallico, lib. vi. cap. 13. "Si qui aut privatus aut publicus Druidum decreto non ftetit, facrificiis interdicunt. Hæc pœna apud eos eft graviffima. Quibus ita eft interdictum, in numero impiorum et fceleratorum habentur, ab iis omnes decedunt, aditum eorum fermonemque defugiunt, ne quid ex contagione incommodi accipiant; neque iis petentibus jus redditur, neque honos ullus communicatur."

EXCOMMUNICATO CAPIENDO, fo called from its effects, or *Significavit,* thus denominated from the bifhops' certificate, a writ directed to the fheriff, for the apprehenfion of one who ftands obftinately excommunicated the fpace of forty days.

Such a one not feeking abfolution, hath, or may have, his contempt certified into the chancery; whence this writ iffues for taking him up and imprifoning him in the county gaol, without bail or mainprize, until he is reconciled to the church, and fuch reconciliation is certified by the bifhop.

EXCOMMUNICATO *Deliberando,* is a writ directed to the under fheriff, for the delivery of an excommunicated perfon out of prifon; upon certificate of the ordinary of his conformity to the ecclefiaftical jurifdiction F. N. B. 62.

EXCOMMUNICATO *Recipiendo,* is a writ whereby perfons excommunicated,

excommunicated, being for their obſtinacy committed to priſon, and unlawfully delivered from thence before they have given ſecurity to obey the authority of the church, are commanded to be ſought for and laid up again.

EXCORIATION, in *Surgery*. A part is ſaid to be excoriated, when it is deprived of its cuticle, by reaſon of inflammation, the action of irritating matter, or of ſtimulating ſubſtances, &c. applied to the ſkin.

Very ſuperficial ulcerations are, alſo, frequently denominated excoriations.

In conſequence of inattention to cleanlineſs, and not occaſionally waſhing away the ſebaceous ſecretion, which is naturally produced under the prepuce, the matter acquires an irritating acrid quality, brings on inflammation all round the corona glandis, followed by extenſive excoriations and ſuppuration. This ſort of caſe is ſeriouſly annoying to the patient, on account of the violent itching, and troubleſome ſoreneſs, which always attend the complaint. The diſorder has ſometimes been named the *falſe gonorrhœa*, and the patient is often rendered very uneaſy in his mind by an apprehenſion of the affection being venereal. Indeed, ignorant and careleſs practitioners have occaſionally miſtaken mere excoriations for chancres, and, quite improperly, have preſcribed a courſe of mercury.

The proper treatment conſiſts in waſhing away all the acrid ſecretion under the prepuce with ſome ſoap-ſuds; injecting under the ſame part, four or five times a day, the ſaturnine lotion; and keeping linen, wet with this application, round the extremity of the penis. The excoriations, if very bad, are to be dreſſed with the ſaturnine ointment. The prepuce, if much ſwelled, and in a ſtate of phymoſis, ſhould have two or three leeches put upon it; but the principal means of cure is attention to keeping the parts clean, and tenderly waſhed with plenty of ſoap once or twice a day. As in all other caſes of inflammation the bowels ought to be kept open.

Excoriation of the nipples is a moſt diſtreſſing complaint. It is more common in the firſt, than the ſubſequent nurſings, and when independent of any diſeaſe in the child's mouth, is owing to the irritation occaſioned by the ſuction.

In many inſtances, a cure may be effected by bathing the parts with a little port wine, or brandy. A more effectual remedy is ſaid to be the tincture of opium.

EXCORTICATION, the act of ſtripping off the cortex or bark from any thing; called alſo decortication.

EXCREMENT, in *Chemiſtry*. See FECES.

EXCREMENT, in *Phyſiology*, is the reſidue of our food, after the nutritious particles have been extracted from it, and it has undergone certain changes by its reſidence in the large inteſtine. See DIGESTION.

EXCREMENT is alſo attributed, by way of analogy, to plants. Thus gums, diverſe juices, balms &c. iſſuing ſpontaneouſly from their reſpective trees, are ſometimes called excrements.

EXCRESCENCE, in the language of *Surgery*, implies a preternatural protuberance, or any morbid growth, which *projects out of* the ſubſtance or ſurface of a part. When the diſeaſe is involved in the ſurrounding fleſh, though it may be attended with a conſiderable ſwelling, it does not rank as an excreſcence, which word eſſentially ſignifies that the tumour, or whatever the diſeaſe is, *grows out of* the part. Funguſes, polypi, and warts of all kinds, are very often, and with ſtrict propriety, denominated excreſcences.

Excreſcences, of the nature of warts, are particularly apt to grow about the anus. Some of them are generally regarded by ſurgical authors as venereal complaints, becauſe they ſometimes get well under a courſe of mercury. This, however, is a very fallacious criterion of a diſeaſe being ſyphilitic; for mercury is a cure for numerous affections beſides venereal ones. Some ſurgeons have doubted whether there is any ſuch thing as a really venereal excreſcence; and as far as our obſervations extend, all thoſe warty growths which ariſe about the anus and perinæum, and are commonly reputed to be of a ſyphilitic nature, may be cured upon the ſame principles as any other ordinary tumours, not of a ſpecific kind.

Excreſcences in general, not being original parts of the body, are known to be weak in the vital power, and to be incapable of bearing the action of ſuch ſtimulating applications as would not deſtroy a part, which may be ſaid to enter into the natural compoſition of the body. Hence it is, that ſprinkling on warty excreſcences a powder, conſiſting of ſavin and ærugo æris, in equal proportions, generally effects a cure. The ſwellings are partly diminiſhed by abſorption, and partly by ſloughing. We have never ſeen about the anus any excreſcences which could withſtand this application.

But the plan which we particularly recommend to be adopted, when ſuch excreſcences are large and numerous, as they frequently are, is to remove them at once with a knife, or a pair of ſciſſars. When they grow from a narrow neck, their deſtruction might be accompliſhed by tying them with a ligature. The latter method, indeed, is often practiſed by ſurgeons who are fearful of hæmorrhage, or whoſe patients have a remarkable dread of a cutting inſtrument, even in caſes in which the object could be fulfilled much more eaſily, and with leſs pain, by means of exciſion; that is to ſay, in examples in which the baſe of the ſwellings is rather broad. Indeed, where the excreſcences are connected with the ſkin by a wide root, the mode of removing them with a ligature becomes exceedingly troubleſome and painful; for the practitioner is firſt under the neceſſity of introducing, through the centre of their baſe, a needle armed with a double ligature. The needle being cut off, one ligature is then to be firmly tied over one ſide of the root of the tumour, and the other over the oppoſite one. In this manner the ſupply of blood to the excreſcence is ſuppreſſed, and the part ſloughs away. Sometimes when the baſe of the diſeaſe is very broad, and the ligature has not been applied with due tightneſs, it becomes neceſſary to apply another one, the doing of which is attended with as much, if not more, pain than the firſt operation.

Upon the whole, when the excreſcences are ſmall, we prefer ſtimulating them with the powder of ſavin and ærugo æris; when they are large, we recommend extirpating them with a cutting inſtrument.

EXCRETION, from *excerno*, *I throw off*, or *ſeparate*, is the ſeparation of any ſuppoſed noxious matter from the blood in any of the organs of the animal body. The proceſs itſelf is not eſſentially different from that of ſecretion. But the latter term is applied to thoſe ſubſtances which, when formed, are applied to uſeful purpoſes in the animal economy. Thus the mucus of mucous membranes imparts to them a neceſſary moiſture, and defends them from the action of the foreign matter which comes in contact with them; the ſerous exhalation of ſerous membranes preſerves them conſtantly ſmooth and poliſhed, and therefore in a fit ſtate for their oppoſed ſurfaces to move without any obſtacle, &c. The excretions are matters ſuppoſed to be noxious to the body, and to be ſeparated on that account, as the urine, bile, perſpiration, &c. The matters voided from the large inteſtine, conſiſting of the reſidue of our food, are often called the alvine excretions.

EXCRETORY, is applied to certain little ducts or veffels in the fabric of the glands.

Excretory ducts are the tubes through which the humours feparated in the feveral glands are emitted or difcharged out of the gland, into fome convenient receptacle or emunctory.

A capillary artery, to which a capillary vein is joined, with an excretory duct, convolved or wound together, make up the body of the glands, the organs of fecretion. The excretory ducts fpring from the extremities of the arteries and veins, and carry off a liquor feparated from the blood. Drake.

The lymphatic glands have either lymphæducts for their excretory ducts, or lacteal veffels, as in the mefentery. Idem.

EXCURSION, in *Aftronomy*. See ELONGATION.

EXCURSION, *circles of*. See CIRCLES.

EXCUSABLE HOMICIDE. See HOMICIDE.

EXCUSATI, in *Church Hiftory*, a term ufed to denote flaves, who, flying to any church for fanctuary, were excufed and pardoned by their mafters; but thefe were obliged to take an oath to that purpofe, before they could have them again; and if they broke the oath, they were punifhed and fined as perfons guilty of perjury.

EXDORF, in *Geography*, a town of Germany, in the county of Henneberg; 7 miles S.E. of Meinungen.

EXE, a river in England, has its origin among the wild eminences of Exmoor, in the weftern corner of Somerfetfhire, and after uniting with the Barle, enters the confines of Devonfhire, near Exe bridge; thence flowing near Bampton, it finks into a rich wooded vale, and paffing Tiverton, has its current increafed by the ftreams of the Loman. Soon after, the Creedy, from Crediton, in the north-weft, and the Culm, or Columb, from Cullumpton, in the north-eaft, intermingle their waters with the Exe, and the vale expanding, opens into a beautiful plain, encircled by towering eminences, clothed with wood. Paffing Exeter, the river proceeds through a fine range of meadows to Topfham, where meeting the tide, and fuddenly widening to an extent of more than a mile, it becomes navigable for veffels of feveral hundred tons burthen. Hence fpreading into a grand eftuary, it rolls onward; but its direct courfe being impeded by a vaft fand-bank, called the Warren, it winds to the eaftward, and flows into the Britifh channel near Exmouth, its whole courfe being about 60 miles. See CANAL.

EXEA DE LOS CAVALLEROS, an inconfiderable town of Spain in the province of Aragon, feated between two rivulets, in the northern part of the province. Its furname commemorates the bravery of fome French and Gafcogne cavalry, when Alphonfo I. king of Aragon, took it from the Moors. N. lat. 42° 6'. W. long. 1° 9'.

EXEAT, in *Church Difcipline*, a Latin term ufed for a permiffion which a bifhop grants a prieft to go out of his diocefe; or an abbot to a religious, to go out of his monaftery.

The word is alfo ufed in feveral great fchools for leave given a fcholar or ftudent to go out. His mafter has given him an exeat.

EXECRATION, EXECRATIO, among the *Ancients*, a kind of punifhment, confifting of direful curfes and marks of infamy. Livy relates an inftance of it, which was ufed againft Philip king of Macedon, by the Athenians. A general affembly of the people being called, they made a decree, that all the ftatues and images of that king, and of all his anceftors, both of the male and female fex, fhould be demolifhed, and their very names rafed; that all the feftivals, facred rites, priefts, and whatever elfe had been inftituted in honour of him, fhould be profaned; that the very place where there had been any monument or infcription to his honour, fhould be deteftable, and that nothing fhould be fet up, or dedicated in them, which could be done in clean places; and, laftly, that the public priefts, as often as they prayed for the Athenian people, allies, armies, and fleets, fhould as many times deteft and execrate Philip, his children, kingdom, land, and fea forces, and the whole race and name of the Macedonians.

Cornelius Nepos, in his life of Alcibiades, calls it *devotion*.

At the taking or demolifhing of a city, it was frequent to pronounce direful curfes and execrations upon any perfon who fhould endeavour to rebuild it; which fome imagine was the reafon that Troy could never be raifed out of its afhes, though feveral perfons attempted it, being devoted to eternal and irreparable ruin by Agamemnon. This feems to have been a very ancient cuftom, and derived from the Eaftern nations; for we find Jofhua, at the deftruction of Jericho, to have fixed an imprecation upon the perfon who fhould rebuild it, which was thought to be accomplifhed in Hiel the Bethelite many ages after. Potter, Archæol. tom. ii. p. 97.

EXECREBRONCHOS, in *Surgery*, from ἐξέχω, *to abound*, and βρόγχος, *a throat*, a term which probably fignified a fwelling of the thyroid gland, which affection is now almoft always named bronchocele.

EXECUTANT, Fr. in *Mufic*, a participle ufed fubftantively. A mufician or performer who executes his part in a band, in the fame fenfe as concertant implies a performer in a concert. See CONCERTANT, EXECUTER, and EXECUTION.

EXECUTED *Contract*, *Eftate*, *Fine*, and *Remainder*. See the fubftantives.

EXECUTER, *Fr.* to execute, play, fing, or perform a compofition, or piece of mufic, in all its parts, whether vocal or inftrumental, and to let every note and paffage be heard agreeable to the notation in the fcore.

As mufic is an object for the ear, it can only be judged by its effects in the execution. Many pieces of counterpoint look correct and learned on paper, which no real judge can hear without difguft; and others that look thin, fimple, and common, which in the execution afford the higheft pleafure, by unexpected effects. Vulgar compofers, attentive to fymmetry and the filling up all the parts, often appear to be great contrapuntifts, while they are judged merely by the eyes; and fuch compofers often have the addrefs to employ fo many different inftruments, and fuch a number of parts in their mufic, that it is with great difficulty a fufficient band can be collected to do it juftice in the execution. Rouffeau.

EXECUTION, the act of executing, *i. e.* of accomplifhing, finifhing, or atchieving any thing to be done.

We fay, the execution of a teftament; of a law; of a treaty; of a building, or the like.

EXECUTION, in *Common Law*, fignifies the laft performance of an act; as of a writ, a judgment, or the like.

EXECUTION *of a judgment*, denotes the putting of the law in force, or it is the obtaining the poffeffion of any thing recovered by judgment of law.

This is performed in various ways, according to the nature of the action upon which it is founded, and of the judgment which is had or recovered. If the plaintiff recovers in an action real or mixed, whereby the feifin or poffeffion of land is awarded to him, the writ of execution fhall be an *habere facias feifinam*, or writ of feifin, of a freehold; or an *habere facias poffeffionem*, or writ of poffeffion, of a chattel intereft. (Finch. L. 470.) Thefe are writs directed to the fheriff of the county, commanding him to give actual poffeffion to the plaintiff, of the land fo recovered; in the execution of which the fheriff may take with him the *poffe comitatus*, or power of the county, and may juftify breaking open doors, if the poffeffion be not quietly delivered. But if it is peaceably yielded up, the delivery of a twig, a turf, or the ring of the door, in the name of feifin, is fufficient execution of the writ. Upon a prefentation to a benefice recovered in a *quare impedit*, or affife of *darrein prefentment*, the execution is by a writ *de clerico admittendo;* directed not to the fheriff, but to the bifhop or archbifhop, and requiring him to admit and inftitute the clerk of the plaintiff. In other actions, where the judgment is, that fomething fpecial be done or rendered by the defendant, then, in order to compel him fo to do, and to fee the judgment executed, a fpecial writ of execution iffues to the fheriff, according to the nature of the cafe. As, upon an affife of nufance, or *quod permittat profternere*, where one part of the judgment is *quod nocumentum amoveatur*, a writ goes to the fheriff to abate it, at the charge of the party, which likewife iffues even in cafe of an indictment. (Comb. 10.) Upon a replevin, the writ of execution is the writ *de retorno habendo;* and if the diftrefs be eloigned, the defendant fhall have a *capias in withernam;* but on the plaintiff's tendering the damages, and fubmitting to a fine, the procefs *in withernam* fhall be ftayed. (2 Leon. 174.) In detinue, after judgment, the plaintiff fhall have a *diftringas*, to compel the defendant to deliver the goods, by repeated diftreffes of his chattels, (1 Roll. Abr. 737. Raft. Entr. 215); or alfo a *fcire facias* againft any third perfon in whofe hands they may happen to be, to fhew caufe why they fhould not be delivered; and if the defendant ftill continues obftinate, then (if the judgment hath been by default or on demurrer) the fheriff fhall fummon an inqueft to afcertain the value of the goods, and the plaintiff's damages; which (being either fo affeffed, or by the verdict in cafe of an iffue, Bro. Abr. tit. *Damages*, 29.) fhall be levied on the perfon or goods of the defendant.

Executions in actions, where money only is recovered, as a debt or damages, (and not any fpecific chattel,) are of five forts: either againft the body of the defendant; or againft his goods and chattels; or againft his goods and the *profits* of his lands; or againft his goods and the *poffeffion* of his lands; or againft all three, his body, lands, and goods. The *firft* of thefe fpecies of execution is by writ of Capias *ad fatisfaciendum*, which fee. This writ is an execution of the higheft nature, inafmuch as it deprives a man of his liberty, till he makes the fatisfaction awarded. When a defendant is once in cuftody upon this procefs, he is to be kept in *arcta et falva cuftodia;* and if he be afterwards feen at large, it is an *efcape*, which fee; and the plaintiff may have an action thereupon againft the fheriff for his whole debt. If a *capias ad fatisfaciendum* be fued out, and a *non eft inventus* is returned thereon, the plaintiff may fue out a procefs againft the bail. The *fecond* fpecies of execution is againft the goods and chattels of the defendant, and is called a writ of Fieri *facias*, which fee. A *third* fpecies of execution is by writ of Levari *facias*, which fee. This affects a man's goods and the *profits* of his lands. This writ is now little ufed, the remedy by *elegit* being much more effectual. This writ of *elegit* is the *fourth* fpecies of execution. Moreover, upon fome profecutions given by ftatute, as in the cafe of recognizances or debts acknowledged on ftatutes merchant, or ftatutes ftaple; (purfuant to the ftatutes 13 Ed. I. *de Mercatoribus*, and 27 Ed. III. c. 9.) upon forfeiture of thefe the body, land, and goods may all be taken at once in execution, to compel the payment of the debt. This procefs is the *fifth* fpecies of execution, and is ufually called an *extent*, or *extendi facias*, which fee. It is to be obferved, that all thefe writs of execution muft be fued out within a year and a day after the judgment is entered, otherwife the court concludes *prima facie*, that the judgment is fatisfied and extinct; yet, however, it will grant a writ of *fcire facias*, in purfuance of ftatutes Weftm. 2. 13 Edw. I. c. 45. for the defendant to fhew caufe why the judgment fhould not be revived, and execution had againft him; to which the defendant may plead fuch matter as he has to allege, in order to fhew why procefs of execution fhould not be iffued: or the plaintiff may ftill bring an action of debt, founded on this dormant judgment, which was the only method of revival allowed by the common law. (Co. Litt. 290.) Blackft. Comm. B. III.

Sir Edward Coke, in his Reports, makes two forts of executions; one *final*, another with *a quoufque*, as only tending to an end.

Execution *final*, is that which maketh money of the defendant's goods, or extendeth his lands, and delivers them to the plaintiff; which he accepts in fatisfaction; and this is the end of the fuit, and all that the king's writ commands to be done.

Execution *with a quoufque*, is that which only tends to an end; as in the cafe of a *capias ad fatisfaciendum*, &c. This is not final; but the body of the party is to be taken, to the intent and purpofe to fatisfy the plaintiff; and his imprifonment is not abfolute, but till he doth fatisfy; fo that the body is but a pledge for the debt. 6 Rep. 87.

Execution, *Tenant by*. See Tenant.

Execution *of criminals*, muft be according to judgment; and the king cannot alter a judgment from hanging to beheading, becaufe no execution can be warranted, unlefs it be purfuant to the judgment. (3 Inft. 52. 211. H. P. C. 252.) But there are ancient precedents wherein men condemned to be hanged for felony, have been beheaded by force of a fpecial warrant from the king. (Bract. 104. Staundf. 13.) And the king may pardon part of the execution in judgment for treafon, *viz.* all but beheading. It has been faid by fir Edward Coke, and fir Matthew Hale, that the king cannot change the punifhment of the law, by altering the hanging or burning into beheading. But others have thought (Foft. 270. F. N. B. 244.), and as judge Blackftone fays, more juftly, that this prerogative being founded in mercy, and immemorially exercifed by the crown, is part of the common law. The court may command execution to be done without any writ; (Finch, L. 478.) though fometimes execution is commanded by writ. (2 Hawk. P. C. 463.) Judgment belongs to the judge; but the execution may be done by the fheriff, or his deputy; and an execution cannot be lawfully made by any but the proper officer, whofe warrant for fo doing was anciently by precept of the judge under his hand and feal; as it is ftill practifed in the court of the lord high fteward, upon the execution of a peer; (2 Hal. P. C. 409.) though in the court of peers in parliament, it is done by writ from the king; and if the fheriff, or other officer alters the execution, or any other executes the offender, or if he is killed without the authority of law, it is felony. (2 Hawk. ib.) The ufage now is for the judge to fign the calendar, or lift of all the prifoners' names, with their feparate judgments in the margin, which is left with the fheriff. As for a capital felony, it is written oppofite to the prifoner's name, "let him be hanged by the neck;" formerly,

formerly, in the days of Latin and abbreviation, "ſuſ. per coll." for *ſuſpendatur per collum.* And this is the only warrant which the ſheriff has for ſo material an act, as taking away the life of another. (5 Mod. 22.) Upon this judge Blackſtone obſerves, that it may certainly afford matter of ſpeculation, that in civil cauſes there ſhould be ſuch a variety of writs of execution to recover a trifling debt, iſſued in the king's name, and under the ſeal of the court, without which the ſheriff cannot legally ſtir one ſtep; and yet that the execution of a man, the moſt important and terrible taſk of any, ſhould depend upon a marginal note. The ſheriff, upon receipt of his warrant, is to do execution within a convenient time, which in the country is alſo left at large. In London a more ſolemn and becoming exactneſs is uſed, both as to the warrant of execution, and the time of executing thereof; for the recorder, after reporting to the king in perſon the caſes of the ſeveral priſoners, and receiving his royal pleaſure, that the law muſt take its courſe, iſſues his warrant to the ſheriffs, directing them to do execution on the day, and at the place aſſigned; and in the court of king's bench, if the priſoner be tried at the bar, or brought there by *habeas corpus*, a rule is made for his execution, either ſpecifying the time and place, (State Trials, p. 332. Foſt. 43.) or leaving it to the diſcretion of the ſheriff. And, throughout the kingdom, by ſtatute 27 Geo. II. c. 37. it is enacted, that in caſe of murder, the judge ſhall in his ſentence direct execution to be performed on the next day but one after ſentence paſſed. But otherwiſe, the time and place of execution are by law no part of the judgment, as was held by the twelve judges. (Mich. 10 Geo. III.) Beccaria has well obſerved, (On Crimes, &c. ch. 19.) that it is of great importance, that the puniſhment ſhould follow the crime as early as poſſible; that the proſpect of gratification or advantage, which tempts a man to commit the crime, ſhould inſtantly awake the attendant idea of puniſhment. Delay of execution ſerves only to ſeparate thoſe ideas, and then the execution itſelf affects the minds of the ſpectators rather as a terrible ſight, than as the neceſſary conſequence of tranſgreſſion.

In caſe a man condemned to die, come to life after he is hanged, as the judgment is not executed till he is dead, he ought to be hung up again. (2 Hal. P. C. 412. 2 Hawk. P. C. 463.) For the former hanging was no execution of the ſentence; and if a falſe tenderneſs were to be indulged in ſuch caſes, a multitude of colluſions might enſue. The body of a traitor, or felon, is forfeited to the king by the execution. Execution may be avoided by a *reprieve* or a *pardon*, which ſee reſpectively.

Execution *of decrees*, in *Scots Law*, is effected by diligence, either againſt the perſon, or againſt the eſtate of the debtor. The firſt ſtep of perſonal execution is by letters of horning, which paſs by warrant of the court of ſeſſion, on the decrees of magiſtrates of boroughs, ſheriffs, admirals, and commiſſaries. If the debtor does not obey the will of the letters of horning, within the days of the charge, the charger, after denouncing him rebel, and regiſtering the horning, may apply for letters of caption, which contain a command, not only to meſſengers, but to magiſtrates, to apprehend and impriſon the debtor. All meſſengers and magiſtrates who refuſe their aſſiſtance in executing the caption, are liable *ſubſidiarè* for the debt; and ſuch ſubſidiary action is ſupported by the execution of the meſſenger employed by the creditor, expreſſing that they were charged to concur, and would not. Letters of caption contain an expreſs warrant to the meſſenger, in caſe he cannot get acceſs, to break open all doors, and other lock-faſt places. The law ſecures peers, married women, and pupils, againſt perſonal execution of caption upon civil debts. Such commoners alſo as are elected to ſerve in parliament, are ſecured againſt perſonal execution by the privilege of parliament. No caption can be executed againſt a debtor within the precincts of the king's palace of Holyrood-houſe; but this privilege of ſanctuary afforded no ſecurity to criminals, as that did which was by the canon law conferred on churches and religious houſes. When the perſonal preſence of a debtor, under caption, is neceſſary in any of our ſupreme courts, the judges are empowered to grant him a protection, for ſuch time as may be ſufficient for his coming and going, not exceeding a month. Protection from diligence is alſo granted by the court of ſeſſion, under the late bankrupt ſtatute, when it is applied for, with concurrence of the truſtee, or a certain number of the creditors, as the caſe may require.

Execution, *military*, is the pillage or plundering of a country by the enemy's army.

Execution alſo denotes every kind of puniſhment inflicted on an army by ſentence of a court-martial. This is of various kinds; as tying up to three halberts, and receiving a number of laſhes with a whip compoſed of nine cord-laſhes, and each laſh of nine knots, from the drummer; or running the gantlope through the parade at guard-mounting, drawn up in two lines for that purpoſe. On this occaſion the provoſt marches through with twigs or ſwitches, and every ſoldier takes as many as there are criminals to be puniſhed; the criminal then marches through the two lines, and each ſoldier gives him a hard ſtroke, the major riding up and down, to ſee that the men lay on properly. When a ſoldier is to be puniſhed with death, a detachment of about two hundred men from the regiment to which he belongs forms the parade, and a file of grenadiers ſhoots the priſoner to death. Different nations have different modes of puniſhment. The cat with nine tails is deſigned to puniſh foot-ſoldiers; but dragoons and cavalry-men are generally picketed.

Execution, in *Muſical Performance*, the action of conveying to the ear, by the aſſiſtance of the eye, what has been written in the ſcore. As much muſic is compoſed of many parts ſo interwoven and linked together, that both the time and intonation are very difficult to ſeize, and of which the ſpirit depends more on taſte than notation of ſuch pieces, nothing is ſo uncommon as a perfect execution. The reading of the notes exactly is no great merit, the performer muſt enter into all the ideas of the compoſer, and feel, and make the hearer feel, the fire or pathos of the expreſſion; but above all he muſt be poſſeſſed of a nice and acute ear, always attentive to the effect of the whole. In French muſic the leader muſt be particularly careful to preſs and relax the time according to the taſte of the melody, the power of voice, and the geſticulation of the ſinger; the other parts muſt conſequently be extremely attentive in following him. "The totality of the opera at Paris, where muſic had no other meaſure than the geſtures of the ſinger, muſt, in my opinion, require an admirable muſician indeed to keep all the performers together." N. B. This was written by Rouſſeau near 40 years ago, and at that time little diſputed; but the editors of the late edit. of the Encyc. men of taſte and judgment, will, perhaps, ſay with Moliere, "medicin malgre lui," this may have been ſo formerly, "mais, nous avons changés tout ca."

"If the French," ſays St. Evremond, "compoſe in a bolder ſtyle than formerly by their intercourſe with the Italians, the Italians in their turn have gained by their commerce with the French, by learning of them a more

 agreeable

agreeable touching, and perfect execution." Letter to the duke of Buckingham.

The reader (says the author of the Lettre sur la Muf. Fran.) will, I believe, excuse me if I wave making any remarks on this passage, I shall only observe, that the French think all the world interested about their music; but on the contrary, in three fourths of Italy, Italian musicians are totally ignorant that there exists a music in France different from their own.

A facility of reading and performing a single part is likewise called, if difficult, execution; particularly when rapid passages are played correctly, and without hesitation, at sight.

Execution of this kind depends in an especial manner on two things; the first in having a powerful hand and quick eye; and the second in having read much music, and being able to phrase it at a glance: for while we only look at single notes, we shall hesitate in pronouncing them: a great facility of execution is only acquired by uniting them into meaning, and putting the thing itself in the place of the sign. In this manner the memory of the reader of a book is no less assisted than by his eyes; and what he would read with great difficulty in a foreign language, though written or printed with the same characters as his own.

Execution, in *Painting*, is a technical term signifying the style and manner in which a painter performs his work: in other words, the mechanical part of the art, as far as relates to the handling of the pencil in laying on the colours of a picture.

It is evident from this definition, that without possessing it in some degree, all knowledge of the other branches of the art is totally nugatory; to what purpose would the theory be made perfect, if no practical means of applying it were understood; but besides that degree of execution absolutely requisite to produce any thing in the shape of a picture, it well deserves to be made an object of particular study, as its various modes are productive of much utility in the progress of a picture. A great deal of the character of many objects in painting depends on the manner in which they are wrought, that is, on the peculiarity of the strokes of the pencil; such, for instance, are all skins of beasts; feathers of birds; trees; various kinds of drapery; armour, &c. in producing the effects of which, execution will alone go very far, in spight of bad form and bad colour. There is a charm in it which few perhaps but painters know, and which, unhappily, too many painters feel and value too highly, and desert for it qualities of a much more valuable kind; and are content too often to let their works pass imperfect, even with the knowledge of their imperfections, rather than disturb the beauty of clearness of touch which they may happen to possess.

It is indeed a task of no easy nature fully to obtain this quality, as it requires the utmost precision of judgment so to execute a work of art, that spirit and vigour should be maintained, accompanied with softness and truth. Without which union the display of it is a vice of art instead of an excellence, and damns instead of exalting the work.

Knowledge of the general character of the object about to be represented is the only foundation of a beautiful, decided, and just execution: possessed of that, the artist holds in his hands the master-key of the expression of its qualities, and renders its effect without difficulty. Wanting it he produces his work with heaviness, with bungling, and confusion.

It has been remarked that the countenances of men scarcely differ more than do the characters of their hand-writing, and not far, if at all, short of the variety of either of these, is that of the manner in which painters have executed their works. Each man in this also has his peculiarity; no two are so exactly alike in the execution of their pictures that an able connoisseur would not distinguish between them, and presently attribute each to its respective author.

This discrimination of hands constitutes almost the tout-ensemble of the knowledge of the host of would-be connoisseurs; and unhappily, too many of them have obtained an influence over the opinions of men well able to teach them in better things appertaining to the arts, if common sense were allowed to rule; and this merely by having pored over the works of painters to endeavour to ascertain the distinguishing characteristics of each one's workmanship: a species of knowledge agreeable and useful to a certain degree, but of easy acquirement, and to which those who have a genuine feeling for the really good and valuable qualities pictures may possess, seldom give sufficient attention to obtain an extended information in it. The works of good artists will force themselves upon our notice, and after sufficiently admiring the general effects of beauty, of sublimity, or character they exhibit; we naturally seek to know by what means or in what manner their various parts are executed, and for the purposes of connoisseurship a satisfactory acquaintance soon takes place on that head. The works of those whose power in art is not sufficient to attract by those better qualities are surely not worthy of that close inspection which is required to become acquainted with their peculiarities of execution. But the trick of the connoisseur dealer is, by some fancied resemblance or some slight reality of resemblance, to pass off an inferior work under the sanction of a great name; while, as we have observed, if common sense were allowed to rule, the name would add no value to the picture, the tinsel would still glare under the gold, and the bauble be soon lost.

This indispensable portion of the art of painting requires early tuition in order to possess a ready power over the hand, so that it shall move freely at the command of the will to effect its desires. The same in fact is the case with regard to the acquirement of free execution in any other art, such as music, writing, &c. For though our muscles appear to act merely on our willing that their office should be performed, and without any particular direction of the power of the mind over the particular muscles which produce the motion, yet, in fact, that immediate influence is applied, although from habit and its extreme rapidity, we are insensible of the communication. This is plain when we require the use of muscles, in a direction we are not constantly in the habit of using them in. For instance, a man not accustomed to ride, or first mounting a horse, finds it necessary to exert all his mental influence to cause those muscles to act which are requisite to maintain his seat on the back of the animal, and the communication of that influence is evidently felt; but when habit has confirmed him in his seat on horse-back, though those same muscles continue to act when he is mounted, he is unconscious of constraining them to do so, the dictates of his will are then so instantaneously excited, that the connection between the exertion of its influeuce, and its effect is completely unobservable.

It is therefore requisite for men desirous of making considerable progress in the practical part of an art, early in life to apply themselves earnestly to its attainment. The best mode of obtaining it in painting, is, by copying the works of those most skilful in their display of it, taking care at the same time to lay in a good store of knowledge of the materials requisite for the art, particularly (if historical painting be the course intended to be pursued) of the human figure, the foldings of draperies, &c. &c., and after some

time

time fpent in making copies of fine works, to paint from nature herfelf, keeping in view the manner in which the great painters, whofe works they have imitated, faw her productions; obferving how they difpofed of thofe touches allowed to remain vifible, and decided both of light and of dark; alfo how they characterized by their execution of the different parts; for, in a well executed work no touches are allowed to remain that are not neceffary in fome meafure to determine the character of the object; the reft are all blended or foftened together, and ferve as a bafe to receive thofe finifhing touches (as they are called) which are the decided features of the ftyle of the mafter, (fee STYLE, in *Painting*,) the fpring of energy and vigour in the work, and without which it would appear tame and infipid.

A picture, wherein the colours and forms are blended all over, is fure to appear either folid like a ftone, or have the texture of dough, of fomething foft and fpiritlefs. On the contrary, where no foftening takes place, and every touch remains vifible, confufion inevitably reigns, with the character of tinfel, and a fluttering want of folidity.

While the ftudent is endeavouring to acquire facility of handling his pencil, or of execution, he muft take care not to be led away by its fafcination, but to remember that it is only the means of prefenting to the world, in an agreeable fhape, other more dignified, and more valuable qualities in art, which lie deeper than the furface; and without which this is worfe than an empty nothing. 'Tis the bane of many an ingenious youth who, happening to poffefs it early, and outfhining his companions in years, fatisfies himfelf that he has made a large advance in his art, when in fact he has obtained only a means of doing fomething, which more important part, his vanity leads him to forget to make the ftudies requifite to enable him to perform, *viz.* to acquaint himfelf thoroughly with the nature of bodies, and the happieft and beft modes of combining them in forms and colours: and as he advances in life he is mortified to find himfelf furpaffed by thofe he had regarded with contempt, but whofe more ftcady and better directed minds have purfued attentively more valuable objects of ftudy, and the more ufeful principles of their art, and now foar to a height which leaves his weaker talent far beneath.

It muft, however, be remarked, that a good execution is a highly valuable quality in a picture, which being wrought with judgment, with fpirit, and eafe, acquires thereby an additional relifh to the enjoyments its better properties difpenfe, and raifes the artift in our eftimation.

Of all thofe who have exhibited this talent with fuccefs, Giacomo Robufti, called Il Tintoretto, ftands foremoft for vigour, as has been noticed under the word ENERGY, in *Painting*. He has no competitor in the freedom, the boldnefs, and the finifh of ftyle in which his beft works are executed.

Of this his picture of St. Mark defcending from heaven to refcue a Chriftian flave condemned to torture among the Turks, originally painted for the Scudo di San Marco at Venice, but now among the fpoils adorning the Louvre at Paris, is a moft decided and aftonifhing proof. This picture is an immenfe work containing twenty figures or more, thofe in front larger than life, yet it is wrought all over with the rapidity and eafe generally characteriftic of fmall pictures, or a fketch within the compafs of the hand to perform at once; and at the fame time it has all the effect of rotundity of finifh the moft laboured works poffefs. In the midft of the fine pictures which furround it, it ftands quite alone in its vigour of effect and fplendour of valour; even a work of Rubens, who is extremely fkilful in this as well as in all other branches of the art; even his, appeared comparatively clumfy in its execution, though one of his fineft productions, the opening of the Temple of James, or, as it is ufually called, the Peace and War. Titian, from his fenfe and truth in the St. Peter martyr, beft withftands the power of Tintoretto. The comparifon of thefe two works may be faid to be fomewhat fimilar to that of a man of wit with a man of fenfe: the former fhines for a moment by the brilliancy and gaiety of his genius, but when the latter is attentively heard, and his obfervations confidered, his greater value becomes apparent.

Titian perhaps on the whole is the beft model to follow for execution: he does not, like Tintoretto, leave his heads without a character in the heat of workmanfhip, though they are not always of the beft; they are not wrought too minutely: the lights and darks are freely placed, his pencil is full and rich, and each part is made out to its full relievo, and his finifhing touches are laid on with the niceft difcrimination of truth in direction of light and hue of colour; nothing can exceed the delicacy and fkill his draperies are wrought with as to character; and though not fo ftrong as Tintoretto's, they have fufficient force, and are far more juftly difpofed and characterized. After Titian in imitating him are, Velafquez and Vandyke for excellence in their execution. Of the former, a Spanifh painter, there are but few works in this country, but what there are, fully juftify the remark. The latter in his very fineft works equals his great predeceffor in this refpect, many of whofe pictures he carefully copied. His touch is exceedingly delicate, and his underftanding of his fubject enabled him to place it with the greateft juftnefs and propriety. There is rarely feen in his works a confufion in effect or relievo, and his power in his earlier productions feems to have encreafed with his canvas; the large picture at Wilton of the Pembroke family is wrought in a ftyle fo broad and mafterly, that it appears to have been as eafily managed as any of his fmaller pictures; and he knew how to give with the greateft eafe the juft character of every object he attempted to reprefent. Gout and confequent weaknefs effected a change in his execution fo great, that his hand is hardly cognizable in fome of his latter works by thofe who have only feen his former ones. When he was in Italy, his manner was that of Titian, with fomewhat of Tintoretto; from this bravura ftyle, as it may be termed, he fell afterwards to one more tame and fpiritlefs; foftened, and rounded up, with few of thofe vigorous touches, and with lefs billiancy of effect. Inftances of both thefe, and alfo intermediate degrees, are at the earl of Egremont's at Petworth. Of the firft are whole length portraits of fir Robert and lady Shirley, which he painted when he was very young at Venice; of the others, are portraits of feveral branches of the Pony family, who once poffeffed that noble manfion. Vandyck certainly furpaffed his mafter Rubens in beauty of execution, but was more than equally furpaffed by him in vigour and variety of imagination; yet the execution of Rubens was extremely powerful, but apt to become flovenly, and he is not, generally fpeaking, a good model to be followed on that head.

For thofe who are intent upon yielding the foft, the delicate, and gentle impreffions produced by highly laboured works without minutenefs, Correggio is the exemplar of the whole clafs of that ftyle of painters. In one particular he, and our own fir Jofhua, in fome of their works, ftand unrivalled in execution. Other painters have given a beautiful furface, which, at a proper diftance, deceives the eye, and prefents the full appearance of flefh: thefe two have, we may almoft fay, made flefh itfelf; the clofeft infpection merely confirms the delufion, and the obferver fancies he could indent his finger in the furface, and expect it to fpring again like nature; fuch ſuch is the fullneſs of the texture of the colour wrought with the many varying hues of nature. Guido Rheni follows in this claſs of the pleaſing ſtyle. His pictures of the lighter kind are exceedingly grateful to the eye, from the intelligence and eaſe with which his pencil appears to have been conducted through all the various parts. Annibal Carracci, in a more bold manner, is alſo a maſter of great power in the execution part of the art; but he often appears to have laboured to expreſs his thoughts; his works, however, poſſeſs great beauties of this nature.

In works of a different and ſmaller claſs from thoſe produced by the maſters whoſe names we have mentioned, almoſt the whole of the Dutch and Flemiſh ſchools are wonderfully ſkilful in their execution, particularly Rembrandt, Teniers, Jauſſen, Metzu, Netſcher, &c. and ſtill more minute Gerard Dow, and Meins. In landſcape, Cuyp, Berghem, Both, Ruyſdael, and Hobbima, are all well worthy of the utmoſt attention in this reſpect; and many others, too numerous to be mentioned here, both of theſe and the Italian ſchool, will greatly aſſiſt the ſtudent who attentively examines their productions to form his judgment, on thoſe points wherein lie the greateſt beauties of this neceſſary branch of the art of painting. But as a good execution conſiſts in a free and ready hand, marking with fullneſs of preciſion and truth the characters of the objects repreſented; nothing but an intimate knowledge of nature will ever enable him to apply his obſervations on works of art to any beneficial purpoſe in completing the productions of his own imagination.

EXECUTIONE *facienda*, in *Law*, a writ commanding execution of a judgment.

Executione *facienda in withernamium*, lies for taking the cattle of one who had formerly conveyed out of the county the cattle of another, ſo that the ſheriff cannot replevy them.

Executione *Judicii*, a writ directed to the judge of an inferior court, to do execution upon a judgment therein, or to return ſome reaſonable cauſe wherefore he delays the execution. F. N. B. 20.

If execution be not done on the firſt writ, an *alias* ſhall iſſue, and a *pluries*, with this clauſe, *vel cauſam nobis ſignifices quare*, &c. And if, upon this writ, execution be not done, or ſome reaſonable cauſe returned why it is delayed, the party ſhall have an attachment againſt him who ought to have done the execution, returnable in B. R. or C. B. New. Nat. Br. 43.

EXECUTIVE Power, *Supreme*, is by the conſtitution of theſe kingdoms lodged in a ſingle perſon, the king or queen for the time being. See Crown and King.

EXECUTOR, a perſon nominated by a teſtator, to take care to ſee his will and teſtament executed or performed, and his effects diſpoſed of according to the tenor of the will.

The teſtaments made in Latin, in the fourteenth century, call executors *proviſores teſtamentarii*.

All perſons are capable of being executors that are capable of making wills, and others beſides, as feme-coverts and infants, and infants unborn; (Weſt. Symb. p. 1. § 635.) but no infant can act as executor till he is ſeventeen years of age. This appointment of an executor, either by expreſs words, or by ſuch as ſtrongly imply the ſame, is eſſential to the making of a will; (Weſt. c. 1. Plowd. 281.) but if the teſtator names no executors, or names incapable perſons, or if the executors that are named refuſe to act, the ordinary muſt grant letters of adminiſtration. See Administrator.

A perſon appointed to be executor is not compellable to execute the will; he may refuſe the charge, before he has adminiſtered as executor, or performed ſuch acts, as paying debts due by the teſtator, or receiving debts due to him, or giving acquittances for the ſame; but if he meddles with the goods of the teſtator, as executor, his ſubſequent refuſal is void, and he ſhall be charged as executor. A perſon to whom a legacy is left may be compelled either to ſtand the executorſhip, or to reſign his legacy. The refuſal of executorſhip muſt be entered and recorded in court. If ſeveral executors are named in a will, and ſome of them refuſe, and others prove the will, they who refuſe may afterwards adminiſter and act; and they muſt be joined in all ſuits, where the co-executors are plaintiffs; but not where they are defendants, becauſe the plaintiff in the action is not bound by law to take notice of any beſides thoſe who have proved the will. Such joint-executors, though they are accounted in law but as one perſon, ſhall not be charged by the acts of their companions, any further than for effects *actually* come to their hands. (Moor. 620. Cro. Eliz. 318. 2 Leon. 209.) But if two or more executors join in a receipt (in writing) and one of them only actually receives the money, each is liable for the whole, as to creditors at law, but not as to legatees or next of kin. (1 Salk. 318.) If joint-executors, by agreement among themſelves, agree that each ſhall intermeddle with a certain part of the teſtator's eſtate, yet each ſhall be chargeable for the whole (to creditors) by agreeing to the other's receipts. Hard. 314.

The intereſt, veſted in the executor by the will of the deceaſed, may be continued and kept alive by the will of the ſame executor, ſo that the executor of A.'s executor is to all intents and purpoſes the executor and repreſentative of A. himſelf. (Stat. 25 Edw. III. ſt. 5. c. 5. 1 Leon. 275.) But the executor of A.'s adminiſtrator, or the adminiſtrator of A.'s executor, is not the repreſentative of A. For the power of an executor is founded upon the ſpecial confidence and actual appointment of the deceaſed; and ſuch executor is therefore allowed to tranſmit that power to another, in whom he has equal confidence; but the adminiſtrator of A. is merely the officer of the ordinary, preſcribed to him by act of parliament, in whom the deceaſed has repoſed no truſt at all; and therefore, on the death of that officer, it reſults back to the ordinary to appoint another.

As to the office or duty of an executor, it is to be obſerved that he may do many things before he proves the will, which an adminiſtrator cannot do; becauſe the former derives his power from the will, and not from the probate or appointment of the ordinary, as the latter does. (Comyns. 151. Wentw. ch. 3.) He may maintain actions of treſpaſs, replevin, or detinue; releaſe an action, aſſent to a legacy, be ſued, alien, or otherwiſe intermeddle with the goods of the teſtator: by adminiſtering, the executor is entitled to receive all debts due to the teſtator, and all payments made to him are good, though he ſhould die, and never prove the will; but he cannot maintain a ſuit or action of debt, or the like, before he has proved the will. The ordinary, &c. may cite the executor, either to prove the will, or refuſe the office; and he may ſequeſter the goods of the deceaſed, till the executor has proved it; and if he does not appear on the proceſs, the ordinary may excommunicate him. On the other hand, the ordinary is compellable by mandamus to proceed to probate, when the will is not controverted. The executor muſt bury the deceaſed in a manner ſuitable to the eſtate he leaves behind him; neceſſary funeral expences are allowed, previous to all other debts and charges; but if he be extravagant, he is chargeable with devaſtation, or waſte of the ſubſtance of the deceaſed, which ſhall be only prejudicial to himſelf, and

and not to the creditors or legatees of the deceafed. (Salk. 196. Godolph. p. 2. c. 26. § 2.) He is then to make an inventory of all the goods and chattels, whether in poffeffion or action of the deceafed, which he is to deliver in to the ordinary upon oath, if lawfully required. He is then to collect all the goods and chattels fo inventoried; for which purpofe the law confers on him ample powers, as the reprefentative of the deceafed; (Co. Litt. 209.) and having the fame property in his goods as the principal had when living, and the fame remedies to recover them; and if there be two or more executors, a fale or releafe by one of them fhall be good againft all the reft. (Dyer. 23.) The executor muft in the next place pay the debts of the deceafed, in the order of their priority. See DEBT, and DEBTEE *Executor*.

Among debts of equal degree, the executor (and alfo the adminiftrator) is allowed to pay himfelf firft, by retaining in his hands fo much as his debt amounts to. (10 Mod. 496.) If a creditor conftitutes his debtor his executor, this is a releafe or difcharge of the debt, whether the executor acts or not, (Plowd. 184. Salk. 299.) provided there be affets fufficient to pay the teftator's debts.

If no fuit has commenced againft him, the executor may pay any one creditor in equal degree his whole debt, though he has nothing left for the reft; for, without a fuit commenced, the executor has no legal notice of the debt. After the debts, the executor is to pay the legacies, which he is to pay as far as his affets will extend; but he may not give himfelf the preference herein, as in the cafe of debts. In cafe of a deficiency of affets, all the *general* legacies muft abate proportionably, in order to pay the debts; but a *fpecific* legacy, as of a piece of plate, horfe, &c. is not to abate at all, unlefs there be not fufficient without it. (2 Vern. 111.) If the legatees have been paid their legacies, and debts come in more than enough to exhauft the refiduum, they are afterwards bound to refund a rateable part. (Ibid. 205.) See LEGACY, and DONATION *Caufa Mortis*.

When all the debts and legacies are difcharged, the furplus or refiduum muft be paid to the refiduary legatee, if any be appointed by the will; if there be none, it was formerly underftood to belong to the executor; (Perkins, 525.) but it feems to be now the general opinion, that, if there be an exprefs legacy given to an executor, and no devife of the furplus, fuch furplus fhall not go to the executor; but be difpofed to the next of kin, according to the ftatute of diftributions; the executor ftanding on the fame footing as an adminiftrator. (Prec. Chanc. 323. 1 P. Wms. 7. 544. 2 P. Wms. 338. 3 P. Wms. 43. 194. Stra. 559.) See INTESTATE.

Where no exprefs legacy is given to the executor, the furplus fhall go to the executor, and not otherwife difpofed of by will. When there are feveral executors, and fome of them are dead, the legatary muft fue the furviving executors, and not the executors or adminiftrators of thofe that are dead. And if all the executors are dead, he muft fue the executors or adminiftrators of thofe that died laft, and not thofe of the reft.

By the French law, an executor fhould be feifed of all the moveables of the deceafed during one year; at the end whereof he is to account for them. To the validity of a teftament, it is not neceffary there be an executor nominated therein.

EXECUTOR *de fon tort*, or of his own wrong, is he who takes on him the office of an executor by intrufion, not being conftituted thereto by the teftator or deceafed, nor authorized by the ordinary to adminifter.

If an executor in his own wrong takes upon himfelf the office of an executor, without lawful authority, he is chargeable to the rightful executor, and to all the creditors of the teftator, and likewife to the legatees, fo far as the goods amounted to, which he wrongfully poffeffed; and fuch an executor is made by any act of acquifition, transferring, or poffeffing himfelf of any of the eftate or goods of the deceafed; but not by acts of neceffity, piety, or charity. (2 Nelfon Abr. 793.) Such an executor cannot bring an action in right of the deceafed; but actions may be brought againft him; neither can he retain for his own debt or legacy. In cafe of his death, his executors or adminiftrators are liable to the fuit of the lawful executor, creditors, and legatees, by 30 Car. II. cap 7.

EXECUTOR, *Debtee*. See DEBTEE.

EXECUTORY, that which has, or carries with it a fufficient authority for being executed.

EXECUTORY *contract*. See CONTRACT.

EXECUTORY *devife of lands*, is fuch a difpofition of them by will that thereby no eftate vefts at the death of the devifor, but only on fome future contingency.

It differs from a *remainder* (which fee) in three very material points: 1. That it needs not any particular eftate to fupport it. 2. That by it a fee-fimple, or other lefs eftate, may be limited after a fee-fimple. 3. That by this means a remainder may be limited of a chattel intereft, after a particular eftate for life created in the fame. The *firft* cafe happens, when a man devifes a future eftate to arife upon a contingency; and, till that contingency happens, does not difpofe of the fee fimple, but leaves it to defcend to his heir at law. As if one devifes land to a feme-fole and her heirs upon her day of marriage; here is in effect a contingent remainder without any particular eftate to fupport it; a freehold commencing *in futuro*. This limitation, though it would be void in a deed, yet is good in a will, by way of executory devife. (1 Sid. 153.) For, fince by a devife a freehold may pafs without corporal tradition or livery of feifin, it may therefore commence *in futuro*; becaufe the principal reafon why it cannot commence *in futuro* in other cafes is the neceffity of actual feifin, which always operates *in præfenti*. And fince it may thus commence *in futuro*, there is no need of a particular eftate to fupport it; the only ufe of which is to make the remainder, by its unity with the particular eftate, a prefent intereft. And hence it follows, that fuch an executory devife, not being a prefent intereft, cannot be barred by a recovery, fuffered before it commences. (Cro. Jac. 593.) The *fecond* cafe happens where a devifor devifes his whole eftate in fee, but limits a remainder thereon to commence on a future contingency. As if a man devifes land to A. and his heirs; but if he die before the age of 21, then to B. and his heirs; this remainder, though void in a deed, is good by way of executory devife. (2 Mod. 289.) But in both thefe fpecies of executory devifes, the contingencies ought to be fuch as may happen within a reafonable time; as within one or more life or lives in being, or within a moderate term of years; for courts of juftice will not indulge even wills, fo as to create a perpetuity, which the law abhors. (12 Mod. 287. 1 Vern. 164.) *Thirdly*, by executory devife a term of years may be given to one man for his life, and afterwards limited over in remainder to another, which could not be done by deed; for by law the firft grant of it, to a man for life, was a total difpofition of the whole term; a life eftate being efteemed of a higher and larger nature than any term of years. (8 Rep. 95.) On this fubject, fee Blackft. Comm. vol. ii. p. 176, 8vo.

EXECUTORY *eftate*. See ESTATE.

EXECUTORY *fine*. See FINE.

EXEDENS Herpes. See Herpes.

EXEDRÆ, Ἐξέδραι, among the *Ancients*, were places wherein the philofophers, fophifts, rhetors, &c. ufed to hold their conferences and difputes.

M. Perrault is of opinion, the exedræ were a fort of little academies, where the men of learning met together. See Academy.

Budæus rather thinks, that what the ancients called exedræ, might anfwer to what we call chapters in the cloifters of monks, or collegiate churches.

EXEGESIS, Ἐξήγησις, a term fometimes ufed by the learned, to fignify *explication*.

Several interpreters of the Bible are of opinion, that in the paffages of Scripture, where we meet with Abba Pater, two words, the firft Syriac, and the fecond Greek or Latin, but both fignifying the fame thing; the fecond is only an exegefis, or explanation of the firft.

Exegesis is alfo ufed for an entire difcourfe by way of explication or comment on any thing.

Exegesis *numerofa*, or *linealis*, fignifies the numeral, or lineal folution, or extraction of roots, out of adfected equations, firft invented by Vieta. Ozanam calls it *la rhetique*. See Extraction *of roots*.

EXEGETES, formed of ἐξηγέομαι, *I explain*, among the Athenians, perfons learned in the laws, whom the judges ufed to confult in capital caufes.

EXEGETICA, in *Algebra*, the art of finding, either in numbers or lines, the roots of the equation of a problem, according as the problem is either numerical or geometrical. See Root and Equation.

EXELCOSIS, from ἕλκος, *an ulcer*, in *Surgery*, an incipient ulceration, or an excoriation, which is juft beginning to fuppurate.

EXEMPLAR, a model or original to be imitated or copied.

Exemplar alfo denotes the idea or image conceived or formed in the mind of the artift, whereby he conducts his work. Such is the idea of Cæfar, which a painter has in his mind when he goes to make a picture of Cæfar. The exemplar is ordinarily numbered among the caufes. See Cause.

EXEMPLIFICATION *of Letters Patent*, denotes an exemplar, or copy of letters patent, made from the inrolment thereof, and fealed with the great feal of England.

Such exemplifications are as effectual to be fhewed, or pleaded, as the letters patent themfelves.

EXEMPLIFICATIONE, in *Law*, is a writ granted for exemplification of an original record. Reg. Orig. 290.

EXEMPTION, a privilege, or difpenfation, whereby a perfon is excepted out of fome general rule.

Exemption is particularly applied to churches, chapels, and monafteries, which have a privilege given them by the popes, or princes, whereby they are exempted from the jurifdiction of the bifhop or ordinary.

The council of Conftance revoked all exemptions, to reftore to the general law, weakened and diminifhed by a relaxation of feveral ages, its ancient force and vigour, and make it every where obtain in all its latitude.

The council of Trent prohibited, and declared them null for the future; confirming only fuch as were well founded on legal conceffions from the holy fee.

Exemption, in *Law*, denotes a privilege to be free from fervice or appearance; thus, knights, clergymen, &c. are exempted from appearing at the county courts by ftatute, and peers from ferving on inquefts. (6 Rep. 23.) Perfons feventy years of age, apothecaries, &c. are alfo exempted by law from ferving on juries, and juftices of peace, attornies, &c. from parifh offices. 2 Inft. 247.

EXERCISE, a repetition of any operation, for the ftrengthening or retaining of a habit.

Exercise, or bodily motion, conftitutes, in the language of the older phyficians, one of the fix *non-naturals*, and has been juftly confidered, from the earlieft times, as an important meafure in the prefervation of health, as well as in the cure of feveral difeafes.

The value of corporeal exercifes in the eftimation of the ancient phyficians, from Hippocrates downwards, is manifeft from their writings, in which the various kinds of exercife, as well as the degrees and times in which they are ufeful, are particularly difcuffed. Efculapius himfelf is faid by Galen to have recommended riding on horfeback, and other exercifes, as the means of benefiting invalids. But Herodicus, a Thracian, feems to have been the firft who paid ferious attention to exercife, as a remedy for difeafes. He was mafter of one of the academies, called *Gymnafia*, in which the military and athletic exercifes were taught; and having remarked that his pupils ufually enjoyed high health, he turned his attention to the regulation of the gymnaftic exercifes, with a view to attain or preferve good health; thus adding the *medical gymnaftic* art, to the two others juft mentioned. (See Gymnastic, and Herodicus.) This mafter of the gymnafium, however, went to work empirically, and is accufed by Hippocrates of doing confiderable mifchief, in attempting to cure febrile difeafes by his exercifes. (De Morb. Epidem. lib. vi.) Hippocrates and his commentator, Galen, have left many obfervations relative to the different exercifes, and their particular effects in the alleviation of particular difeafes. Friction, efpecially by means of the *ftrigil*, or flefh brufh, is much inculcated; on which fubject Galen has compofed his fecond book, "De Sanitate Tuenda." The various modes of wreftling, the exercifes of the *corycus*, or hanging ball, &c. are commented on by Hippocrates in lib. ii. De Diæta: and Galen wrote a little treatife *de parva pila*, (the little ball,) which he recommends as an exercife that influences both the body and the mind at the fame time. In his difcourfe to Thrafibulus he difcuffes the queftion, whether the prefervation of the health properly belongs to medicine, or to the gymnaftic art: he inveighs againft the athletic and other violent practices of the gymnafium, but approves of the more moderate exercifes, which he confiders as fubfervient to the purpofes, and confequently a part of the art of the phyfician. Antyllus, and other Greek writers, have treated of the various exercifes in the fame light, as is evinced by the collections of Oribafius. (See Collect. Med. lib. vi.) The Romans even exceeded the Greeks in their attention to the medical gymnaftics. Afclepiades, in the time of Pompey, as Pliny informs us, confidered the different modes of exercife, *viz.* friction, walking, and geftation, as the chief auxiliaries of the phyfician, efpecially when combined with the proper regulation of diet; and by the employment of thefe exercifes, the inftitution of baths, the invention of hanging beds, *lecti penfiles*, and other means of making phyfic agreeable, he is faid to have acquired the general applaufe of all mankind: "univerfum prope humanum genus circumegit in, &c." (Plin. Nat. Hift. lib. xxvi. cap. 3.) Many eminent examples of the benefits of exercife among the Romans are on record. Suetonius ftates that Germanicus was cured of a fort of atrophy of the lower extremities, (crurum gracilitas) by riding. And Cicero himfelf, when reduced to a ftate of infirmity, which rendered it neceffary for him to defift from pleading, recovered his health by travelling, and by exceffive diligence in the ufe of friction. (Plutarch.) Friction was an exercife, indeed, reduced to a regular fyftem among the ordinary habits of the Romans, and was prefcribed to a great extent by their phyficians. See FRICTION.

That exercife, efpecially in the open air, is highly beneficial to the conftitution, is a truth which univerfal experience has eftablifhed. It is fcarcely neceffary, therefore, to appeal to the arguments of phyfiology to corroborate the propofition. It may be fufficient to ftate, that the immediate refult of bodily exertion is an acceleration of the circulation of the blood; a quicker and ftronger contraction of the heart, by which the blood is pufhed more effectually to every part of the fyftem, and efpecially through the fmall and extreme branches of the veffels. Hence a glow is produced on the furface, and the complexion affumes a redder hue, from the diftention of the capillary veffels with blood; and the exhalent arteries begin to pour out the thinner portions of the fluids in perfpiration. In the fame manner, the extreme arteries of all the other parts of the body are diftended, and excited to greater action; whence all the organs of fecretion, which are principally made up of convolutions of the extreme arteries, are neceffarily ftimulated to an active performance of their feveral functions. The veffels of the ftomach pour out the gaftric liquors more abundantly, and the work of digeftion is more perfectly and actively completed; the appetite for a new fupply of aliment quickly returns, and the ftomach is prepared for repeating the digeftive procefs, by the increafed fupply of the digeftive liquor. The liver and the pancreas, in like manner, elaborate their refpective fluids, the bile and pancreatic juice, more copioufly, and thus contribute an increafed aid to the operations of the alimentary canal. The lungs, in the mean time, being called upon for an augmented fupply of the vivifying principle derived from the oxygen of the atmofphere, by the increafed circulation of the blood through them, refpiration is increafed in proportion to the quantity of venous blood which they receive. Thus, notwithftanding the greater rapidity with which the blood is carried to the fecreting organs, it is rendered adequate to the fecretion of the healthy fluids peculiar to each, by the increafed operation of the lungs; as well as to the fupport of the greater mufcular action, in which the exercife confifts.

It muft be obvious, then, that this general activity of the whole fyftem, this free circulation through the moft minute ramifications of the veffels, and through the glands and organs which they compofe, and this prompt feparation of the excrementitious and other parts of the blood, by the fecretions, cannot but contribute to the general health of the body. It is not lefs obvious that it contributes to the evolution and growth of the different parts of the body; whether we confider the great influx of the blood, from which all growth is derived; or obferve the fact, that thofe mufcles and limbs, which are moft actively exercifed, invariably acquire fuperior bulk, as well as fuperior ftrength. The mufcles of the arms in blackfmiths, and thofe of the loins in porters, and all others employed in raifing or carrying great weights, invariably acquire a difproportionate fize; and, on the contrary, thofe mufcles which are little employed are apt to fhrink, and to be comparatively enfeebled, as in the legs of tailors. The effect of exercife in giving ftrength and rigidity of fibre to the mufcular or flefhy part of animals is well known, and daily exemplified in the difference of texture in the wings and legs of birds which we ufe as food. In the common fowls, which feldom ufe the wing, and conftantly employ the legs in walking, the hardnefs of the flefh of the latter, and tendernefs of that of the former, are notorious. From this influence of exercife in contributing to the growth and ftrength of the animal body, we may obvioufly trace the final caufe of that inftinctive difpofition to activity and motion, which the young of all animals poffefs.

Regular exercife, not too violent in degree, nor continued too long, fo as to induce exceffive fatigue, is therefore to be confidered as the moft important preventive of difeafes. It is not eafy to lay down rules by which it fhould be regulated; fince the conftitution, age, ftrength and habits muft modify its effects in different individuals. A fudden tranfition from a ftate of reft to violent exertion is injurious to the invalid, efpecially after a full meal, or if continued until a profufe perfpiration, or great laffitude takes place; for this over-exertion neceffarily leads to a languor and imperfect performance of all the vital actions, every organ partaking of the general fatigue. The various kinds of exercife may be confidered under two claffes, the active and the paffive; the former being the refult of our own mufcular activity, fuch as walking, dancing, running, fwimming, fencing, the military exercife, and different athletic games; the latter the refult of communicated motion, as riding in a carriage, failing, fwinging, friction, &c.; riding on horfeback, or driving a carriage, partakes in fome meafure of both the active and paffive exercifes.

Walking, which feems to be the moft natural exercife, is capable of producing all the effects above detailed, if adapted in degree and duration to the various circumftances. Hence the moft obftinate cafes of hypochondriacal diforders, of indigeftion, and other ftomach complaints, have been frequently removed by perfeverance in walking, efpecially in the open air of the country. But when the exercife of walking is adopted with a view to banifh the complaints juft mentioned, which a fedentary life is apt to induce, it is moft effectual when regularly and ftrenuoufly purfued. That degree of walking, which, when reforted to occafionally, or with confiderable intermiffions, produces great fatigue and languor, and therefore is rather prejudicial than advantageous, would, if daily continued, foon ceafe to fatigue, and would then contribute greatly to reftore the healthy ftate of the functions. It muft be recollected that the animal vigour is confumed, or, to ufe the language of Brown, the excitability is exhaufted, by the mental functions as well as by mufcular exertion; therefore, to carry with us, in our walks in fearch of health, the brooding anxieties and cares of our profeffions,—to attempt to combine ftudy with fuch exercife by reading, or by ferious reafoning in converfation, is to thwart the good effects of the plan. We may obferve that, fo incompatible is deep thought with mufcular exertion, that moft people ftop in the midft of their activity, when their arguments require great reflection. Serenity of mind, and a relaxation from the ferious occupations of life, are therefore neceffary, when walking is reforted to as a remedy.

Of the more violent fpecies of active exercife, which can only be reforted to as a prefervative from difeafe, by thofe who are in a ftate of good health, it is unneceffary to fpeak.

The modes of exercife which are particularly ufeful in the cure of difeafes, or in the reftoration of the health of convalefcents, are the different fpecies of geftation, efpecially riding in carriages, or on horfeback, and failing.

The motion of a fhip produces the moft gentle exercife, and is therefore adapted even to the relief of very infirm conditions of the body, and it has been employed from early times in the cure of confumption. The Romans, in the time of Pliny, ufed to fend their confumptive patients to Egypt; not, as that author takes care to inform us, on account

account of any peculiarity of that country, but in consequence of the length of the voyage. Annæus Gallio, who had been conful, was cured of a confumption by fuch a voyage. (Nat. Hift. lib. xxxi. cap. 6.) Celfus feems to have confidered failing, when reforted to early, as the principal remedy for confumption: "opus eft, fi vires patiuntur, longa navigatione," he fays; and where the ftrength is not equal to it, he recommends fhort voyages, or the ufe of a litter, or other means of gentle geftation. (De Medicina, lib. iii. cap. 22.) The advantages of a fea voyage, efpecially to a warmer climate, are well known to modern phyficians; and inftances of the fuccefs of fuch a voyage to Madeira, Lifbon, &c. when undertaken in the incipient ftage of confumption, as Celfus recommends it, are very numerous. This, however, like all other remedies for confumption, is too often reforted to when the difeafe has already advanced too far to admit of any effectual relief. See CONSUMPTION.

The exercife of geftation by means of a carriage, and the more active exercife of riding on horfeback, being more eafily obtained, are of more importance in our confideration of the fubject. Horfeback exercife was not much adopted by the ancients, with a view to the cure of difeafes; partly becaufe that valuable animal was lefs ufed by the Greeks and Romans, and partly becaufe their mode of riding, without ftirrups, was incompatible with the weaknefs of invalids. (See Fuller, Medicina Gymnaftica, p. 231.) Hence we may underftand the obfervation of Antyllus, that "riding is of little ufe to thofe who are fickly, becaufe a flow pace is productive only of laffitude, efpecially in the loins;" he admits, however, that "a quick pace of the horfe, although it occafions a troublefome fhaking of the whole body, is neverthelefs fomewhat beneficial, and ftrengthens the fyftem, efpecially the ftomach and the organs of fenfe, more than all other exercifes." (Oribafius, loc. cit. lib. vi. cap. 24. de Equitatione.) The great advantages of riding in the prevention and cure of many difeafes are infifted upon in the ftrongeft terms by Sydenham, who, indeed, appears, in feveral parts of his writings, to have confidered it as a remedy of ineftimable value, provided it be perfevered in with conftancy, in the manner which we have inculcated in refpect to *walking*. Speaking of the mode of cure in chronic difeafes, that fagacious phyfician obferves, "nothing, among all the expedients which have hitherto come to my knowledge, fo effectually fupports the fpirits and ftrength, as long and conftant riding on horfeback." (Diff. Epiftolaris.) Again in his Treatife on the Gout, and particularly refpecting the prevention of the paroxyfms by exercife, he fays, "riding on horfeback is far preferable to all other exercifes for this purpofe; in truth I have frequently confidered, that if any perfon were acquainted with a medicine, which he chofe to keep fecret, of equal efficacy in this, and in the greater number of chronic difeafes, with a conftant and perfevering exer ife on horfeback, he would fpeedily accumulate the moft ample wealth." And to exprefs his full conviction of the value of this exercife in confumptive complaints, he ufes thefe ftrong terms: "in fhort, however fatal confumption is deemed to be, and actually is, fince it deftroys two thirds of thofe who die of chronic difeafes, yet I folemnly affirm, that neither is mercury a more effectual remedy for the lues venerea, nor Peruvian bark for agues, than is the exercife juft commended for confumption, provided that the patient be always careful to fleep in dry linen, and that his journey be fufficiently long." The truth of this great encomium is indeed queftioned by modern practitioners in general, however weighty the authority of Sydenham may be. But there are many cafes on record, which feem to juftify this obfervation. Witnefs the cafe of the late Dr. Currie, of Liverpool, as related by himfelf, in the Zoonomia of Darwin. (Vol. ii. clafs ii. Ord. i. 6.) In this cafe, the patient had an hereditary predifpofition to confumption, and was reftored by travelling from a ftate of debility, in which the erect pofture could fcarcely be borne without fainting, to good health; having begun with the exercife of a carriage, and afterwards ridden on horfeback, as his ftrength augmented. Sydenham has related feveral examples of the value of this exercife, and others may be found detailed by Fuller, &c. We cannot therefore doubt, that in many inftances, in which it has feemed to be deftitute of the efficacy afcribed to it by Sydenham, the failure muft be attributed to the imperfect or too late ufe of the remedy. "I muft here repeat," fays Fuller, quaintly, "that when I fpeak of riding, I underftand the *habit of riding*, the want of which diftinction has made it ineffectual to many a man. He that in this diftemper (confumption) above all others rides for his health, muft be like a Tartar, in a manner always on horfeback; and then from a weak condition he may come to the ftrength of a Tartar." (Medicin. Gymnaft. p. 106.) We have dilated upon this topic, from a conviction that many chronic difeafes, which are included under the epithets of bilious and nervous, as well as many morbid conditions of the vifcera, for which drugs, and even the waters of Briftol, Bath, and Cheltenham, are ineffectually fwallowed, might be removed by a fteady and unremitting exercife, in a carriage, or ftill more certainly on horfeback.

It is unneceffary to enter into a particular enumeration and difcuffion of every poffible form of exercife, the principle being the fame with refpect to all. A late intelligent writer has laid down fome ufeful practical precepts on thefe topics, mixed with a good deal of trifling obfervation, and abfurd hypothefis. (See Willich's Lectures on Diet and Regimen, chap. 7.) The following remarks on the injuries occafioned by want of exercife are from that popular writer.

"We are now to confider the confequences arifing from *want of exercife*. This, indeed, is ftill more debilitating than too violent motion. The folid parts of the human frame are relaxed by it; the circulation of the fluids is retarded; they gradually ftagnate in the fmaller capillary veffels; the fecretions are diminifhed; and abundance of moifture or fat is generated, which renders the body, as well as the mind, more indolent and lethargic, relaxation of the mufcles, obftructions of the inteftines, hemorrhoids, apoplectic fits, various fpecies of dropfy, and at length a premature death, are the fad confequences. Men of letters are the moft unhealthy of all human beings, becaufe their bodies have fcarcely any other exercife but the imperceptible motion of the arms. Want of appetite, flatulency, anxiety, at one time obftructions, at another diarrhœa, and the moft diverfified nervous fymptoms are their attendants. Sleep is beyond their reach; a thoufand tormenting inconveniences, hypocondriafis, and at length a complete ftate of melancholy, is too frequently their lot. Temperance alone will not remedy all thefe evils; for, fince we cannot remain vigorous and healthy for two days together, with the fame mafs of blood, a new accefs of the neweft and moft fubtle parts of our fluids muft daily fupport the nervous fyftem, in order to preferve its regular functions. If this be not continually reftored, weaknefs and relaxation of body and mind are the inevitable confequences; with this difference only, that in a ftate of debility from too much bodily exercife, the thick and coarfe particles of the fluids are carried into circulation with the others, and the next meal or the firft fleep after it, foon soon supplies the deficiency in mental labour; on the contrary, digestion is interrupted, the crude and viscid parts of food remain unassimilated, and the body is prevented from receiving proper nourishment. In like manner sedentary mechanics and artificers are affected, particularly shoe makers, tailors, and weavers. They experience maladies similar to those to which men of letters are subject; and it has been frequently observed, that they are very liable to diseases of the mind, and especially to religious fanaticism."

Exercise, *Field*, in *Military Affairs*, relates to the evolutions performed by companies, regiments, or greater bodies of troops, when learning, or practising, those movements necessary to be correctly understood by persons of all ranks in the military profession. See Evolutions and Tactics.

Exercise, *Gun*, relates to the several arrangements, and motions, made for serving either heavy or light artillery, under every circumstance common to military operations. See Gun-*Exercise*.

Exercise, *Manual*, teaches the several motions of the firelock, whereby all act as it were in unison, and perform their duties when drawn up for display, or for service, in an uniform and appropriate manner. See Manual-*Exercise*.

Exercise, *Sword*, refers to the several positions of the sword, adapted either for attack, defence, or compliment. See Sword-*Exercise*.

Exercise, in a *Naval Sense*, is the preparatory practice of managing the artillery and small arms, in order to make the ships' crew perfectly skilled therein, so as to direct its execution successfully in time of battle. The words of command introduced, during the late war, for the exercise of the great guns, are the following: "Silence: cast loose your guns; level your guns; take out your tompions; run out your guns; prime; point your guns; fire; spunge your guns; load with cartridge; shot your guns; put in your tompions; house your guns; and secure your guns." Falconer's Marine Dict. art. *Exercise*.

Exercise may also denote the execution of the movements, which the different orders and dispositions of fleets occasionally require, and which the several ships are required to perform, by means of signals.

Exercises, in the plural, are particularly understood of what is taught young gentlemen in the academies, or riding-schools, &c. As riding the great horse, dancing, fencing, vaulting, drawing fortifications, &c.

EXERGASIA, Ἐξεργασια, *Exposition*, in *Rhetoric*, a figure consisting of several equivalent expressions, or such as are nearly so, in order to represent the same thing in a stronger manner. The warmth and vehemence of the speaker often urge him to recur to this figure, when he is affected with his subject, and there are no words, no expressions, sufficiently forcible to express his sentiments; and he therefore repeats one after another, as his fancy suggests them. This flow of expression, under the conduct of a good judgment, is often attended with advantage; as it warms the hearers, and impresses their minds, excites their passions, and enables them to see things in a stronger light.

EXERGUM, Exergue, or *Exerge*, often denominated by Evelyn *exurge*, among *Medallists*, is the bottom of a coin, commonly separated from the field by a line, upon which the figures of the reverse stand. It is so called from being ἐξ ἐργυ, *out of the* work of the medal. When the letters or words of a medal run round the margin, are on either side of the figure, or upon the exergue, they are denominated a *legend*; but when they occupy the field, they are called an inscription. See Legend and Inscription.

EXETER, in *Geography*, a city in Devonshire, England is of great antiquity, and, as Risdon emphatically styles it. "may be called the emporium and principal ornament of the west." Its Roman name, as it appears in Ptolemy, is *Isca*; and it is conjectured that the second legion of Augusta was stationed here for some time: this was commanded by Vespasian, who was the conqueror of Britannia Prima, in which province this place was included. In the Itinerary of Antoninus, Exeter is called Isca-Danmoniorum, and is the most westerly station he has noticed: though, from the Iters of Ptolemy and Richard; from the remains of Roman roads over, and around Haldon; and from the vestiges of ancient ways through Drew-Teignton to Oakhampton, and perhaps of a road hence over Dartmoor, by Hollow-street in the parish of Chagford; it is apparent that various principal roads ran westward from this city; and, therefore, it is probable that the Romans had other stations west of this. How long Exeter retained the name of Isca-Danmoniorum is uncertain; though it seems probable that it fell into disuse very soon after the Romans quitted the island, about which time it appears to have been re-occupied by the Britons who had preserved their independence by retiring to the wilds of Cornwall. They did not, however, continue in the possession of it many years; for Cerdic, the founder of the kingdom of Wessex, having greatly extended his territories, either by conquest or intrigue, included the most considerable portion of Devonshire within his dominions: and at length Exeter became subjugated to the power of the Saxons. Under their government its name was changed to Evan-Cestre, Ex-Cestre, &c., and thence, through various similar appellations, softened to Exeter.

This city has been several times besieged; but the greatest calamities it experienced were inflicted by the Danes, who, in the reign of Alfred, in violation of a solemn treaty, surprised and routed the king's horsemen, and mounting their steeds, rode to Exeter, and remained there for the winter. Alfred collected all his forces and invested the city by land, while his fleet blocked up the harbour: the Danes capitulated, and agreed to evacuate all the territories of the West Saxons. Between the period of the death of Alfred and the reign of Athelstan, the Cornish Britons had recovered possession of Exeter; but Athelstan having defeated and driven them to the west of the Tamar, they were never afterwards able to oppose the Saxon arms. To secure his conquests he surrounded Exeter with a wall of hewn stones defended by towers: and under his auspices, says Malmsbury, "it became such a place of trade, that it abounded with opulence." He adds that many other remarkable works of Athelstan were to be seen in the city and its neighbourhood. In the year 1003 Exeter was the first sacrifice to the fury of Swein king of Denmark, when he came to revenge the inhuman massacre of his countrymen: being delivered up by the treachery of its governor, after a siege of two months, many of the inhabitants were put to the sword, and most of the buildings destroyed by fire. Before it was well recovered from this calamity, it was again besieged and taken by William the Conqueror. In the reign of Stephen, this city was alternately garrisoned by the forces of the king and the empress. It again became the scene of hostility during the contest between Henry VI. and Edward IV. In the reign of Henry VII. it was closely, though ineffectually, besieged by three thousand men under Perkin Warbeck. The last siege Exeter experienced was in Edward VI.'s reign, when religious innovations occasioned an alarming insurrection in the west of England: the inhabitants, though reduced nearly to famine, so so bravely defended the city for thirty-five days, that the insurgents abandoned their design.

The ground inclosed within the walls of the city is nearly in the form of a parallelogram, of four furlongs in length, and three in breadth: this space is intersected by the four principal streets which meet near the centre, and diverging at right angles, connect the city with the suburbs. The whole extent occupied by buildings is about one mile and three quarters in length, and one mile in breadth. In the year 1769 the surrounding walls were entire; but many parts have been since destroyed. Stukeley speaks of them as being, in his time, in pretty good repair, and having many turrets and towers, various parts of which are still remaining. Leland, speaking of this city, observes, that it is "a good mile and more in cumpace, and is right strongly waullid and maintainid. Ther be diverse fair towers in the toune waul bytwixt the south and the west gate. Ther be four gates in the toune, by the names of est, west, north, and south. The est and the west gates be now the fairest, and of one fascion of building: the south gate hath beene the strongest." In the year 1769 the north gate was taken down, to make a more convenient entrance into the city; and in 1784 the east gate was removed for the same purpose. The south gate, the interior arch of which Dr. Stukeley remarks to be of Roman workmanship, is intended to experience the same fate.

The situation of Exeter is commanding and pleasant: it stands on the acclivity of an eminence on the eastern banks of the river Exe, which flows in a semi-circular direction round the south-west side of the city. "What adds to its wholesomeness and cleanliness," says Stukeley, "is, that the ground is higher on a ridge along the middle of its length declining on both sides. Further, on the south-west and north-west sides it is precipitous; so that with the river, the walls, the declivity of ground, and ditch without side, 'twas a place of very great strength, and well chose for a frontier." In the highest part of the city, on the north side, stand the remains of Rougemont castle, which was formerly the seat of the West Saxon kings, and afterwards of the dukes of Exeter. This building has little to recommend it but its antiquity and pleasant situation. The ruins of the exterior walls are nearly all that remain; these inclose a considerable space, of a pentagonal form, and were defended by four towers; two on the west, and two on the east side. The ramparts of the castle command a most delightful view over the adjacent country. When the castle was erected is unknown; though Grafton's tale, that it was built by Julius Cæsar, is unquestionably false. William the Conqueror either rebuilt, or much repaired, the whole edifice, and bestowed it on Baldwin de Briono, husband of Albreda his niece, whose descendants, by the female line, enjoyed it, together with the office of sheriff of Devon, which seems to have been annexed to it, till the fourteenth year of Henry III.'s reign, when that prince, resuming into his own hands sundry castles and forts in this realm, dispossessed Robert de Courtney, in whose family it had been for three descents. In the civil war of the seventeenth century the castle was completely ruined, when the city withstood a blockade of two months against Fairfax, one of whose forts, Mr. Gough says, still remains in a field to the north. Within the area inclosed by the walls, a small chapel was erected by lady Elizabeth de Fortibus, countess of Devon, who endowed it with lands, called the prebends of Hays and Catton, for the payment of certain weekly services therein to be performed. A sessions-house, of Portland-stone, has been recently built within the area on the north-west side.

Within the walls of the city are fifteen parish churches, and in the suburbs four; but most of them being small, they present nothing worthy of particular description.

The cathedral is a large interesting edifice, and, according to Hooker and some other writers, was five hundred years in building; it consists of a nave with two aisles, a choir with aisles, a north and south transept, which are terminated by lofty towers. On the south side was a large cloister, which is mostly destroyed. To the east of this is the bishop's palace, which, with its gardens, are inclosed within a lofty wall. For a particular history and description with several architectural points, see a large folio work published by the Society of Antiquaries.

The episcopal see of Devon was seated at Crediton previous to its establishment at Exeter; but Leofric, who was bishop of that see, and lord chancellor of England, prevailed on Edward the Confessor to remove it to the latter town in the year 1049. That monarch, in person, with Eadyga, his queen, attended the installation, and placed the bishop in his new see; which at the same time he endowed with the lands and emoluments appertaining to that of Crediton. The see being thus established, it appears probable that a suitable cathedral was soon afterwards erected: but whether it was constructed by the enlargement and alteration of some existing edifice, or whether a separate and entire building was now raised, is uncertain. "It seems not unlikely," observes sir Henry Englefield, "that the first cathedral was not more than about sixty feet in length, and occupied the site of the present chapel of St. Mary." That the chapel, in its present state, was not the Saxon church, is satisfactorily proved by an examination of its architecture. No particular alteration appears to have been made in the cathedral before the time of William Warlewast, the third bishop, who was a Norman, and had been chaplain to the Conqueror, and his two sons, William and Henry; the latter of whom inducted him to this see in 1107. This prelate was a liberal benefactor to his cathedral; and it appears that he considerably enlarged it, and laid the foundation of the present choir: to him the towers yet remaining are probably to be ascribed; they are perfectly similar in style to the buildings of Gundulphus his cotemporary, and bear much more resemblanee to the magnificence of the Norman architects, than to the simplicity of the English Saxons.

Exeter has been from time immemorial, and still is, invested with great privileges. At the period of the Norman survey it enjoyed the same exemption from taxes as London, York, and Winchester. Since that time it has obtained many charters, and grants of immunities, from several monarchs. In the reign of Henry I. the fee-farm rents were granted to Matilda his queen; and in king John's time, Isabel, his consort, held Exeter in dower, with a fair thereunto belonging. In the third year of John's reign, the burgesses paid a fine of 110 marks for a confirmation of their charters; and about this period the city, which had been previously governed by port-reves and bailiffs, was incorporated, and had a mayor for its chief officer. We find in the Notitia Parliamentaria, that "in the reign of Edward I. the burgesses and citizens pleaded that their city was an ancient demesne, and that they held it in fee-farm of the crown, paying 39*l.* 15*s.* 3*d.* To support this claim, they referred to Henry III.'s charter, made to his brother Richard, king of the Romans; whereby they further challenged return of writs, a gallows, pillory, &c. and a fair of four days, besides three weekly markets; which liberties they certified they enjoyed since the time of the conquest; upon which they were allowed." Henry VIII. constituted

conſtituted Exeter a county of itſelf; thus rendering it independent of Devon, and inveſting it with correſponding privileges.

The corporation now conſiſts of a mayor, twenty-four aldermen, a recorder, chamberlain, town-clerk, ſheriff, four ſtewards, and ſeveral inferior officers. The corporate bodies within the city are thirteen, each of which is governed by officers annually choſen from among themſelves. Exeter was one of the firſt cities that returned members to parliament: the right of election is veſted in the magiſtrates and freemen, who are ſuppoſed to amount to about one thouſand perſons. The trade of Exeter is extenſive; yet would probably have been much more ſo, but for a contention between the inhabitants and Hugh Courtenay, earl of Devon, which deprived the city of the uſe of its river for navigable purpoſes during ſeveral centuries. The diſpute is reported by Izacke to have ariſen about ſome pots of fiſh; which, being expoſed for ſale in the market place, were ſeen nearly at the ſame time by the cators of the earl, and of the biſhop of Exeter, both of whom wanted the whole. The mayor, to whom the difference was referred, adjudged one part to the earl, another to the biſhop, and the third he directed to be kept for the uſe of the market. This deciſion, and a ſubſequent determination of the mayor and council, that no freeman of Exeter ſhould wear any foreigner's livery, badge, or cognizance without the mayor's licence, offended the earl, who immediately impeded the navigation of the river, "ſtopping, filling, and quirting the ſame," ſays Hooker, "with great trees, timber, and ſtones, in ſuch ſort, that no veſſel, or veſſels, could paſſe or repaſſe." Previouſly to this occurrence the tides flowed beyond the city; but now they only reach Topſham, a town between three or four miles nearer the ſea, the advantage of which was probably the chief object of the earl's meaſures, as that place was part of his eſtate, and became exceedingly flouriſhing in conſequence. The river was ſo completely choaked up, that though many attempts were made to reſtore the navigation, ſcarcely any thing was accompliſhed till the year 1675, when a canal was cut from Topſham to the city; and about twenty years afterwards the preſent haven was conſtructed: and by means of ſluices and flood-gates, veſſels of 150 tons burthen are now admitted to a good quay, formed near the city walls.

Exeter is ſituated 170 miles W. from London. The number of inhabitants, as returned under the late act, was 17,388; of houſes 2836. The principal employ of the labouring claſſes of people ariſes from the woollen trade; and the city has derived immenſe profits from the exportation of ſerge, kerſeys, and other articles, the value of which together has been computed at the average ſum of 600,000*l. per annum*: the chief markets were, during peace, Spain, Portugal, Germany, and Italy. About 300 perſons are alſo employed in manufacturing cotton, at a large factory eſtabliſhed on the banks of the river. Exeter had anciently a mint, which was granted by king Athelſtan; and money has been coined here ſo late as the reign of William III., the place of coinage being denoted by the letter E under the buſt.

This city has been the birth place of ſeveral very eminent and learned men. Among the moſt diſtinguiſhed are, Joſephus Iſcanus, whoſe writings adorned the commencement of the thirteenth century: John Hooker, ſir William Petre, and ſir Thomas Bodley, who all flouriſhed in the ſixteenth century; and ſir Peter, afterwards lord King, who held the high office of lord chancellor from 1725 to 1733.

In the vicinity of Exeter are ſeveral handſome, and reſpectable ſeats, belonging to the nobility and gentry. The principal of theſe are, Powderham-caſtle, belonging to viſcount Courtney; Mamhead, the ſeat of lord Liſburne; Haldon-houſe, the ſeat of ſir Lawrence Palk, &c.; Mount-Radford, the ſeat of John Baring, eſq.; Peamore, the ſeat of Samuel Kekewich, eſq.; Cleve, the ſeat of Thomas Northmore, eſq.; Cowicke, the ſeat of James White, eſq.; Oxton-houſe, the ſeat of the Rev. John Swete. Polwhele's Hiſtory of Devonſhire, 8vo. Jenkins's Hiſtory and Antiquities of Exeter, 12mo. 1806.

Exeter, a poſt-town of America, in the county of Rockingham and ſtate of New Hampſhire, and, Portſmouth excepted, the moſt conſiderable ſea port town in the ſtate. It is ſituated on the head of the navigation on Swamſcot, or Exeter river, a branch of the Piſcataqua, 15 miles S.W. of Portſmouth. The tide riſes here eleven feet. This town is well ſituated for manufactures, and has already ſix ſaw mills, a fulling mill, ſlitting mill, paper mill, ſnuff mill, two chocolate and ten griſt mills, iron-works, and two printing offices. The ſadlery buſineſs is very conſiderable. Some few veſſels of different burden are built here, and the river is capable of floating thoſe of 500 tons. The ſituation of Exeter is adapted for an extenſive population. The public edifices are, two congregational churches, an elegant building appropriated to the academy, a handſome and capacious court-houſe, and a gaol The public offices of the ſtate are at preſent kept in this place. It contains 1727 inhabitants. The townſhip is of an irregular figure, and about four miles ſquare. It was incorporated in 1638, before which period it was called Swamſcot falls; it lies 50 miles N. of Boſton. N. lat. 42° 59′. W. long. 71°. The academy was founded and endowed by the Hon. John Phillips, L.L.D. of Exeter, and incorporated by act of aſſembly in 1781. It is ſaid to be a reſpectable inſtitution, under the inſpection of a board of truſtees, and the immediate government and inſtruction of a preceptor and an aſſiſtant. Its annual income is 480*l.* and the number of ſtudents is commonly between 60 and 80. In 1794 a building was erected, which, in point of convenience, and perhaps of elegance, is exceeded by few buildings of the kind in the United States. Morſe.

Exeter, the north-weſternmoſt townſhip in Waſhington county, and ſtate of Rhode iſland, in which the ſeveral branches of Wood river unite; containing 2476 inhabitants, of whom 24 are ſlaves.—Alſo, a townſhip in Luzern county, Pennſylvania, including 737 inhabitants.—Alſo, a town in New Hanover county, in Wilmington diſtrict, North Carolina; ſituated on the N.E. branch of Cape Fear, about 36 miles from Wilmington.

EXFOLIATION. This term, in *Surgery*, denotes the proceſs by which the dead part of a bone ſeparates from the living portion. It is alſo not uncommon for ſurgeons to ſignify, by the word *exfoliation*, the piece of bone itſelf that has periſhed, though this is certainly an abuſe of language.

Exfoliation, or the ſeparation of a dead portion of bone from the living, is effected much in the ſame way as a ſlough is thrown off from the ſoft parts. The piece of bone which has periſhed is not detached by becoming rotten; for, in fact, it poſſeſſes conſiderable firmneſs, and at firſt coheres as intimately as ever to the living bone immediately contiguous to it. As Mr. Hunter has accurately obſerved, if the proceſs of exfoliation were not to take place, the dead piece of bone would remain undetached for years, inaſmuch as putrefaction is concerned in producing the ſeparation.

The more the pathologiſt conſiders the diſeaſes of the bones

bones, the more he will find them refemble thofe of the foft parts. This fact, indeed, anatomy would lead one to infer, fince the texture of the bones is the more fimilar to the ftructure of the reft of the body, than an uninformed perfon would fuppofe. The chief difference is, that the bones contain lime, which the foft parts do not.

Mr. Hunter defcribes the procefs of exfoliation as follows; a dead bone (he fays) acts on the fyftem in the fame manner as any other extraneous body. It ftimulates the adjacent living parts, in confequence of which fuch a procefs is begun, as muft end in the dead piece being thrown off. The effects of this ftimulus are; firft, that the living adjacent bone becomes more vafcular, a circumftance which always takes place, when a part has more to do than is juft fufficient for the fupport of life. Secondly, that the earth of the living part, when it is in contact with the dead bone, is abforbed. Hence the bone becomes fofter, and is now only adherent by the animal matter in its texture. Thirdly, that the living animal part is at laft abforbed along the furfaces of contact. This part of the procefs begins long before the laft is finifhed. Both of them begin firft at the furface, though, in their courfe, they do not every where take place, in an equal degree, at the fame time. Fourthly, that, in proportion to the wafte made by the laft part of the procefs, a fungus arifes from the living furface, and fills up the intermediate fpace, fo as to prevent a vacuum. Mr. Hunter obferves, that thefe different ftages, taken together, conftitute ulceration. He remarks, that when any part of a bone is once loofe, it will be pufhed towards the furface of the body, as moft other inanimate fubftances are. This part of the procefs is partly mechanical, and partly a continuation of ulceration. The fame diftinguifhed furgical writer alfo notices, that a proof of the third ftage above mentioned, may be derived from certain cafes, in which people die while exfoliation is going on. A fmall groove, or worm-eaten canal, may then be difcovered, which becomes gradually deeper, and follows the irregularities of the dead and living furfaces. After the application of the trepan, a circular piece of bone is frequently thrown off, which is always lefs than the fpace from which it came. This, fays Mr. Hunter, could never be the cafe, if there were not a lofs of fubftance.

Thus we find that exfoliation, and the procefs by which a flough of the foft parts is detached, are nearly alike. In both inftances, the matter which forms the bond of connection between the dead and living fubftances, is abforbed, the dead part is loofened, and is next pufhed off by the rifing of the granulations.

The bones, on which exfoliations moft frequently occur, are fuch as are of a firm, folid ftructure; thofe which are of a fpongy cellular texture, are more fubject to the affection called caries.

All the old furgical practitioners and writers ufed to promulgate the doctrine, that whenever the furface of a bone was laid bare, and deprived of its periofteum, an exfoliation muft inevitably follow. The practice, which was reforted to in confequence of this notion, did really, for the moft part, occafion a deftruction of a part of the bone, and the progrefs of the cafe feemed a confirmation of the erroneous opinion, refting on experience itfelf for its foundation. For it followed almoft as a matter of courfe with the ancient furgeons that fince they confidered the occurrence of exfoliation unavoidable in the circumftance which we have mentioned, their grand aim was to promote and accelerate the procefs, fo as to fhorten, as they conceived, the duration of the cafe. With this view, they ufed to put on the uncovered part of the bone ftimulating, drying, fpirituous applications, and, very often, the actual and potential cautery. Alfo, fancying that the wound could never heal till the dead piece of bone had come away, they ufed to avoid laying down the flefh, fo as not to leave the furface of the bone a long while expofed, a caufe, of itfelf, quite adequate to the production of an exfoliation.

However, the fact is, that a mere temporary expofure of part of a bone, fuch a tranfient denudation, as need only be permitted in cafes of wounds, is not neceffarily, or even commonly followed by an exfoliation, when a proper method of treatment is purfued.

We have already remarked that the difeafes of the bones are more like thofe of the foft parts, than many would imagine. The expofed furface of a bone will not die, if it be otherwife free from injury, and the furgeon, immediately he is called, take care to lay down the detached flefh in the fituation which it previoufly occupied. Even when the denuded bone, on account of lofs of fubftance, cannot be directly covered again, it will not always exfoliate, provided the furgeon, inftead of ufing the cautery, cauftics, fpirituous, or any other irritating applications, applies only fome plain foft lint, or a pledget of any mild fimple ointment.

When the foft parts are merely divided, the expofed furface will not flough; but when the wound is complicated, with a violent degree of contufion, laceration, &c. the cafe is different, and the fibres, veffels, &c. moft injured, will die and be thrown off. Thefe parts may either be killed at once by the violence, or the mifchief which they have fuftained may give rife to inflammation, which may terminate in floughing. Things are nearly the fame with refpect to the bones. We will bring to our confideration a few circumftances relating to the fubject of wounds of the head, which are, perhaps, more frequently than any other kind of wounds followed by exfoliations. In thefe inftances, if the foft parts be fimply cut, fo as to occafion an expofure of the cranium, without the bone itfelf being violently contufed, the wound may be healed by the firft intention, and no part of the fkull will exfoliate. The fame occurrences may happen, together with a detachment of the pericranium, and yet the fame confequences will follow.

However, when the external violence has affected the bone, as well as the foft parts, the injured part of the fkull will frequently die and exfoliate, notwithftanding the moft judicious treatment.

The procefs by which an exfoliating piece of bone is thrown off, depends almoft entirely upon nature, and the furgeon can interfere very little, with any real utility. The milder and lefs irritating his dreffings are, the better. Sometimes, when the dead part of the bone is loofe, but is fo covered with flefh that it cannot come away, the practitioner may greatly expedite the cure, by making a proper opening for the removal of the piece of bone that has exfoliated. Sometimes, when the procefs of exfoliation is long and tedious, he may render effential aid by occafionally introducing a pair of fmall forceps into fome finus leading down to the affected bone, and moving the exfoliating portion a little every now and then, fo as to accelerate its feparation. This latter proceeding, it is obvious, is only admiffible when the opening in the foft parts is large enough, and when the dead piece of bone either projects, or is of fuch a fhape as will allow of its being taken hold of with a pair of forceps. Sometimes, when the dead piece of bone is prevented from exfoliating, by being overlapped by new offeous matter at its circumference, the furgeon may properly make fome attempt to cut away the portion which is fo wedged, that its fpontaneous detachment would require an unreafonable length of time. Endeavours of this kind, however, on the part

part of the surgeon, should be made with great circumspection and prudence; and, indeed, they can only be justifiable when the affected bone is sufficiently superficial.

EXFOLIATIVUM, from *exfolio, to shed the leaf*, an instrument for scraping exfoliating bones.

EXFREDIARE, in our *Old Writers*, denotes the breaking of the peace, or committing open violence. Leg. Hen. I. cap. 31.

The word is formed from the Saxon, *frede, peace*.

EX GRAVI QUERELA, in *Law*, a writ that lies for him to whom any lands or tenements in fee are devised by will (within any city, town, or borough, wherein lands are deviseable by custom), and the heir of the devisor enters, and detains them from him. (Reg. Orig. 244. Old Nat. Br. 87.) And if a man devises such lands or tenements unto another in tail, with remainder over in fee, if the tenant in tail enter, and is seised by force of the intail, and afterwards dieth without issue, he in the remainder shall have the writ, ex gravi querela, to execute that devise. (New Nat. Br. 441.) Also where a tenant in tail dies without issue of his body, the heir of the donor, or he who hath the reversion of the land, shall have this writ in the nature of a *formedon in the reverter*. Ibid.

If a devisor's heir be ousted by the devisee, by entry on the lands, he may not afterwards have this writ, but is to have his remedy by the ordinary course of the common law. (Co. Litt. 111.) If the claimant's title accrues within 20 years, the most eligible method of proceeding, is now by *ejectment*; which see.

EXHÆREDATIO. See EXHEREDATION.

EXHALATION, a fume or steam exhaling or issuing from a body, and diffusing itself in the atmosphere.

The terms exhalation and vapour are ordinarily used indifferently, but the more accurate writers distinguish them; appropriating the term vapour to the moist fumes raised from water and other liquid bodies; and exhalation to the dry ones emitted from solid bodies, as earth, fire, minerals, sulphurs, salts, &c. In this sense, exhalations are dry subtile corpuscules, or effluvia, loosened from hard terrestrial bodies, either by the heat of the sun, or the agitation of the air, or some other cause, and emitted upwards to a certain height of the atmosphere, where, mixing with the vapours, they help to constitute clouds, and return back again into dews, mists, rains, &c.

Sir Isaac Newton takes true and permanent air to be formed from the exhalations raised from the hardest and most compact bodies. See AIR, DAMP, EVAPORATION, and VAPOUR.

EXHAUSTED RECEIVER, a glass, or other vessel, applied on the plate of an air-pump, and having the air extracted out of it by the working of the engine. (See AIR-*pump*.) Things placed in an exhausted receiver, are said to be *in vacuo*. See VACUUM.

EXHAUSTIONS, in *Mathematics*. Method of exhaustions is a way of proving the equality of two magnitudes, by a *reductio ad absurdum*; shewing, that if one be supposed either greater or less than the other, there will arise a contradiction. The method of exhaustions was of frequent use among the ancient mathematicians, as Euclid, Archimedes, &c. It is founded on what Euclid says in his tenth book, *viz.* that those quantities whose difference is less than any assignable quantity, are equal; for if they were unequal, be the difference ever so small, yet it may be so multiplied, as to become greater than either of them; if not so, then it is really nothing.

This he assumes in the proof of prop. I. book X. which imports, that if, from the greater of two quantities you take more than its half, and from the remainder more than its half, and so continually, there will, at length, remain a quantity less than either of those proposed.

On this foundation it is demonstrated, that if a regular polygon of infinite sides be inscribed in or circumscribed about a circle, the space, which is the difference between the circle and the polygon, will by degrees be quite exhausted and the circle become equal to the polygon.

EXHEBENUM, in *Natural History*, the name of a white and smooth stone, used by the ancient artificers in polishing gold. It seems to be the same with the lapis Samius, a small smooth stone which they often found in the Samian earth.

EXHEREDATION, EXHÆREDATIO, in the *Civil Law*, with us ordinarily called disinheriting, is the father's excluding his son from inheriting his estate.

There are fourteen causes of exheredation expressed in Justinian's Novel; without some one of which causes, he decrees the exheredation null, and the testament inofficious, as the civilians call it.

Indeed, by the ancient Roman law, the father might pronounce exheredation without any cause; but the rigour of this law was restrained and moderated by Justinian.

EXHIBIT, in *Law*. When a deed, acquittance, or other writing is, in a chancery suit, exhibited, to be proved by witness, and the examiner writes on the back, that it was shewed to the witness at the time of his examination; this is called an exhibit.

EXHIBITION, a producing or shewing of titles, authorities, and other proofs of a matter in contest.

Anciently, they used the phrase, exhibition of a tragedy, comedy, or the like; but now we say representation in lieu thereof.

EXHIBITION, *Exhibitio*, in our *Old Writers*, is used for an allowance of meat and drink, such as was customary among the religious appropriators of churches, who usually made it to the depending vicar. The benefactions settled for the maintaining of scholars in the universities, not depending on the foundation, are also called exhibitions.

EXHORTATION, HORTATIO, in *Rhetoric*, differs only from *suasion*, in that the latter principally endeavours to convince the understanding, and the former to work on the affections.

EXHUMATION, of *ex, out of*, and *humus, ground*, the act of digging up a body interred in holy ground, by the authority of the judge.

In France, the exhumation of a dead body is ordered, upon proof that he was killed in a duel. By the French laws, a parson has a right to demand the exhumation of the body of one of his parishioners, when interred out of the parish without his consent.

EXIDEUIL, in *Geography*, a town of France, in the department of Dordogne, and chief place of a canton, in the district of Perigueux; 18 miles N. E. of Perigueux. The place contains 870, and the canton 8378 inhabitants, in 15 communes, and on a territorial extent of 190 kiliometres.

EXIGENCE, or EXIGENCY, that which a thing requires, or which is expedient and suitable thereto.

EXIGENT, or EXIGI FACIAS, in *Law*, a writ which lies where the defendant, in a personal action, cannot be found, nor any thing of his within the county, whereby to be attached, or distrained. It is directed to the sheriff, ordering him to proclaim and call the party five county-court days successively, and charge him to appear, under pain of outlawry.

The

The fame writ alfo lies in an indictment of felony, where the party indicted cannot be found.

It is called an exigent, becaufe it exigit, *i. e.* exacts, or requires the party to appear, or, by forthcoming, to anfwer the law. If he appear not at the laft day's proclamation, he is faid to be *quinquies*, or *quinto exactus*, and then is outlawed. See OUTLAWRY.

EXIGENTERS, four officers of the court of common pleas, who make all exigents and proclamations, in all actions where the procefs of outlawry lies.

Anciently, the making writs of *fuperfedeas* upon fuch exigents as paffed in their offices, did likewife belong to them; but this branch of bufinefs was taken from them under king James I. and committed to a particular officer in the court of common pleas, created by patent. See SUPERSEDEAS.

EXILE, BANISHMENT. See BANISHMENT.

Among the Romans, the word exile, *exilium*, properly fignified an interdiction or exclufion from water and fire; the neceffary confequence of which was, that the interdicted perfon muft betake himfelf into fome other country, fince there was no living without fire and water. Thus Cicero ad Herenn. obferves, that the form of the fentence did not exprefs exile, but only *aquæ & ignis interdictio*. See INTERDICTION.

The fame author remarks, that exile was not properly a punifhment, but a voluntary flying, or avoiding the punifhment decreed: "Exilium non effe fupplicium, fed perfugium, portufque fupplicii." Pro Cæcina.

He adds, that there was no crime among the Romans, as among other nations, punifhed with exile; but exile was a recourfe people flew voluntarily to, in order to avoid chains, ignominy, ftarving, &c.

The Athenians frequently fent their generals, and great men into exile, out of envy of their merits, or diftruft of their too great authority.

EXILE is fometimes alfo ufed for the relegating a perfon into a place, whence he is obliged not to ftir without leave.

The word is derived from the Latin *exilium*, or from *exul*, a banifhed perfon; and that, probably, from *extra folum*, out of his native foil.

Figuratively, we ufe the phrafe, *honourable exile*, for an office, or employment, which obliges a man to refide in fome remote or difagreeable place.

Under the reign of Tiberius, remote employments were a kind of myfterious exiles. A bifhopric, or even a lord-lieutenancy, in Ireland, has been fometimes deemed a kind of exile. A refidence, or embaffy, in fome barbarous country, is alfo a fort of exile. Accordingly, it is faid, that the king cannot even conftitute a man deputy, or lord-lieutenant of Ireland, nor make one a foreign ambaffador againft his will, fince thefe in reality might be no more than honourable exiles. 2 Inft. 46.

EXILES, in *Geography*, a town of France, in the department of the Po, on the river Doria; 5 miles W. S. W. of Sufa. This town was fortified, and guarded one of the paffes into Piedmont; but by the treaty of peace between the French republic and the king of Sardinia, in 1796, the fortifications were to be razed.

EXILIUM, in *Law*, fignifies a fpoiling; and, by the ftatute of Marlbridge, it feems to extend to the injury done to tenants, by altering their tenure, ejecting them, &c. And this is the fenfe that Fleta determines; who diftinguifhes between vaftum, deftructio, and exilium. For he tells us, that vaftum and deftructio are almoft the fame, and are properly applied to houfes, gardens, or woods; but exilium is when fervants are enfranchifed, and afterwards unlawfully turned out of their tenements. Flet. lib. i. cap. 11. Stat. Marlb. cap. 25.

EXIMA, in *Geography*, a tribe or kabyle in the province of Sufa, in the fouthern divifion of Morocco; amounting to about 11,000 perfons.

EXIMENO, ANTONIO, in *Biography*, a Spanifh Ex-Jefuit, who had refided at Rome many years, and publifhed in that city, in 4to. 1744, a work, intitled "Dell' Origene e della Regole della Mufica," in which, too confident of his own powers, he imagined himfelf capable, with four years ftudy only, intuitively to frame a better fyftem of counterpoint than that upon which fo many great muficians had been formed. Poffeffed of eloquence, fire, and a lively imagination, his book has been called in Italy, "a whimfical romance upon the art of mufic, in which is difcovered a rage for pulling down, without the power of rebuilding." The author has certainly, with fhrewdnefs and accuracy, ftarted feveral difficulties, and pointed out imperfections in the theory and practice of mufic, as well as in the particular fyftems of Tartini and Rameau; but his own refources and experience are totally infufficient to the tafk of correcting the errors of the old fyftem, or forming a new one that is more perfect. He has more eloquence of language than fcience in mufic. His reafoning is ingenious and fpecious, even when his data are falfe; but his examples of compofition are below contempt; and yet, they are courageoufly given as models for ftudents, fuperior to thofe of the old great mafters of harmony.

When Sig. Eximeno calls fugues and canons Gothic compofitions, he does not difgrace their ftructure any more than he would our cathedrals, by calling them Gothic buildings. Let fugues be banifhed from the theatres and private concerts, if he pleafes, and let them remain in the church as a diftinct fpecies of compofition, where they were firft generated, and where they can never become vulgar or obfolete. The ftyle being naturally grave, requires mufical learning, and will, by the folemnity of the words and place of performance, continue to be reverenced and refpected. It is allowed that variety is more wanted in mufic than in any other art, and by totally excommunicating canons and fugues from the church, the art will lofe one capital fource of variety, as well as ingenuity; and intelligent hearers will be deprived of a folemn ftyle of mufic, to be heard no where elfe.

EXINANITION, the fame as evacuation.

EXISTENCE, that whereby a thing has an actual effence, or is faid *to be*, *effe*.

The notion of exiftence is applicable not only to a created but an uncreated fubftance: but it muft be added, that the exiftence of created fubftances, and efpecially corporeal ones, implies a refpect to place, time, and even an efficient caufe; whence the fchoolmen generally define it, that whereby a thing is formally and extrinfically without [*extra*] its caufes, and that here, and now.

Exiftence and effence come very near the nature of each other; in effect, they only differ in that we have different manners of conceiving the fame thing.

For, 1. Effence is ufually explained either by the firft, nobleft, and radical attribute of the thing, *e. gr.* that of body, by extenfion; that of mind by thinking, &c. or by fpecifying all the intrinfic attributes; and exiftence, either by fpecifying all place and all time, as in that of God; or by fpecifying fome definite place, and time, together with the caufe, as in the creatures.

2. The foundation and occafion of this diftinction is this

this; that eſſence belongs to the queſtion, *What is it? Quid eſt?* but exiſtence to the queſtion, *Is it? An eſt?*

3. Exiſtence, neceſſarily pre-ſuppoſes eſſence, and cannot be conceived without it; but eſſence may be conceived without exiſtence; in that eſſence belongs equally to things that are in *potentia*, and *in actu;* but exiſtence only to thoſe *in actu.* Note, however, that this does not obtain in God, about whoſe nature and eſſence the mind cannot think without conceiving his exiſtence.

We have divers ways of arriving at the knowledge of the exiſtence of things. Our own exiſtence we know by intuition; the exiſtence of a God, by demonſtration; and that of other things, by ſenſation.

As for our own exiſtence, we perceive it ſo plainly, that it neither needs, nor is it capable of any proof. In every act of ſenſation, reaſoning, or thinking, we are conſcious to ourſelves of our own being, and in this matter come not ſhort of the higheſt degree of certainty.

As to our knowledge of the exiſtence of a God, though he has given us no innate ideas of himſelf, yet, having furniſhed us with faculties of ſenſe, perception, and reaſon, we can never want a clear proof thereof. See God.

The knowledge of the exiſtence of other things, *i. e.* of external objects, bodies, a world, &c. we only have by ſenſation; for there being no neceſſary connection of real exiſtence with any idea a man hath in his memory, nor of any other exiſtence but that of God, with the exiſtence of any particular man; no particular man can know the exiſtence of any other being, but only when, by actually operating upon him, it makes itſelf be perceived by him. The having the idea of any thing in our mind, no more proves the exiſtence of that thing than the picture of a man evidences his being in the world, or the viſions of a dream make a true ſtory. It is, therefore, the actual receiving of ideas from without that gives us notice of the exiſtence of other things, and makes us know that ſomething doth exiſt at that time without us, which cauſes that idea in us, though we neither know nor conſider how it doth it.

This notice which we have by our ſenſes, of the exiſtence of things without us, though it be not altogether ſo certain as intuition and demonſtration, yet deſerves the name of knowledge, if we perſuade ourſelves that our faculties act and inform us right concerning the exiſtence of thoſe objects that affect them.

Now, beſides the aſſurance of our ſenſes themſelves, that they do not err in the information they give us of the exiſtence of things without us, we have other concurrent reaſons, as, 1. It is plain thoſe perceptions are produced in us by exterior cauſes affecting our ſenſes; becauſe thoſe that want the organs of any ſenſe never have the ideas belonging to that ſenſe produced in their minds. 2. Becauſe we find we cannot avoid having thoſe ideas, produced in our minds. When our eyes are ſhut, we can at pleaſure recal to our mind the ideas of light or the ſun, which former ſenſations had lodged in our memories; but if we turn our eyes towards the ſun, we cannot avoid the idea which the light or the ſun then produces in us, which ſhews a manifeſt difference between thoſe ideas laid up in the memory, and ſuch as force themſelves upon us, and we cannot avoid having; beſides, there is no one who doth not perceive the difference in himſelf between actually looking upon the ſun, and contemplating the idea he has of it in his memory; and therefore he hath certain knowledge, that they are not both memory or fancy. 3. Add to this, that many ideas are produced in us with pain, which we afterwards remember without the leaſt offence; thus, the pain of heat or cold, when the idea of it is received in our mind, gives us no diſturbance, which, when felt, was very troubleſome; and we remember the pain of hunger, thirſt, head ach, &c. without any pain at all, which would either never diſturb us, or elſe conſtantly do it, as often as we thought of it, were there nothing more but ideas floating in our minds, and appearances entertaining our fancies, without the real exiſtence of things affecting us from abroad. 4. Our ſenſes, in many caſes, bear witneſs to the truth of each other's report concerning the exiſtence of ſenſible things without us: he that doubts, when he ſees a fire, whether it be real, may feel it too if he pleaſes; and, by the exquiſite pain, may be convinced, that it is not a bare idea or phantom. Such is Mr. Locke's demonſtration of the exiſtence of external bodies.

The ingenious Dr. Berkeley has a different ſyſtem: external bodies, he contends, have no exiſtence, but in a mind perceiving them; that is, they only exiſt, *quatenus,* they are perceived; and of this he has given us what he and ſeveral others account a demonſtration.

In reality, "that neither our thoughts, paſſions, nor ideas formed by the imagination, exiſt without the mind, he obſerves, is allowed; and that the various ſenſations impreſſed on the mind, whatever objects they compoſe, cannot exiſt otherwiſe than in a mind perceiving them, is not leſs evident. This appears from the meaning of the term exiſt, when applied to ſenſible things. Thus, the table I write on, exiſts, *i. e.* I ſee and feel it; and were I out of my ſtudy, I ſhould ſay it exiſted; *i. e.* that were I in my ſtudy I ſhould ſee and feel it as before. There was an odour; *i. e.* I ſmelt it, &c. but the exiſtence of unthinking beings, without any relation to their being perceived, is unintelligible, their *eſſe* is *percipi.*" The notion of bodies, he endeavours to ſhew, is founded on the doctrine of abſtract ideas: "What are light and colours, heat and cold, extenſion and figure; in a word, the things we ſee and feel, but ſo many ſenſations, notions, ideas, or impreſſions on the ſenſe? And is it poſſible to ſeparate, even in thought, any of theſe from perception? The ſeveral bodies, then, that compoſe the frame of the world, have not any ſubſiſtence without a mind: their *eſſe* is to be perceived or known; and as long as they are not perceived by me, nor any other thinking being, they have no ſhadow of exiſtence at all. The things we perceive are colour, figure, motion, &c. that is, the idea of thoſe things; but has an idea any exiſtence out of the mind? To have an idea is the ſame thing as to perceive; that, therefore, wherein colour, figure, &c. exiſt, muſt perceive them. It is evident, therefore, there can be no unthinking ſubſtance or ſubſtratum of thoſe ideas: but you may argue, if the ideas themſelves do not exiſt without the mind, there may be things like them, whereof they are copies or reſemblances, which exiſt without the mind; it is anſwered, an idea can be like nothing but an idea; a colour or figure can be like nothing elſe but another figure or colour. It may be farther aſked, whether thoſe ſuppoſed originals, or external things, whereof our ideas are the pictures, be themſelves perceivable or not? If they be, they are ideas; if they be not, I appeal to any one, whether it be ſenſe to ſay, a colour is like ſomewhat which is inviſible; hard or ſoft, like ſomewhat intangible, &c. Some diſtinguiſh between primary and ſecondary qualities; the former, *viz.* extenſion, ſolidity, figure, motion, reſt, and number, they maintain have a real exiſtence out of the mind; as for the latter, under which come all other ſenſible qualities, as colours, ſounds, taſtes, &c. they allow the ideas we have of them are not reſemblances of any things exiſting exifting without the mind, or unperceived, but depend on the fize, texture, motion, &c. of the minute particles of matter. Now, it is certain, that thofe primary qualities are infeparably united with the other fecondary ones, and cannot even in thought be abftracted from them, and therefore muft only exift in the mind. Can any man conceive the extenfion and motion of a body without its other fenfible qualities? For my part, I find it impoffible to frame an idea of a body extended and moving, without giving it fome colour, &c. In effect, extenfion, figure, and motion, abftracted from all other qualities, are inconceivable; where the others, therefore, are, there thefe too muft be, *i. e.* in the mind, and no where elfe. Again, great and fmall, fwift and flow, are allowed to exift no where without the mind, being merely relative and changing, as the frame or pofition of the organ changes: the extenfion, therefore, that exifts without the mind, is neither great nor fmall, the motion neither fwift nor flow; *i. e.* they are nothing. That number is a creature of the mind, is plain (even though the other qualities were allowed to exift) from this; that the fame thing bears a different denomination of number, as the mind views it with different afpects; thus, the fame extenfion is 1, or 3, or 36, as the mind confiders it, with reference to a yard, a foot, or an inch. Nay, many of the modern geometricians hold, that a finite line may be divided into an infinite number of parts, and each of thefe infinitefimals, into an infinity of others; and fo on, *in infinitum*; fo that the fame thing is either unity or infinity, either no number or all number. In effect, after the fame manner as the modern philofophers prove colours, taftes, &c. to have no exiftence in matter, or without the mind; the fame thing may be proved of all fenfible qualities whatfoever: thus, they fay, heat and cold are only the affections of the mind, not at all patterns of real beings exifting in corporeal fubftances; becaufe the fame body which feems cold to one hand, feems warm to another. Now, why may we not as well argue, that figure and extenfion are not patterns or refemblances of qualities exifting in matter; becaufe to the fame eye, at different ftations, or to eyes of different ftructure, at the fame ftation, they appear various? Again, fweetnefs, it is proved, does not exift in the thing fapid, becaufe the thing remaining unaltered, the fweetnefs is changed to bitternefs, as in a fever, or by an otherwife vitiated palate. Is it not as reafonable to fay, that motion does not exift out of the mind? fince, if the fucceffion of ideas in the mind become fwifter, the motion, it is acknowledged, will appear flower, without any external alteration. Again, were it poffible for folid figured bodies to exift out of the mind, yet it were impoffible for us ever to know it: our fenfes, indeed, give us fenfation of ideas, but do not tell us that any things exift without the mind, or unperceived, like thofe which are perceived: this the materialifts allow. No other way therefore remains, but that we know them by reafon's inferring their exiftence from what is immediately perceived by fenfe. But how fhould reafon do this, when it is confeffed, there is not any neceffary connection between our fenfations and thefe bodies? It is evident, from the phenomena of dreams, phrenfies, &c. that we may be affected with the ideas we have now, though there were no bodies exifting without them; nor does the fuppofition of external bodies at all forward us, in conceiving how our ideas fhould come to be produced. The materialifts own themfelves unable to conceive in what manner body can act on fpirit, or how it fhould imprint any idea on the mind. To fuppofe, therefore, bodies exifting without the mind; is little elfe than to fuppofe God has created innumerable beings entirely ufelefs, and ferving to no purpofe at all. On the whole it appears, that the exiftence of bodies out of a mind perceiving them, is not only impoffible, and a contradiction in terms; but, were it poffible, nay real, it were impoffible we fhould ever know it. And again, that fuppofing that there are no fuch things, yet we fhould have the very fame reafon to fuppofe there were that we now have. Suppofe, *e. gr.* an intelligence affected with the fame train of fenfations, impreffed in the fame order, and with the fame vividnefs, would it not have all the reafon to believe the exiftence of bodies reprefented by his ideas that we have? All our ideas and fenfations are vifibly inactive; nay, the very being of an idea implies paffivenefs and inertnefs; fo that it is impoffible for an idea to do any thing, or, in ftrictnefs, be the caufe of any thing; it cannot, therefore, be the refemblance or pattern of any active being, unlefs oppofites can be faid to refemble one another. Now, we find a continual fucceffion of ideas of the mind; but thefe, it has been proved, do not depend on any external body as their caufe; it remains, therefore, that their caufe is an incorporeal active fubftance or fpirit: for that I am not the caufe of my own ideas, is plain from this, that when I open my eyes in broad day-light, I cannot help feeing various objects. Now, the fixed rules or methods wherein the mind we depend on excites in us the ideas of fenfe, are called *laws of nature*; thefe we learn by experience, which teaches us, that fuch and fuch ideas are attended with fuch and fuch other ideas in the ordinary courfe of things. Ideas are not any how, and at random, produced; there is a certain order and connection eftablifhed among them like that of caufe and effect; and there are feveral combinations of them made in a very regular artful manner, which we call *bodies*; and the fyftem of thofe, *the world*. In ftrictnefs, however, the connection of ideas does not imply the relation of caufe and effect, but only of a mark or fign of the thing fignified: the fire I fee is not the caufe of the pain I feel, but the mark that forewarns me of it; the noife I hear is not the effect of this or that motion or collifion of natural bodies, but the fign thereof. The Cartefians own fomewhat like this: the action of bodies on our organs, fay they, is not the efficient caufe of our ideas and perceptions, but only the occafional caufe, which determines God to act on the mind, according to the laws of the union of the foul and body." (See CAUSE.) Dr. Berkeley, indeed, taking away bodies, takes away what thefe philofophers account the occafions of their ideas: "by an occafion, he fays, muft either be meant the agent that produces an effect, or fomething obferved to accompany or go before it in the ordinary courfe of things; but matter is allowed to be paffive and inert, and cannot therefore be an agent or efficient caufe; and this matter primitively, and in itfelf, is allowed imperceivable, and devoid of all particular fenfible qualities; *i. e.* it has not this or that particular colour, this or that particular figure, &c. but has colour in the general, figure in the abftract, &c. but an abftract is no object of fenfe; matter, therefore, cannot be the occafion of our ideas in the latter fenfe." See Berkel. Princip. of Human Knowl. See ABSTRACTION.

How far the great argument of the maintainers of a material world from the impoffibility of God's deceiving us, and from the evidence that he does fo, if there be no fuch thing, will go againft this reafoning, we leave to the reader. See Stanl. Hift. Philofoph. part xii. p. 816. where the objections of the ancient Pyrrhonift to the exiftence of bodies are recited.

As to the exiftence of fpirits, Mr. Locke allows, that our having ideas of them does not make us know that any fuch things do exift without us; or that there are any finite fpirits, or any other fpiritual beings, but God. We have ground

ground from revelation, and feveral other reafons, to believe with affurance, that there are fuch creatures; but our fenfes, being not able to difcover them, we want the means of knowing their particular exiftence; for we can no more know that there are infinite fpirits really exifting by the idea we have of fuch beings, than by the ideas any one has of fairies or centaurs, he can come to know that things anfwering to thofe ideas do really exift.

EXIT, properly expreffes the departure of a player from off the ftage, when he has acted his part.

The word is alfo ufed in a figurative fenfe, to exprefs an kind of departure, even death.

EXITERIA, Εξιτήρια, in *Antiquity*, oblations or prayers to any of the gods for a profperous expedition or journey. There were alfo feafts under this denomination, which were celebrated by the Greeks, with facrifices and prayers, when their generals undertook expeditions againft any enemy.

EXITURA, from *exeo, to come from*, in *Surgery*, an abfcefs which difcharges matter.

EXITUS, Issues, in *Law*, the yearly rents or profits of lands or tenements. See Issue, &c.

EXLEGALITUS, the fame with an outlawed perfon. See Outlaw.

EXLUNZA, in *Geography*, a town of Spain, in the province of Leon; 5 miles S.E. of Leon.

EX MERO MOTU, in *Law*, formal words ufed in the king's charters and letters patent, fignifying that he does what is contained therein of his own will and motion, without petition or fuggeftion of any other.

The effect of thefe words is to bar all exceptions that might be taken to the inftrument, by alleging that the prince in paffing fuch charter was abufed by falfe fuggeftions.

EXMES, in *Geography*, a town of France, in the department of the Orne, and chief place of a canton in the diftrict of Argentan; 9 miles E. of Argentan. The place contains 618, and the canton 7358 inhabitants, in 31 communes, and on a territorial extent of $147\frac{1}{2}$ kiliometres.

EXMOUTH, though a watering place of confiderable fize and repute, is only a hamlet belonging to the parifh of Littleham, in the county of Devon, England. As its name imports, it ftands near the mouth of the river Exe. The buildings in general are low, but here are fome good houfes inhabited by genteel families. The vicinity is highly picturefque: from an eminence, called Chapel-hill, a line of coaft prefents itfelf, which extends from Exeter to Berry-head, a diftance of about twenty miles. This line is broken by feveral hills, behind which fpring up fome bold towering head-lands.

The plantations of Mamhead and Powderham-caftle heighten the beauty of the profpect; which is additionally embellifhed by the noble buildings connected with thofe eftates. Holinfhed mentions a caftle erected here to defend the entrance of the haven; and fome flight veftiges of embrafures are ftill apparent. Exmouth is fituated 168 miles W. from London; and contains, including the parifh of Littleham, 432 houfes, and 1909 inhabitants, of whom 570 are returned as employed in trade or manufacture. Polwhele's Devonfhire, vol. ii.

EXOACANTHA, in *Botany*, from εξακανθουμαι, *to be armed with fpines*; Mart. Mill. Dict. v. 2. Billard. Pl. Syr. fafc. 1. 10. Willd. Sp. Pl. v. 1. 1378. Clafs and order, *Pentandria Digynia*. Nat. Ord. *Umbellatæ*.

Gen. Ch. *General Umbel* of many fpreading rays; the inner ones gradually fhorter; the innermoft extremely fhort; *partial* of many rays. *General involucrum* moftly of 12 channelled leaves, with fpinous points; *partial* halved, its intermediate leaf very long, exactly like thofe of the general involucrum. *Perianth* fcarcely perceptible. *Cor.* uniform, of five equal, inflexed, heart-fhaped petals. *Stam.* Filaments five, longer than the corolla; anthers roundifh. *Pift.* Germen inferior, ovate; ftyles two, fhort, ftraight; ftigmas fimple. *Fruit* fomewhat ovate, ftriated, feparable into two parts. *Seeds* two, ovate, convex and ftriated on the outfide, flat on the inner.

1. E. *heterophylla*. Billard. Syr. fafc. 1. t. 2. Gathered by M. La Billardiere near Nazareth. *Root* biennial, tap-fhaped. *Stem* two feet, or more in height, flightly zig-zag, branched, round, ftriated, leafy, fmooth. *Leaves* pinnate, fmooth; leaflets one or two pair with an odd one; thofe of the radical leaves ovate, fharply ferrated, often cut; thofe of the ftem-leaves lanceolate, acute, narrow, entire, the odd ones very long. *Umbels* terminal, folitary, of about 40 rays; the partial ones of about as many, which are equal and crowded. The *involucral* leaves are very long, prominent, curved downwards, each ending in a fharp fpine. *Petals* white. *Anthers* yellowifh. This plant is a-kin to the *Echinophora*, (fee that article,) but differs generically in the want of a perianth, and in having all the flowers perfect and regular, with naked fruit, not imbedded in the involucrum.

EXOCARPUS, from εξ, *out of*, and καρπος, *a fruit*, becaufe the feed ftands naked at the top of a flefhy bafis or receptacle refembling a pulpy fruit. Billard. Voy. Engl. ed. v 1. 167. t. 14. Clafs and order, *Polygamia Monoecia*, or rather, perhaps, *Pentandria Monogynia*. Nat. Ord. *Terebintaceæ*, Juff.

Gen. Ch. *Cal.* Perianth inferior, in five deep roundifh, equal fegments. *Cor.* none. *Stam.* Filaments five, inferted into the calyx between its fegments: anthers fmall, roundifh. *Pift.* Germen fuperior, globular; ftyle, fhort, folitary; ftigma peltate, orbicular. *Peric.* none. *Seed* a roundifh nut, of one cell, ftanding on the top of an elliptical, hollow, flefhy *receptacle*, about thrice its own fize. Some flowers have an abortive germen, others have no ftamens, all on the fame plant.

Eff. Ch. Calyx inferior, in five deep fegments. Corolla none. Stamens five. Piftil one. Stigma peltate. Nut of one cell, ftanding on a hollow flefhy receptacle.

E. *cupreffiformis*, the only known fpecies, is an evergreen tree, found in New Holland by M. La Billardiere, as well as by Dr. White. It bears innumerable, compound, pendulous, angular, leaflefs *branches*, at whofe extremities are fituated the minute greenifh *flowers*, produced in the month of May. The *fruit* is red, not unlike that of the yew in fize, form, and colour, but the feed is perfectly expofed to view. This plant has been raifed from feed in England, but whether it ftill remains in the gardens we know not. Its fingularity entitles it to notice, and, we believe, it is by no means very tender, if not hardy enough to bear our winters in the open air.

EXOCATACŒLUS, in *Antiquity*, a general denomination, under which were included feveral grand officers of the church at Conftantinople; as, the grand œconomus, grand facellarius, grand mafter of the chapel, grand fceuophylax, or keeper of the veffels, grand chartophylax, the mafter of the little chapel, and the protecdicus, or firft advocate of the church.

There are many opinions with refpect to the etymology of this term. F. Goar apprehends, that all the inferior priefts were called Κατακοιλοι, *catacœli q. d.* people of a low condition, and that their fuperiors were called exocatacœli, *q. d.* people out of the number of catacœli, or above them. Upon the whole, however, he adheres to the fentiment of G. Corcfius, who fays, that the patriarchal palace, and the apartments of the fyncellus, and of the monks in the patriarch's patriarch's fervice, were in a very low part of the city which, with regard to the reft, feemed a valley or pit; and that the officers above mentioned had their feveral houfes or palaces ἐξω, out of the valley; whence the name exocatacœli. M. Du-Cange derives the appellation from their being above the level or rank of the other clerks, and feated at church, &c. in more honourable places erected for that purpofe on either fide of the patriarch's throne.

The exocatacœli were of great authority: in public affemblies they had the precedence of bifhops; and in the patriarchate of Conftantinople did the office of deacons, as the cardinals originally did in the church of Rome. Accordingly, in the letter of John IX. to the emperor Bafilius Leo, they are called cardinales.

At firft they were priefts; but fome patriarchs of Conftantinople, whom Codin does not mention, would have them for the future to be no more than deacons. The reafon was, that being priefts, each of them had their feveral churches, wherein they were to officiate on all the grand feftival days; fo that it unhappily fell out, the patriarch, on the moft folemn days, was deferted by all his chief minifters.

EXO'CHAS, or Exoche, from ἐξω, *without*, and ἐχω, *to have*, in *Surgery*, a kind of excrefcence on the outfide of the anus.

EXOCIONITÆ, Exocionites, in *Church Antiquity*. The Arians were firft called Exocionites, becaufe, when expelled the city by Theodofius the Great, they retired into a place called Exocionium, and there held their affemblies. Juftinian gave the orthodox all the churches of the heretics, excepting that of the Exocionites.

The word is derived from Ἐξακιονιον, or Ἐξωκιονιον, the name of the place above mentioned. Codin, in his Origines, fays, that the Exocionium was a place encompaffed with a wall, built and adorned by Conftantine; and that without the circumference of the wall there was a column, with a ftatue of that emperor, whence the place took its name, *viz.* from ἐξω, *without*, and κιων, *column*.

EXOCŒTUS, in *Ichthyology*, a genus of the abdominal kind of fifhes; the head is fcaly; mouth without teeth; jaws connected at each fide; in the gill-membrane ten rays; body whitifh; abdomen angulated; pectoral fins large, and formed for flying; anterior part of the rays carinated. Thefe are the flying fifhes of Englifh authors.

Species.

Volitans. Abdomen carinated each fide. Linn. Amœn. Acad. *Exocœtus*, Gronov. *Winged flying fifh*, Donov. Brit. Fifhes.

This is an inhabitant of the American and Red feas, and alfo thofe of the warmer parts of Europe: in one or more inftances it has been known to appear as far north as Britain. The vaftly difproportionate magnitude of the pectoral fins in this genus of fifhes affords them extraordinary advantage in effecting their efcape when clofely purfued by their voracious enemies in the water; but this facility of efcape expofes them oftentimes to the attacks of other adverfaries, and they not unfrequently elude the purfuit of the bonito, or the porpeffe, in their native element, to become the prey of gulls, corvorants, and other aquatic birds that hover over the water to feize on them in their aerial flight. They remain only for a fhort time fufpended in the air before they again dive into the water, and after a paufe of a few moments emerge again at fome diftance. They often quit the water in fhoals, and fometimes alight on board fhips in great numbers. The flefh is occafionally eaten.

The colour is filvery, with the back rather blueifh; the pectoral fins blueifh, edged with yellow; ventral fins and extremity of the tail fometimes reddifh.

Exiliens. Ventral fin reaching to the tail. Gmel. Bloch. *Swallow fifh*.

A native of the Mediterranean and Red feas. The colour is filvery, blue on the back, with the fins yellowifh at the bafe, with the extremity blueifh. The flefh is in efteem.

Mesogaster. Ventral fins in the middle of the abdomen. Bloch. *Atlantic flying-fifh*.

Native of the Atlantic feas, and was obferved by Plumier about the coafts of the Antilles. The fifh is bright filvery, with the back and fins blueifh. The fpecies is fufficiently diftinguifhed by the fituation of the ventral fins.

Commersonii. Dorfal fin marked with a dark blue fpot.

Cepede. *Commerfonian flying-fifh*. Shaw Gen. Zool.

Defcribed by Commerfon as refembling the firft fpecies, except in having a dark blue fpot on that part of the dorfal fin neareft the tail, and the ventral fins placed beyond the middle of the abdomen, their tips reaching to about the middle of the anal fin.

The laft mentioned fpecies, we are inclined to believe, may not differ fpecifically from the fifh defcribed by Bloch under the name of mefogafter: the evolans and volitans of Linnæus, according to fome writers, conftitute but one fpecies; and we fhould alfo fpeak with diffidence of the fifh denominated exocœtus non volitans by Forfkal; is it a variety of volitans β, as Gmelin confiders, or rather an error arifing from fome accidental circumftance?

EXOCY'STE, or Exocy'stis, from ἐξω, *without*, and κυστις, *the bladder*. Writers define this term of furgery a prolapfus of the lining of the bladder. We are probably to underftand by the word, a protrufion of the lining outward, between the fafciculi of the mufcular coat of this organ, an occurrence which we know does really fometimes take place. Stones have been found protruded in this manner, carrying along with them a part of the lining of the bladder.

EXODIARY, Exodiarius, in the *Ancient Roman Tragedy*, was a droll, or mime, who appeared on the ftage when the tragedy was ended, and performed what they called the exodium, or conclufion of the fhew, to divert the company.

EXODIUM, Ἐξοδιον, in the *Ancient Greek Drama*, was one of the four parts or divifions of a tragedy.

The word is formed from the Greek, ἐξοδος, *going out*, *digreffion*, of ἐξ and οδος, *way*, *road*. Feftus, lib. v. calls it *exitus*.

The exodium, according to Ariftotle, was fo much as was rehearfed after the chorus had ceafed to fing for the laft time; fo that exodium with them was far from being what the epilogue is with us, as feveral people have imagined it was.

The exodium was fo much of the piece as included the cataftrophe and unravelling of the plot; which cataftrophe, &c. in pieces regularly compofed, always began after the laft finging of the chorus, anfwering nearly to our fourth and fifth acts. M. Dacier's Comment. on Ariftotle's Poetics, chap. 12. See Catastrophe and Chorus.

Among the Romans the exodium was a different thing; it was pretty nearly what farces are with us. After the tragedy was over, came a pantomime on the ftage, called the exodiarius, who, by his grimace, jefting, and buffoonery, diverted the people, compofed their minds, and wiped away the tears which the tragic fpectacle had occafioned to be fhed.

Viginere on T. Livy fays, the exodium confifted of certain

tain humorous drolling verses, rehearsed by the youth at the end of the fabulæ atellanæ, and answering to our farces. In another place, the same author says, that the exodia were a kind of interludes in the intervals between the acts, partly fable and pleasantry, partly music, &c. to give time both for the spectators and actors to recover breath. The passage in Livy, whence he takes the notion, is lib. vii. dec. I. "Ridicula intexta versibus, quæ juventus inter se more antiquo jactare cœpit, eaque conferta sunt fabulis potissimum atellanis." See also Juvenal.

"Urbicus exodio risum movet Attellanæ
Gestibus Autonoes."

Exodium, in the *Septuagint*, signifies the end or conclusion of a feast.

The Hebrew text calls the day עצרת, which the Seventy render Ἐξόδιον.

In particular, exodion is used for the eighth day of the feast of tabernacles, which, it is said, had a special view to the commemoration of the Exodus, or departure out of Egypt, though there is nothing of it expressed in Scripture.

Exodium, was also the name of a song sung at the conclusion of a meal or feast.

EXODUS, the second of the five books of Moses.

The word in its original Greek, Ἔξοδος, literally imports a *going out*, or *journey*; and was applied to this book, because the history of the Israelites' passage out of Egypt is related therein. Besides this, it contains the story of what was transacted in Egypt from the death of Joseph to the delivery of the Jews; as well as what passed in the wilderness, and particularly at mount Sinai, to the building of the tabernacle.

The Hebrews call it *veelle semoth*, q. d. *hæc nomina*, these are the initial words of the book; for the same reason they call Genesis, *beresith*, q. d. *in principio*, *in the beginning*.

EX OFFICIO, in *Law*, denotes a power which a person has in virtue of his office, to do certain things without being applied to; as a justice of peace may not only grant surety of the peace, at the complaint or request of any person, but he may demand and take it, ex officio, at discretion, &c. Dalt. 270.

By a branch of statute 1 Eliz. the queen, by her letters patent, might authorize any persons exercising ecclesiastical jurisdiction to administer an oath, ex officio, whereby supposed offenders were forced to confess, accuse, or clear themselves of any criminal matter, &c. but this branch relating to this oath is repealed by 17 Car. I. cap. 11.

Ex officio *Informations*. See Information.

EXOLICETUS, in *Natural History*, a name used among the writers of the middle ages to express a small stone which had such a variety of colours that it dazzled, as they say, people's eyes in looking at them. It is said to have been found in Libya. The name is probably only a corruption of the hexacontalithos of Pliny and the older writers; and this seems to have been no other than a name for the opal.

EXOMIS, of ἐξ, *out of*, and ὦμος, *shoulder*, in *Antiquity*, a straight narrow garment through which the shoulders appeared. It had something in common with the tunic, and something with the pallium. It was worn by slaves, servants, and the lower classes of people among the Romans.

EXOMOLOGESIS, Ἐξομολογησις, formed of Ἐξομολογεω, *I confess*, a term little used but in speaking of the ancient ceremonies of repentance, whereof the exomologesis, by us called *confession*, was a part.

Some of the ancients, and particularly Tertullian, De Pœnit. cap. 9. use the word in a greater latitude, as comprehending the whole of repentance.

A public exomologesis was never commanded by the church for secret sins, as may be seen in the capitulars of Charlemagne, and the canons of divers councils.

EXOMPHALOS, from ἐξ, *out*, and ὀμφαλος, *the navel*, in *Surgery*, an umbilical hernia, or a disease which consists of a protrusion of some of the abdominal viscera at the navel. The subject will be particularly considered in the article Hernia.

EXONCHOMA, from ἐξ, *out*, and ογχος, *a tumour*, any large prominent swelling.

EXONEIROSIS, from ἐξ, *out*, and ονειρος, *dream*, a nocturnal pollution or emission of the semen in dreams. This, if it happens but rarely, is usually a sign only of redundant vigour; but if it happens frequently, is a sign of weakness of the seminal vessels, which is most frequently the case.

EXONERATIONE Sectæ, in *Law*, a writ that lay for the king's ward, to be freed from all suit to the county-court, hundred-court, leet, &c. during the wardship. F. N. B. 158.

EXONYCHOS, of ἐξω, *without*, and ονυξ, *a nail*, in *Botany*, a name given by some of the ancient writers, among whom are Dioscorides and Pliny, to the gromwell or lithospermum. See Ægonychus.

EXOPHTHALMIA, from ἐξ, *out*, and οφθαλμος, *the eye*, in *Surgery*, a disease consisting of a protrusion, or a preternatural projection of the globe of the eye from the orbit, so that the part cannot be duly covered by the eye-lids. The disorder may proceed either from a morbid enlargement of the eye-ball, or what, perhaps, is a still more common cause, some tumour which occupies or diminishes the cavity of the orbit, and consequently displaces the eye.

The affection has several other names besides exophthalmia; as, for instance, buphthalmus, ophthalmoptosis, prolapsus oculi, ecpiesmos, melon, &c.

From the few words already delivered on the subject, it is easy to perceive that exophthalmia may arise from a variety of causes, and must of course require very different modes of treatment in different cases.

One cause of the disorder noticed by writers, is a disease of the fat and cellular substances situated in the orbit, and serving as a support to the eye-ball. In this case the surface of the eye appears more moistened with tears than usual, and the fat and cellular substance becoming thickened and indurated, forces the eye-ball forward out of its socket. As the eye cannot now be properly covered and sheltered by the eye-lids, it inflames, and ulcerates on its surface, and the patient becomes afflicted with very severe and deep-seated pain. This sort of cause is as difficult of removal, when the disease has advanced to a certain extent, as it is difficult of detection at an early period of the case. The famous oculist, Saint Yves, pretends, however, to have sometimes dispersed such thickenings of the cellular substance in the orbit by persevering in the exhibition of calomel and purgative medicines. The same author assures us, that he successfully exhibited the æthiops mineralis to a scrofulous patient for three months, whose eye-ball protruded to the extent of three lines, by reason of a morbid thickening of the cellular substance, and an enlargement of the lachrymal gland.

When the disease does not yield to any remedies, the symptoms may become so urgent as to render the extirpation of the eye indispensably necessary, as is proved by the following case related by Saint Yves. A woman's eye-ball protruded out of its natural situation, in consequence of a morbid thickening of the fat at the bottom of the orbit. The

The difeafe was attended with infupportable pain, and great reftleffnefs. The fymptoms were appeafed by the employment of general means, and the progrefs of the affection was for a time retarded. Three years afterwards, the eye having been left in a projecting condition, Saint Yves was requefted to vifit the patient. She was now labouring under a violent fever, accompanied with fevere head-ach. The globe of the eye was of a leaden colour, and exceedingly prominent, its coats being fwollen, and appearing likely to become gangrenous. The medical practitioners who were in the habit of attending the woman were of opinion that the eye ought to be extirpated. The neceffity for performing the operation, indeed, feemed to them fo urgent, that the proceeding was immediately adopted. The febrile and all untoward fymptoms fubfided on the fourth or fifth day, and, in about three weeks, the cure was complete.

Exophthalmia may alfo be occafioned by fome tumour of the furrounding parts, either of thofe within, or of others on the outfide of, the orbit. The celebrated French furgeon, M. Louis, met with a man, 40 years of age, in whom a carcinomatous fungus, fituated in the antrum, had deftroyed the bony plate which conftitutes the bottom of the orbit, and pufhed the eye-ball almoft entirely on the cheek, fo as to produce a great deformity of the countenance. The upper jaw bone was carious, both towards the palate and nofe, and the patient perifhed of the afflicting complaints, brought on by the carcinomatous ulceration of all the difeafed parts. The exophthalmia was the effect of the prodigious fize of the tumour, the growth of which could not be effectually refifted by the bones. The protrufion of the eye, fays M. Louis, might have been prevented by attacking the firft difeafe at a proper period, on the fide towards the mouth. The growth of the cancerous fungus is reprefented by this diftinguifhed writer as the effect of a difeafe of the bone, which latter affection he defcribes as the confequence of fyphilis, which had not been fkilfully treated.

Raw makes mention of a child whofe left eye was completely protruded from the orbit, and as large as one's two fifts. The difeafe, which had only begun a few months before, proved fatal. On opening the cranium, a fungous fwelling was difcovered, the bafe of which was connected with the dura mater above the orbit, without any difeafe of the cerebrum.

Exophthalmia, however, originates ftill more frequently from the enlargement of an exoftofis, which arifes within the orbit, and forces the eye-ball out, in proportion as it increafes in magnitude. When the bony fwelling is fituated near the edge of the orbit, the tumour may be attacked with beneficial effects, without meddling with the eye itfelf. The truth of what has juft now been obferved is illuftrated by the following cafe. A woman, 30 years of age, had a fiftula lachrymalis, for which fhe had undergone an operation to no purpofe. The bones became enlarged, and, fifteen years afterwards, an exoftofis of the os planum and internal angular procefs of the os frontis had attained the fize of an egg. The globe of the eye, being laterally compreffed, was forced out of the orbit, and, in fome meafure, hung over that part of the cheek which was near the leffer angle. M. Braffant applied a cauftic to the exoftofis; fuppuration enfued, and in the courfe of three or four months an exfoliation of a confiderable portion of the bony fwelling took place, the eye refumed its natural pofition, and the cure was completed a fhort time afterwards.

Exophthalmia is fometimes produced by the formation of a fteatomatous, or fchirrous tumour, at the bottom, or fides of the orbit. Trincavelli, Bonnetus, and Saint-Yves, furnifh us with feveral examples of this fort. Here an operation is requifite; but a great deal of patience and dexterity are effential in its performance. As the recital of facts tends to the elucidation both of precept and practice, we fhall offer an abridged account of a cafe, related by Dr. Hope, in the Philofophical Tranfactions, where every thing refpecting the method of treatment is very perfpicuoufly explained. A young woman, eighteen years of age, was affected, when twelve years old, with a diftortion of her left eye, towards the temple. This circumftance arofe gradually, in confequence of the growth of a tumour between the eye and the orbit. In a few years, the fwelling protruded externally, in the form of a hard tumour, which extended from the greater angle nearly to the leffer one, beneath the lower eyelid, and which reached nearly half an inch over the cheek. This tumour had pufhed almoft the whole eye-ball out of the orbit, fo that the pupil was removed more than three inches from its proper place. The eye was alfo much more prominent than the other, pufhed over the temple, and quite motionlefs, which circumftances, together with the tumour, prefented a frightful appearance. The fight, however, was not loft. Dr Hope, though diffuaded by Monro, undertook the cure of the patient in the year 1744. Having placed her in a convenient pofture, and made the integuments tenfe, he made an incifion about an inch long, from the greater to the leffer angle, following the direction of the fibres of the orbicularis palpebrarum mufcle. The lips of the wound being feparated, he next paffed a crooked needle, armed with fome filk, through the middle of the tumour, and, regularly as he cut all the adhefions with a biftoury, he drew outward the whole mafs of the difeafe. Sciffars were employed for dividing fuch connections, as were the moft deeply fituated. The part which was thus cut out appeared to be furnifhed with a thick membranous fubftance, exclufively of the body of the tumour, which was of a regular, fpherical, fmooth form, and about as large as a fmall pigeon's egg; the interior was of a flefhy ftructure. In detaching the fwelling from its adhefions, feveral callous indurations were met with, attached to the globe of the eye. The tumour being extirpated, Dr. Hope introduced his finger to the bottom of the orbit, where he felt feveral hardneffes and callofities ftill remaining; he kept his finger there, and having by this means paffed in a needle and ligature, he drew them through the bafe of the callofities. Now having directed an affiftant to hold up the ligature, he paffed in the point of a pair of fciffars, on the end of his finger, and made two or three ftrokes with them, in the place where he felt the roots of the callous hardneffes. Thus he fucceeded in cutting away the whole of the indurated parts, fo as to leave the bottom of the orbit, as far as he could afcertain, perfectly fmooth and free from callofity. All the time that the operation lafted, no hæmorrage of any confequence took place: only a large quantity of dark-coloured grumous blood was poured out from the varicous veffels. The wound was dreffed with fome dry lint, which was not removed till the third day. The eyelids and tunica conjunctiva were affected with a flabby kind of fwelling, attended with a flight inflammation and pain in the anterior part of the head. The dreffings confifted of fimple digeftive and refolvent applications. The pain in the head, and the tumefaction continued three days, without any formation of matter. Dr. Hope then touched the bottom of the wound with the lapis infernalis, and, a few hours afterwards, a large quantity of black blood was difcharged. From this period the pain in the head, and the fwelling ſwelling ſubſided; there was alſo emitted, during the two ſucceeding days, a bloody ſanies, which occurrence induced Dr. Hope to make uſe of ſome injections of warm water, mixed with a little ſpirit of wine, and honey of roſes. After the adoption of this plan of treatment, the pus aſſumed a more favourable appearance. Such ſoft, fungous excreſcences as aroſe in the courſe of the cure, were deſtroyed with the lapis infernalis, and it was not long before the wound was entirely healed. The eye, however, remained unalterably immoveable; for the abductor muſcles had been ſo long contracted, while the adductors had been for ſo conſiderable a time ſtretched and tenſe, that they had completely loſt all power of action.

Finding, that by making rather forcible preſſure on the eye-ball, the part could be made to return, in a great degree, into the orbit, though it became protruded again as ſoon as ſuch preſſure was diſcontinued; Dr. Hope conceived, that a bandage which would conſtantly keep up a graduated compreſſion, might be attended with ſome benefit, and determine the muſcles more ſpeedily to reſume their proper tone, by maintaining the eye in its natural ſituation. Conformably to this idea, this gentleman cauſed a ſteel bandage to be conſtructed, with a concave plate proportioned to the convexity of the globe of the eye. This apparatus made preſſure on the ſide of the eye-ball next the temple, by means of a ſcrew. The machine was put on, after gently puſhing back the eye into its natural ſituation with the hand; and then laying a ſoft compreſs between the eye and the plate of copper, Dr. Hope uſed to make the preſſure act on the part by means of the ſcrew, in ſuch a way, that it was impoſſible for the eye to become diſplaced outward again, as it uſually was before. With the aid of this bandage, which the patient wore conſtantly, night and day, and which was gradually tightened more and more, the eye regained its natural poſition in the ſpace of about twenty days, and did not deviate from it again. At the time when the caſe was publiſhed, the eye was capable of motion in every direction, and the patient could ſee quite as well with it as the other. The wound got completely well in about a month, and only ſeven weeks elapſed before the cure was, in every reſpect, perfect.

Reſpecting the foregoing caſe, M. Louis obſerves, that it certainly does honour to the ſkill and intelligence of the gentleman who undertook the treatment.

Le Dran was equally ſucceſsful in the treatment of a ſimilar diſeaſe, though certainly it was not ſo conſiderable as the preceding. The means made uſe of, were the actual cautery and alternative medicines. The ſubject was a young lady, aged eighteen, who, from her infancy, had been ſubject to inflammations about her lips, eyes, and ears. She had had a fiſtula lachrymalis, and, ſome time after the uſual operation for this complaint, there originated, at the leſſer angle of the eye, a fungous excreſcence, which protruded from the orbit, and had been ſucceſſively removed with the knife, and touched with the lapis infernalis; but in vain, as the tumour always made its appearance again. This plan of treatment was not attended with any greater ſucceſs under the hands of Le Dran, and, conſequently, he ſoon made up his mind to attack the excreſcence, by introducing the actual cautery into its centre. For this purpoſe, he took a long, large, ſewing needle, and had it firmly fixed on a handle. The inſtrument, having been made red-hot in the flame of a wax-candle, was puſhed to the depth of about half an inch into the middle of the ſwelling. By repeating the application of the cautery three or four times, at intervals of a few days, Le Dran ſucceeded in deſtroying the tumour as deeply as its root, the action of the fire having extended beyond the parts actually touched with the heated needle. The conſequence was, that the ſwelling never grew again. To render this cure more certain, Le Dran, for a long while, kept the cauteriſed part open, and the patient was ordered to take alterative medicines, the chief of which were calomel and æthiops mineralis.

The two foregoing examples prove what ſurgery can accompliſh, when the diſeaſe is taken in time. However, when the proper kind of treatment has been deferred too long, the affection of the eye becomes of ſuch a deſcription, as to be irremediable. Nothing now remains to be done except extirpating, not only the tumour, but alſo the whole of the eye-ball. Even this formidable operation is often impracticable, particularly when the parietes of the orbit are diſeaſed. For the bones, in conſequence of the preſſure made upon them by the ſwelling, are rendered carious, and very foul ill-conditioned ulcers are produced. In this ſtate there can be but little hope of a recovery, whatever mode of treatment is adopted.

One ſpecies of exophthalmia, which is indeed uncommon, but not the leſs worthy of being known, is that which is occaſioned by an encyſted tumour. In the fourth volume of the Medical Obſervations and Inquiries, there is an inſtance recorded by Dr. Brocleſby. A labouring man of the pariſh of Haſelmere, in Surry, had been for ſeveral years afflicted with a pain and an obſcurity of ſight in one of his eyes. The affection continued, without much attention being paid to it, until, about two or three years afterwards, the man became quite blind on that ſide. At this period, the globe of the eye was protruded outward in ſuch a manner, that almoſt the whole of the inner ſurface of the lower eye-lid was turned out, and hung down over the cheek, ſo as to form a true ectropium.

Several ſurgeons who were conſulted adviſed the patient not to expoſe himſelf to the riſk of an operation, fearful that the diſeaſe might be converted into one of a cancerous nature. Notwithſtanding this counſel, the man did not ceaſe going about to have the advice of all ſuch perſons as ſeemed likely to afford him any aſſiſtance. At length, he applied to Mr. Dale Ingram, who, having carefully examined the diſeaſe, thought, that on compreſſing different places, he felt a decided fluctuation below the globe of the eye. He immediately ſuſpected, that the fluid was contained in a cyſt, and, conſequently, that the patient might receive relief from an operation. However, the above gentleman would not undertake any thing without conſulting Mr. Bromfield.

The latter ſurgeon, after a careful examination, was not againſt the probability of ſucceſs, and he did the operation in the following manner. After having covered the ſound eye, by tying a handkerchief round the head, and put the eye-lids of the affected eye as near together as poſſible, and directed them to be held in this poſition, Mr. Bromfield made an inciſion through the lower eye-lid to the conjunctiva, and thus made a ſufficient opening for the introduction of his finger behind the globe of the eye. In this way he was enabled to put in a very narrow ſharp-pointed knife, for the purpoſe of puncturing the ſubſtance, which was taken to be the cyſt. Mr. Bromfield was not deceived in his expectation; for, as ſoon as the opening was made, nearly a glaſsful of a thin tranſparent fluid was diſcharged. He now waited a little, both in order to give the patient an opportunity of waſhing out of his mouth ſome blood, which had got into it, and for the ſake of conſidering what ſteps could be taken to extirpate the cyſt, which had contained the fluid. At laſt, he determined to proceed as follows: he

paſſed

paſſed into the wound a double kind of tenaculum, with which he took hold of the cyſt, and then diſſected it entirely away. The wound was filled with ſoft lint, and the dreſſings were kept on with a ſuitable bandage.

In leſs than four and twenty hours there appeared on the ſame ſide of the face a conſiderable degree of ſwelling, which ſoon ſubſided, however, on a dilatation of the firſt wound being made, lighter dreſſings being put on, and the bowels opened. In leſs than a month the man got quite well, and returned to his home with infinite ſatiſfaction. Dr. Brocleſby obſerves, that Mr. Ingram was perſuaded, before the operation, that the muſcles would draw back the eye-ball into the orbit, and that even ſome degree of viſion might return. The doctor could hardly ſuppoſe all this poſſible; but, having an opportunity of ſeeing the man, about five months afterwards, he could ſcarcely recognize him. The eye-lids had recovered their original ſtate, and moved as well as thoſe of the oppoſite eye. The man alſo informed Dr. Brocleſby, that, for about the laſt month, he had begun to diſtinguiſh with the affected eye light from darkneſs, and that his power of ſeeing was becoming greater every day. Dr. Brocleſby remarks, that he could not find any caſe of this kind related by authors, except one very analogous inſtance, recorded by Saint Yves in his treatiſe on the diſeaſes of the eyes.

The laſt kind of exophthalmia which we have to notice, is that which Sauvages has termed *traumatic*. In this ſort of caſe, the eye is ſo much protruded from the orbit, that ſurgeons have frequently been induced to remove the diſplaced part altogether, and this ſometimes has been done too inconſiderately for the unfortunate patient. Covillard informs us, in his Chirurgical Obſervations, that he was called to ſee a man, againſt whoſe eye a racket-ball had been ſtruck with ſuch violence, that all the circumference of the globe of the eye was ſeparated from the orbit. A relation of the perſon who was hurt was ſtanding by with a pair of ſciſſars in his hand, ready to cut the reſt of the parts which connected the eye with the head. Covillard entered the room in time, and very fortunately, to reſiſt this proceeding, as a complete cure enſued without having recourſe to it. Indeed, ſuch was the ſucceſs, that the patient's power of ſeeing ſuffered no kind of diminution or impairment. A ſimilar inſtance, though ariſing from a very different cauſe, occurred to Mr. Benjamin Bell. The eye was almoſt knocked out of the orbit by the violence with which a pointed piece of iron had entered betwixt the ſocket and the eye-ball. The iron had paſſed through a portion of the orbit, and remained firmly fixed there for about a quarter of an hour. During the whole of this time, the patient ſuffered inſupportable pain. He had completely loſt the faculty of ſeeing, and the eye-ball protruded in ſuch a manner, that there was every reaſon to fear that the optic nerve was ruptured, and, conſequently, great doubt concerning the propriety of replacing the part, or not. However, as a little delay did not ſeem likely to be dangerous, it was determined to wait a little. On the firſt removal of the dreſſings, and after taking away the iron, which could only be done with difficulty, ſo deeply had it ſtuck, it was with pleaſure and aſtoniſhment that the ſight was found to return immediately, even before the eye had been replaced. The inflammation which followed was ſoon appeaſed by proper remedies, and viſion was re-eſtabliſhed in its original perfection.

Mr. White makes mention of an analogous example in his book of ſurgical caſes, with this difference, however, that the eye was protruded in a ſtill greater degree.

Theſe two inſtances confirm the one recorded by Covillard, and weigh againſt what Maitre Jean has ſtated, namely, that Covillard's caſe is not authentic.

In order to conceive the truth of the foregoing obſervations, we have only to recollect the way in which the eye is retained in, and connected with the orbit. The ſurface of the boundaries of each orbit (ſays M. Louis, in defending Covillard's caſe,) is oblique, and inclines behind more towards the temple than the noſe. The eye-ball is fixed on the ſide towards the noſe, and juts out in front beyond the cavity of the orbit. Hence, it is manifeſt from the ſlighteſt examination, that the globe of the eye, in the natural ſtate, is partly ſituated on the outſide of the orbit. When it is alſo conſidered that the optic nerve is very looſe, in order to be adapted for readily following, without being at all ſtretched, all the rotatory motions of the eye-ball, produced by the action of the different muſcles belonging to this organ, we can then have no difficulty in imagining how the eye may make an immenſe protruſion outward, in conſequence of an inconſiderable ſwelling, and how it may ſeem to be quite diſplaced from its ſocket, without either the optic nerve or the muſcles being torn or lacerated.

EXORCISM, Ἐξορκισμὸς, prayers or conjurations wherewith to exorciſe, *i. e.* to drive out devils or dæmons from perſons apprehended to be poſſeſſed, or to preſerve from danger.

The word is derived from the Greek, ἐξορκίζειν, *adjurare*, *conjurare*, *to adjure*, or *conjure*. In moſt dictionaries, exorciſm and conjuration are uſed as ſynonymous; but in reality, conjuration is only a part of the exorciſm; and the exorciſm the ceremony entire. The conjuration is properly the formula, where the devil is commanded to come forth, &c.

Exorciſms are of great uſe in the Romiſh church; their prelates, &c. are frequently exorciſing dæmoniacal perſons. The prieſts make holy water by exorciſing common water a certain number of times. In reality, the exorciſm is a part in moſt of their conſecrations.

Exorciſms had anciently another and farther purpoſe; being applied by way of trial or purgation to extort the truth from the accuſed.

The exorciſm, in this ſenſe, was a ſort of bread conjured and exorciſed for the purpoſe; and the opinion was, that if the perſon was criminal he could not ſwallow the bread.

This, it ſeems, was a frequent practice in the time of our Edward III. and the bread thus exorciſed was ſaid to be corſned.

Linderbroeck gives inſtances of exorciſms with barley-bread, and others with cheeſe; and hence, probably, might ariſe that popular imprecation, "May this bread choak me, if I tell a lye." See Ordeal and Judicium *Dei*.

EXORCIST, in the *Romiſh Church*, a prieſt, or tonſured clerk, who has received the four leſſer orders, one of which is that of exorciſt.

The term is likewiſe applied to a prelate, or to a prieſt delegated by a prelate, who actually exorciſes a perſon poſſeſſed.

It is a diſpute among divines whether ever the Greeks had any ſuch order as that of exorciſt. Fa. Goar, in his Notes on the Greek Euchologion, has made it probable they had, from ſeveral concurring paſſages in St. Dionyſius and St. Ignatius Martyr.

The ordination of exorciſts is performed in the time of maſs, their principal office being to expel devils. The fourth council of Carthage, can. 7. appoints, that in the ordination of exorciſts, the biſhop, putting the book of exorciſms orcifms in their hands, fhall fay thefe words: "Receive it, and keep it in remembrance, and have power to lay hands on energumeni, whether baptifed or catechumens; which form ftill obtains."

M. Fleury mentions certain people among the Jews who travelled round the country, making profeffion of driving out devils by invocations, which, they pretended, had been taught them by Solomon; thefe were alfo called exorcifts. See Jofeph. Antiq. Jud. lib. viii. cap. Origen. Tract. xxxv. in Matt. 35. 63.

EXORDIUM, in *Oratory*, the preamble or beginning of a difcourfe or fpeech, ferving to prepare the audience and introduce the matter in hand.

The word is formed from the Latin *ordiri*, *to begin*, by a metaphor taken from the weavers, who are faid, *ordiri telam*, *to begin*, or *warp* a web, by difpofing and ordering the threads in a certain manner for the future work. See Warp.

The exordium, on other occafions, is called the *prologue*, *prælude*, and *proem*.

Cicero defines exordium a part of an oration, whereby the minds of the audience are duly prepared for what remains to be faid. The exordium is a part of principal importance, and is to be laboured with extraordinary care; whence Tully calls it "difficillima pars orationis."

Cicero and Quinctilian mention three ends, to one or other of which it fhould be fubfervient; *viz.* "reddere auditores benevolos, attentos, dociles." The firft end, or that of conciliating the good will of the hearers, may be effected by a felection of topics, in caufes at the bar, from the particular fituation of the fpeaker himfelf, or of his client, or from the character and behaviour of his antagonift contrafted with his own; on other occafions, from the nature of the fubject, as clofely connected with the intereft of the hearers; and, in general, from the modefty and good intention with which the fpeaker enters upon his fubject. The fecond end, or that of exciting and engaging the attention of the hearers, may be accomplifhed by giving them fome hints of the importance, dignity, or novelty of the fubject; or fome favourable view of the clearnefs and precifion with which it is to be treated, and of the brevity with which it is to be difcuffed. In order to effect the third end, or to render the hearers docile, or open to perfuafion, the fpeaker muft begin with ftudying to remove any particular prepoffeffions they may have contracted againft the caufe, or fide of the argument which he efpoufes.

The ancient critics diftinguifh two kinds of introduction, which they call "Principium," in which the orator plainly and directly profeffes his aim in fpeaking: and "Infinuatio," where, prefuming the difpofition of the audience to be much againft the orator, he muft gradually reconcile them to hearing him, before he plainly difcovers the point which he has in view. Of this latter fort of introduction we have an admirable fpecimen in Cicero's fecond oration againft Rullus.

Exordiums are of two kinds; either juft and formal, or vehement and abrupt. In the firft, the audience is prepared and conducted by due and eafy fteps; in the fecond, the orator, as if feized with fome fudden paffion, breaks out upon his audience at once. Such is that exordium of Ifaiah; "Hear, Oh heavens! and give ear, Oh earth!" Or that of Cicero againft Catiline; "Quoufque tandem abutere patientia noftra, Catilina?" Abrupt exordiums are moft fuitable on occafions of extraordinary joy, indignation, or the like; though we have inftances of panegyrics of the greateft orators, begun abruptly, without any fuch occafions. Such is that of Gorgias, who began his eloge of the city and people of Elis with Ἦλις, πόλις εὐδαίμων, *Elis, beata civitas.* Abrupt, hafty, exordiums, were more to the tafte and manner of the Greeks than of the Latins.

Agreeably to the objects which the orator fhould have in view in this part of his difcourfe, as we have already ftated them, the requifites in an exordium are, 1. *Propriety*, whereby the exordium appears eafy and natural, becomes of a piece with the whole difcourfe, and matches it as a part does the whole; fo that it could not be accommodated to any other, or, perhaps, a contrary occafion. The ancient orators were very defective in this point; their exordiums had frequently nothing in common with the fubject.

In order to render introductions natural and eafy, Dr. Blair fuggefts that they fhould not be planned, till the fubftance of the difcourfe has been thoroughly digefted in the mind. This mode of forming an introduction is conformable to the rule given by Cicero, though not always to his practice. "Omnibus rebus confideratis," fays he, "tum denique id quod primum eft dicendum, poftremum foleo cogitare, quo utor exordio. Nam fi quando id primum invenire volui nullum mihi occurrit, nifi aut exile, aut nugatorium, aut vulgare;" *i. e.* "when I have planned and digefted all the materials of my difcourfe, it is my cuftom to think, in the laft place, of the introduction with which I am to begin. For if at any time I have endeavoured to invent an introduction firft, nothing has ever occurred to me for that purpofe, but what was trifling, nugatory, and vulgar."

2. *Modefty*, or an ingenuous bafhfulnefs, which recommends the orator exceedingly to the favour of his audience. This is what Cicero extols fo much in L. Craffus, "Fuit enim in L. Craffo pudor quidnam, qui non modo non obeffet ejus orationi, fed etiam probitatis commendatione prodeffet." The fame Tully owns of himfelf, that at the beginning of his oration every limb trembled, and his whole mind was in a flutter. The vain-glory of that author fhould be carefully avoided, of whom Horace fpeaks, and who began his poem "Fortunam Priami cantabo et nobile bellum."

The modefty of the orator fhould difcover itfelf not only in his expreffions at the beginning, but in his whole manner; in his looks, in his geftures, and in the tone of his voice. However, the modefty of an introduction fhould never betray any thing mean or abject. The orator, whilft he exhibits to his hearers modefty and diffidence, real and not affected, fhould manifeft a becoming fenfe of dignity, arifing from a perfuafion of the juftice or importance of the fubject of which he is to fpeak. The modefty of an introduction requires that it fhould not promife too much. "Non fumum ex fulgore, fed ex fumo dare lucem." Horace.

> "He does not lavifh at a blaze his fire.
> Sudden to glare, and then in fmoke expire;
> But rifes from a cloud of fmoke to light,
> And pours his fpecious miracles to fight."—Francis.

Although, in general, the orator fhould not put forth his whole ftrength in the beginning, but gradually rife as his difcourfe advances; yet there are cafes in which he may be allowed to fet out in a high and bold tone; *e. g.* when he rifes to defend fome caufe which has been much decried by the public. In fubjects too of a declamatory nature, and in fermons, where the fubject is ftriking, a magnificent introduction has fometimes a good effect, if it be properly fupported in the fequel. Boffuet, Flechier, and the other celebrated French preachers, very often begin their difcourfes with laboured and fublime introductions; thefe raife attention, and throw a luftre on the fubject; but every fpeaker fhould be on his guard againft ftriking a higher note at at the beginning than he is able to keep up in his progrefs, and thus difappointing the expectations which he has excited. Among Englifh preachers, attempts of this kind are not always fo fuccefsful. Variety fhould be ftudied in introductions as much as poffible. Explanatory introductions from the context are the moft fimple of any, and frequently the beft that can be ufed; but they fhould never be long. An hiftorical introduction has generally a happy effect in roufing attention; when one can lay hold upon fome noted fact that is connected with the text or difcourfe, and by a proper illuftration of it, open the way to the fubject that is to be treated of.

3. *Brevity*, not amplified or fwelled with a detail of circumftances, or a long circuit of words; and in this refpect it fhould be accommodated to the length of the difcourfe; nor fhould the introduction anticipate any material part of the fubject.

4. The *ftyle* of the exordium fhould be juft, eafy, and pleafant. Quinctilian facetioufly compares a faulty exordium to a fcarred face, which is prefently difcerned, and very difagreeable. Thus, Cicero, "Veftibula, aditufque ad caufam facias illuftres."

Correctnefs of expreffion is peculiarly requifite on account of the fituation of the hearers, who are then more difpofed to criticize than in any other ftage of the oration or difcourfe; becaufe they are as yet unoccupied with the fubject or the arguments, and their attention is chiefly, if not wholly, directed to the fpeaker's ftyle and manner. A correct plainnefs, an elegant fimplicity, is the proper character of an introduction, ; "ut videamur," fays Quinctilian, "accuraté non callidé dicere."

5. *Calmnefs* of manner is peculiarly fuitable to the exordium. This is feldom the place for vehemence and paffion. Emotions muft rife as the difcourfe advances. The minds of the hearers muft be prepared, before the fpeaker can venture on ftrong and paffionate fentiments. To this rule there are fome exceptions, as, for inftance, when the fubject is fuch that the mere mention of it naturally awakens fome paffionate emotion, or when the unexpected prefence of fome perfon or object, in a popular affembly, inflames the fpeaker, and makes him break forth with unufual warmth. Either of thefe will juftify what is called the exordium *ab abrupto.* An inftance of this kind we have already referred to in Cicero's firft oration againft Catiline. However, introductions of this kind fhould rarely occur. In the introduction the fpeaker fhould prepare the way for thofe warm emotions, which he defigns to raife in the fubfequent parts of his difcourfe.

The exordium appears an effential part of an oration; though anciently in the Areopagus, Julius Pollux tells us they fpoke without any exordium, and paffions, and any peroration or epilogue. The like is faid to have been done by Xenophon, who began thus: "Darius et Parifatis duos habuere filios."

EXORMISTOS, in *Ichthyology*, a name given by fome of the old writers to that fpecies of the petromyzon which other authors call the lampetra fluviatilis, and we in Englifh the lampern. This is diftinguifhed by Artedi by the name of the petromyzon, with only one feries of fmall teeth in the verge of the mouth, and fome large ones, below. See MUSTELA, LAMPETRA, and PETROMYZON.

EXOS, the name by which Rondeletius diftinguifhes the acipenfer hufo. See STURGEON.

EXOSTOSIS, from ἐξ, *out of*, and ὀστέον, *a bone*. This term, in *Surgery*, fignifies an offeous tumour growing on a bone. Alfo, a fwelling of the bone itfelf.

Boyer remarks, that a fwelling may take place in bones as well as other parts of the body. The particular kind of tumour which occafionally forms on the furface of the bones, is that to which this writer affigns the appellation of *exoftofis.* He notices, however, that this name comprehends different fpecies, which fhould be confidered in a diftinct manner. Thus, *ofteo-farcoma* is one peculiar affection; and there is another fpecies of exoftofis, different from all others, and which confifts principally in a thickening of the periofteum. Boyer is of opinion, that the difeafe might be very properly named *periofiofis.*

In cafes of exoftofis, the bony fwelling acquires, on fome occafions, fuch a degree of hardnefs, that no veftiges of a fibrous texture can be difcerned, and it abfolutely refembles ivory. In fome inftances, the ftructure of the tumour is fpongy; and in others the fwelling is compofed of a mafs of flefhy and bony matter blended together.

According to Boyer, the bones moft frequently affected with exoftofis are the broad bones of the head, the lower jaw, fternum, humerus, radius, cubitus, the bones of the carpus, and the femur, and tibia. However, he remarks, that there is bone, which may not become the feat of the difeafe, and the affection may extend to a fmall, or a confiderable portion of it. It is not uncommon to find the bones of the cranium affected with exoftofis over their whole extent; and Boyer inftances the offa parietalia, as fometimes acquiring an inch in thicknefs, in confequence of the affection.

In the majority of cafes, an exoftofis rifes from the furface of a bone, and appears in the form of a hard round tumour. It fometimes occurs near the extremities of the long bones, and, at other times, near the middle portion. It is remarked, that exoftofes, originating from a venereal caufe, and commonly called *nodes*, are found, for the moft part, on compact bones, and fuch of thefe as are not thickly covered with foft parts, as, for inftance, the bones of the cranium and face, the internal fide of the tibia, &c.

Mr. John Bell has treated of tumours of the bones in the third volume of his Principles of Surgery. The following extract will ferve to fhew fome of this gentleman's opinions upon the fubject: "Many things confpire (fays this author) to give the tumour proceeding from a bone a peculiar afpect; it is always irregular and anomalous, never fimple. I have rarely feen a fingle bony protuberance arifing from the head, or fhaft, of a fingle bone. When a bone falls into difeafe, a large proportion of tendinous and mufcular parts of burfæ, and of cellular fubftance partake of the morbid action. The bone lies in the centre of the limb, connected by its larger head with a joint, and by its periofteum with the tendons, burfæ, and mufcles; and all this mafs of parts is, fooner or later, affected; and fince every depofition from veffels appointed for the fecretions of bone is folid, and every increafe of fuch a tumour permanent, it foon atttains a great fize; it is ponderous and maffive from the proportion of bony fecretion, and from the various ftructure of thefe feveral parts, it has every irregularity of form and fubftance.

"When the tumour of a bone has attained a confiderable fize, much of the original ftructure is deftroyed, and a new irregular mafs of gelatinous and bony matter is fubftituted for it. The bony tumour is firm, bulky, and ponderous, but not folid; feeling it from without, we can conjecture of what fubftance it is compofed within; we are fenfible that the tumour is covered by a fhell, bony in moft parts of its circumference, cartilaginous in fome parts, and, throughout the whole, yielding and elaftic; we are fenfible, alfo, that within there are irregular points, or fpiculæ traverfing the cavities, or cells, of the hollow tumour; that thefe are mixed with the cartilaginous fubftance, and with irregular collections of of matter, partly purulent, but chiefly gelatinous; we are fenfible of fuch foft cartilaginous and gelatinous parts being fucceffively added, in the progrefs of its growth to the tumour, which was, at the firft, folid and firm; and we find at laft, by pain and partial ulcerations, and by the increafe of fluctuation and rednefs at particular points, that ulceration, the laft ftage of the difeafe, approaches. Then the limb is effectually ruined, and the patient muft fubmit to amputation, or die of hectic.

"When fuch tumour is diffected, we find our fufpicions of its internal ftructure confirmed; we fee that foul matter flow out, when we open into the centre of the tumour, which we felt but indiftinctly through its walls; the parts which appeared the moft folid are hollowed out by ulceration, and full of foul and putrid fanies; while the bone has been declining into difeafe, the cancelli and marrow have been degenerating into a fort of fatty mafs, with which much of the cavity of the tumour is filled, and thence fuch difeafe has been very generally defcribed under the name of *ofteo-fteatoma*. This fatty excretion, occupying the difeafed cavity, is the part which, when the tumour burfts into an open ulcer, throws out fuch prolific fungus, growing apparently from the fubftance of the bone, and fprouting up, when amputated, in the courfe of a few hours. The folid bone, whether radius, or thigh-bone, is annihilated, and a mere fhell of offeous matter fubftituted in its place, and that in a manner fo peculiar, that it muft feem to the unintelligent obferver as if the fmall and folid bone had been expanded into an extenfive and flat plate of offeous fubftance, whereas the procefs is in truth very fimple and very intelligible. The bone dies piecemeal of ulceration, what, in technical language, is termed caries, and is conveyed away by abforption; but the bone being dead, the furrounding membranes, *viz.* the periofteum and tendinous expanfions, which once formed a part of its fyftem of circulation, continue ftill alive and ready to fecrete new bone; and thus it happens, that while a carious abfcefs preferves a large cavity full of foul matter, the furrounding membranes continue fecreting bone, which, like a fhell, thin and expanded, covers this cavity, and forms the walls of the tumour, of which fome part is compofed of thin expanded bone, refembling a cranium, fome of cartilage, fome of thickened membrane; and this fhell is formed in proportion as the original fabric of the bone is deftroyed.

"Bone is deftroyed by this internal ulceration, juft as it is by open caries, piecemeal; the procefs would not be ulceration, if, while one part were perifhing, the other were not active and fecreting new matter; fo vigorous ftill is the general life of the bone, while the internal parts are thus fuffering, that while one fide is wafting with ulcer, the other fide is often fecreting bone irregularly and profufely, and fhooting out into fantaftic forms among the membranes and furrounding foft parts, whence the centre of the tumour is cavernous and cellular, and the walls often rough with fpinous and projecting points. So merely local is the action of arteries in a tumour, whether offeous or foft, that one fide, or part, or bump of a tumour, grows vifibly and protrudes; the features and external form of the tumour gradually changing, without any fenfible caufe; and fo peculiar is the fecretion of each fpecies of vafcular ftructure, according to the original deftination of the part, that in one part of the tumour is generated bone, in another griftle, in another gelatinous effufion; while in another part, the vafcular action is violent and deftructive, and the folid bone, marrow, and furrounding membranes, are all refolved into a foul and fetid fuppuration. From the periofteum is fecreted bone: from the marrow, this fteatomatous and folid fat, with which much of the tumour is filled; to the tendinous and aponeurotic parts we can diftinctly trace the cartilaginous fecretion; and the gelatinous effufions, we can perceive, even during life, have their walls thicker, or thinner, according to the degree of inflammation.

"Thefe are the external characters and internal conditions of a tumour occupying any of the bones. Such tumour arifes often from a bruife, or fracture; fometimes from a lefs obvious caufe, or from internal difeafe. The radius, for example, is fractured at the wrift, re-unites and heals; but heals clumfily, the thickening never fubfides, the pain never ceafes, and, though not great, is greater than what is natural to a fracture. At length, a fenfible tumour arifes; at firft it is firm, but in proportion as it increafes in fize, it becomes fomewhat foft and elaftic, the thin plate of bone, of which it is compofed, yielding to the diftention from within. From time to time the tumour changes its form, ftill increafing in bulk. On the fide of the radius, it is firm and folid; it bends and yields at the parts moft diftant from it; it is plainly bony at its bafis, and as obvioufly cartilaginous in the extreme part of its circle; it plainly contains matter in thofe fofter parts, where it yields to the impreffion of the finger. Cartilaginous knobs arife, and fometimes are reddened on the furface; and, at certain points, the fluctuation is of fuch a kind, as to imply that the effufion is in part of a gelatinous nature. Thus the tumour grows and extends, with various irregularities in form and confiftence; it overhangs the dwindled hand, the ufe of the joint is loft, and the patient, who might gladly have been delivered of it at an earlier period, has, in the end, no choice left; for, when once it burfts into carious ulceration, it never heals, the fetor is inconceivably overcoming, attended with hectic. You are alfo to remark, that, when fuch difeafe takes place in the hand itfelf, the joints of each of the fingers grow out into tumours, at firft of a heart-like form, correfponding with the articulations of the finger bones; but, in procefs of time, they grow to globular, irregular, and almoft tranfparent tumours, ftill firm, or, at leaft, of a cartilaginous firmnefs. The whole hand degenerates into a deformed mafs, difcoloured, ulcerated, and fetid; from the individual knobs of which deformed mafs, the points of the refpective fingers project like griffin's claws, with crooked nails of enormous length." Page 58—60.

The foregoing paffage makes us tolerably well acquainted with Mr. John Bell's fentiments relative to the pathology of exoftofes, and though we do not ourfelves adopt fome of his conclufions, nor think that all bony tumours coincide with his account, yet many cafes certainly anfwer the defcription which he has given.

Some exoftofes cannot be difcovered before the patient's death. Such was the cafe referred to by Boyer, of a perfon whofe parietal bone was found after death to be three times thicker than natural. A fimilar cafe is alfo related in the memoirs of the academy of Dijon. In the latter example, the patient died from an exoftofis on the internal fide of the os pubis. The tumour, by preffing on the neck of the bladder, prevented the paffage of the urine, and the introduction of the catheter.

Boyer notices the poffibility of miftaking the head of a luxated bone for an exoftofis. He informs us, that this happened with a young man, whofe clavicle was diflocated at the end, which is articulated with the fternum. The tumour, formed by the end of the difplaced bone, was miftaken for an exoftofis, and was treated as fuch, of courfe, with no benefit.

Boyer alfo adverts to the liability of miftaking the en-

largements

largements of the ends of ricketty bones for exoftofes. Fungous excrefcences of the dura mater might likewife (as the fame author explains) be erroneoufly conceived to be exoftofes; for, after they have deftroyed a part of the bones of the cranium, they form an external protrufion. Their real nature, however, may be eafily difcriminated by attending to their confiftence and progrefs, and particularly their pulfatory motion, which correfponds with the action of the arteries in general. We need not here fay more concerning thefe fwellings, as they are already defcribed in another part of this Cyclopædia. See DURA MATER, *Tumours of.*

There are certain fymptoms which may be faid to be common to all exoftofes; fuch are, a fwelling; a fenfe of weight; pain, or at leaft a degree of uneafinefs arifing from the morbid action; and deformity.

Another clafs of fymptoms may be called *particular*, becaufe they are entirely dependent on the fituation of the tumour. Thus, as Boyer obferves, and as we have related in the article EXOPHTHALMIA, if an exoftofis were to take place in the orbit, the eye would neceffarily be expelled from that cavity. An exoftofis arifing from the inner furface of the clavicle, or fternum, might occafion preffure of confiderable blood-veffels, and on the thoracic vifcera, fo as to induce a train of very dangerous and even fatal confequences

An exoftofis, arifing from the internal fide of the os pubis, may give rife to a fatal retention of urine, as, indeed, we have already detailed. A fimilar tumour, fimilarly fituated, might alfo render parturition, in the natural way, impoffible.

The generality of furgical writers reprefent fcrofula as being a caufe of exoftofes. This ftatement, however, feems to reft on no foundation whatever. The fwelling of the joints, when they are affected with fcrofulous difeafe, is not produced by an expanfion of the bones themfelves, but altogether by a thickening of the foft parts, fometimes conjoined with a collection of a fluid refembling glair, or of purulent matter in the capfular ligament. The head of a bone, really enlarged from fcrofula, has never yet been demonftrated, and cannot be found in any of the collections of morbid preparations in the various mufeums. The particular form of difeafe, with which fcrofula affects the bones, we fhall defcribe in fpeaking of the *White Swelling.*

A fcorbutic diathefis is alfo fet down by authors as fometimes exciting the growth of exoftofes: on this point, we can only profefs our ignorance of any rational evidence in favour of the opinion.

The venereal difeafe does undoubtedly occafion one fort of exoftofes, denominated *nodes;* but, thefe we fhall difmifs from prefent confideration.

It is painful for us to be obliged to acknowledge, that we are almoft in total ignorance, in regard to the caufes of exoftofes; for, excepting contufions and fractures, which fometimes unqueftionably lead to the production of bony tumours, we have no certain knowledge of any others.

Mr. John Bell informs us, that he has feen a woman's ankle fall into this difeafe, in confequence of a very trivial accident; the tibia and fibula grew into a common tumour, the bones feemed annihilated, and a large offeous fhell appeared to be fubftituted in their place. In the courfe of the difeafe, the leg became twifted round in a fingular manner, and enlarged to the fize of a pillow of a fettee. The woman died of hectic from the open caries of the tumour. The fame author remarks, that the wrift, which is more expofed to fprains and fractures, is moft liable to be thus deformed and ruined. He reprefents the hand itfelf as being alfo particularly fubject to fimilar diforder. The original injury is fome flight blow, or fprain; one finger is firft deformed; joint after joint enlarges; one finger after another becomes crooked; the nails project like talons, and force their way into the very flefh of the fwelled and ulcerated hand, which, according to Mr. John Bell, they fometimes penetrate through and through. At length, the hand degenerates into an unwieldy and irregular mafs, ftudded with knobs and bony tumours. This furgeon tells us, alfo, that in confequence of a neglected fracture of the collar-bone, in a ftout young man, he once faw a tumour produced; partly confifting of bone, and partly of cartilage, rifing to the height of fix inches, of round figure, and infulated, moving when the arm was moved, too large and too critically fituated over the axillary artery, to admit of extirpation, and which Mr. John Bell doubts not has by this time become carious, and occafioned death.

When exoftofes originate from external violence, the exciting caufe is involved in no obfcurity; but the caufes in moft other inftances feem to baffle all human refearch. Frequently, a conftitutional difpofition to the formation of bony tumours, in various parts of the body, feems to prevail. Mr. Samuel Cooper, in his "Dictionary of Practical Surgery," quotes an example of a boy, who came out of Cornwall, fo exceffively afflicted with an apparent propenfity to exoftofes, or an exuberant depofition of bony matter, that a very trifling blow would occafion a bony fwelling on any bone of his body. The ligamentum nuchæ was offified, and prevented the motion of his neck; the margins of the axillæ were alfo converted into bone, fo that the poor lad was, as it were, completely pinioned.

There is one fpecies of exoftofis remaining to be noticed, which is of a very peculiar kind, as it is in its appearance exceedingly like a bony fungus.

A ftriking inftance of fuch a difeafe has been recorded by Mr. Abernethy. The cafe being highly interefting, we fhall take the liberty of quoting it. The patient, who was 34 years of age when the account was written, perceived, when about ten years old, a fmall tumour on his left cheek, which gradually attained the fize of a walnut, and then remained for fome time ftationary. About a year afterwards, the tumour having again enlarged, a cauftic was applied to the integuments, fo as to expofe the bone. The actual cautery was next applied, and an opening thus made into the antrum. After the exfoliation, the antrum became filled with a fungus, which rofe out upon the cheek, and could not be reftrained by any applications. Part of the fungus alfo made its way into the mouth, through the focket of the fecond tricufpid tooth, the other teeth remaining natural. The difeafe continued in this ftate nine years, occafionally bleeding in an alarming way. When the patient was in his 20th year, the whole fungus floughed away during a fever, and did not return. After this, the fides of the aperture in the bone began to grow outwards, forming an exoftofis, which grew to a great magnitude. A fmall exoftofis took place in the mouth, but became no larger than a horfe-bean. The exoftofis of the maxillary bone was of an irregular figure, and projected from the whole circumference of the aperture a great way directly forward. Mr. Abernethy compares its appearance, when he was writing, with that of a large tea-cup faftened upon the face, the bottom of which may be fuppofed to communicate with the antrum. The diameter of the cup, formed by the circular edge of the bone, was three inches and a half: the depth two inches and feven-eighths. The general height of the fides of the exoftofis, from the bafis of the face, was two inches; its walls were not thick, and terminated in a thin circular edge. The integuments, as they approached this edge, became extenuated, and they extended over the edge into the cavity. The exoftofis reached to the nofe in front, and to the mafleter mufcle behind; above it included the very ridge of the orbit, and below it grew from the edge of the alveolary procefs. A line that would have feparated the difeafed from the found bone, would have included the orbit and nofe, and indeed one half of the face. Mr. Abernethy faw no means of affording the man relief. Med. Chirg. Tranf. vol. 2.

In regard to the treatment of exoftofes, it is exceedingly difficult to lay down any determinate rules. With the exception of venereal nodes, we cannot fay that we are acquainted with any remedy which has the power of diminifhing bony tumours. Perhaps blifters kept for a long while open, by means of the favin cerate, and applied to the neareft furface of the integuments, might have the effect of exciting the action of the abforbents, fo that the depofited bony matter would be at leaft in part removed. That blifters would operate in this manner, we may conclude from their having been known to diminifh the fwelling of venereal nodes, after mercury has ceafed to be productive of any benefit. However, we do not mean to reprefent this plan as likely to anfwer fully in practice; for, even were it to prove fuccefsful, it could only be after fuch time and perfeverance as few patients would allot.

The chief method of getting rid of an exoftofis is by attacking the tumour with a cutting inftrument, and it is obvious that this mode of proceeding cannot be adopted, except when no anatomical confiderations forbid it. Hopes of its fuccefs, alfo, fhould never be fanguine; becaufe, though you may fucceed in removing every particle of the bony fwelling, ftill the depofition of bone may continue, and the difeafe recur, and this even in a more malignant form.

When an exoftofis has acquired much magnitude, it feldom admits of being cut, or fawn away. But there are exceptions to this remark; for Heifter records an example of an exoftofis, fituated on the middle of the fternum, and as large as a child's head, being fuccefsfully extirpated. If an exoftofis were to be met with, growing on the middle part of one of the long cylindrical bones, with rather a narrow bafe, an attempt might be prudently made to remove the tumour, notwithftanding its fize might be very great. When the attachment of the fwelling is on the head of a bone, near a large joint, an endeavour to extirpate the difeafe is much more dangerous.

It would be in vain to pretend to detail particularly how the operator is to conduct himfelf in extirpating exoftofes. His firft object fhould be, if poffible, to make fuch incifions through the foft parts as will expofe the bafe of the tumour, fo as to allow the faw to be applied to it. When this can be effected, it is manifeft that the whole of the fwelling may be removed by one fection made with the faw. In the majority of cafes, fmall fhort faws with long handles, in a word, the inftruments defcribed in Mr. Hey's "Practical Obfervations in Surgery," will be found much more proper and convenient than larger ones.

Sometimes, when owing to depth of fituation, or fome other anatomical reafon, no direct attempt to cut through the bafe of an exoftofis can be made, the furgeon may venture to remove the tumour by attacking its furface with trephines, the faws defcribed by Hey, or with a gouge and mallet, as the French furgeons are fo much in the habit of doing. When the confiftence of the exoftofis is not too hard, a ftrong knife may be occafionally employed for removing portions of the fwelling, which purpofe it will accomplifh better than any faw.

The ancients, indeed, we might fay feveral of the moderns, have attempted to deftroy exoftofes with the actual and potential cautery. Sometimes thefe violent means have fulfilled the object in view; but, frequently, inftead of affording relief, they have killed a large portion of the bone, and converted the difeafe into the more afflicting one of necrofis, attended with large fores and abfceffes, and often with fuch debility and hectical fymptoms, as have ended in death.

Few good practitioners of the prefent day, in England, ever have recourfe to this plan for the extirpation of exoftofes.

When prudence prohibits an endeavour to cut away an exoftofis, the difeafe fhould never be fuffered to expand itfelf in fo great a degree as to deprive the patient of the choice of parting with his limb for the prefervation of his life. Amputation fhould always be performed ere the diforder attains this deplorable ftate.

We fhall conclude the prefent article with this general obfervation, that if an attempt is to be made to extirpate an exoftofis, let it be done at an early period of the difeafe, before its fize is very confiderable.

EXOSTRA, in the *Ancient Theatre*, a place where fuch parts of the play were recited as were fuppofed to be acted privately in the houfe.

Exostra was likewife the name of a warlike engine ufed in the fieges of towns.

EXOTERIC and Esoteric, are terms denoting *external* and *internal*, and applied to the double doctrine of the ancient philofophers: the one was public or exoteric, the other fecret, acroamatic, or efoteric. The firft was that which they openly profeffed and taught to the world; the latter was confined to a fmall number of chofen difciples. This method was derived originally from the Egyptians, who, according to the united teftimony of Herodotus, Diodorus Siculus, Strabo, Plutarch, &c. had a two-fold philofophy, one fecret and facred, another public and common. The fame practice alfo obtained among the Perfian Magi, the Druids of the Gauls, and the Brachmans of India. The Egyptian priefts, with whom it originated, fuftained the character of judges and magiftrates, and probably introduced this diftinction with a view to the public welfare, and to ferve the purpofes of legiflation and government. Clement of Alexandria informs us, that they communicated their myfteries principally to thofe who were concerned in the adminiftration of the ftate; and Plutarch confirms the fame declaration. However, others have fuppofed that they invented the fables of their gods and heroes, and the other external ceremonies of their religion, to difguife and conceal natural and moral truths; but whatever was the motive of their practice, it was certainly applied to political purpofes. See Aristotle.

EXOTIC, Ἐξωτικος, a term properly fignifying *foreign*, or *extraneous*, *i. e.* brought from a remote or ftrange country. In which fenfe we fometimes fay, *exotic*, or *barbarous terms* or *words*, &c.

The word is derived from the Greek, ἐξω, ἐξωθεν, *extra*, *without*, *on the outfide*.

Exotic is chiefly applied to plants which are natives of foreign countries, particularly thofe brought from the Eaft and Weft Indies, and which do not naturally grow in Europe.

The generality of exotics, or exotic plants, do not thrive in England without fome peculiar care and culture; they require the warmth of their own climates, whence the ufe of hot-beds, glafs-frames, green-houfes, &c. See Green-*houfe* and Stove.

In

In fending plants from one country to another, particular cautions are neceffary. The plants fent from a hotter country to a colder, fhould be always put on board in the fpring of the year, that the heat of the feafon may be advancing as they approach the colder climates; and on the contrary, thofe which are fent from a colder country to a hotter, fhould be fent in the beginning of winter.

The beft way of packing up plants for a voyage, if they be fuch as will not bear keeping out of the earth, is to have boxes with handles, filling them with earth, and planting the roots as clofe together as may be; the plants fhould be fet in thefe boxes three weeks before they are to be put on board; and in good weather they fhould be fet upon the deck, and in bad removed, or covered with a tarpaulin.

If they are going from a hotter country to a cold one, they muft have very little moifture; if, on the contrary, they are going from a colder to a warmer, they may be allowed water more largely, and being fhaded from the heat of the fun, they will come fafe.

Many plants, however, will live out of the earth a great while; as the fedums, euphorbiums, ficoides, and other fucculent ones. Thefe need no other care than the packing of them up with mofs in a clofe box, and there fhould be a little hay put between them, to prevent them from wounding or bruifing one another, and holes bored in the boxes to keep them from heating and putrefying. In this manner they will come fafe from a voyage of two or three, or even four or five months.

Several trees alfo will come fafely in the fame manner, taking them up at a feafon when they have done growing, and packing them up with mofs. Of this fort are oranges, olives, capers, jafmines, and pomegranate-trees. Thefe, and many others, are annually brought over thus from Italy; and though they are three or four months in the paffage, feldom mifcarry. And the beft way of fending over feeds is in their natural hufks, in a bag, or packed up in a gourd-fhell, keeping them dry, and out of the way of vermin. Miller.

Dr. Lifter has a difcourfe in the Philofoph. Tranf. on Exotic Difeafes, *i. e.* fuch difeafes as are never bred among us, but brought, from time to time, by infection from other countries. Such, according to this author, are, 1. The plague, which is properly a difeafe of Afia, where it is epidemic. 2. The fmall-pox, which is an Oriental difeafe, and not known to Europe, or even Afia Minor or Africa, till a fpice-trade was opened to the remoteft part of the Indies, whence it originally came, and where it ftill rages more cruelly than among us. 3. The griping of the guts, which he takes for a difeafe peculiar to the Weft Indies, and yearly received from thence: for this, he adds, is a quite different difeafe from the tormina ventris of the ancients, and is fcarce ever known in the midland counties, or far in the north of England.

EXOUCONTII, in *Church Hiftory*, a kind of Arian heretics, who maintained that the Son of God was made out of nothing: *i. e.* Ἐκ τῶν ἐκ ὄντων, fuppofed by Gothofred to be the fame with the Exocionitæ; but this opinion is contradicted by the authority of Theodoret.

EXPAND, in a *Military Senfe*, relates to the exterior of a line or front, either for the purpofe of occupying a greater fpace, or in order to outflank the enemy, thereby to beat in his wings upon his centre.

It is often of the greateft importance to prefent a more extended line of fire, efpecially if it can be directed towards any particular fpot; for inftance, when a column is iffuing from a defile, a detroit, or pafs, the enemy will certainly endeavour to pour upon its front as heavy a fire as the fpace may allow.

Thus, he will probably oppofe a formidable cannonade thereto, fo that the fhots may range along the column, doing great havoc therein, not only among the foldiery, but deftroying the cattle, and difabling the artillery. The reft of the field he will generally occupy in an inflected form, prefenting a crefcent; much the fame as that oppofed to the immortal Nelfon in his laft victory! By this means every mufket becomes obnoxious, each being levelled at the head of the column.

If we imagine 3000 men to be drawn up in fuch a manner as may produce this effect, and that five or fix guns are brought to bear as above defcribed, with perhaps a body of cavalry ready to charge in flank, when the column may have proceeded to contend with the centre of the oppofing force, we fhall then fee how neceffary it is for the column to expand with all poffible celerity, and not to attempt fuch an attack before a fufficient front can be formed to make it with effect.

The mode of expanding may be feen under the article DEPLOY, where this particular operation will be found more fully defcribed. We fhall in this place remark, that expanfion is by no means proper where the enemy can bring a large body of cavalry to act in an open country, unlefs an equal number of fuch troops may be at hand to oppofe them.

Where a line of intrenchments is to be carried, expanfion is not eligible; yet the concentration muft be managed with peculiar care whenever the enemy may be able to line their works with artillery, efpecially howitzers of large calibre, which, by pouring grape among clofe bodies of men, would foon thin their ranks, and probably occafion, what is delicately called, "a precipitate retreat." The beft authorities inftruct us to fay, that nine battles in ten are loft by allowing the troops to be too expanded: in fuch a condition they are every where weak; whereas, when properly concentrated, they are every where formidable.

We may from this collect, that allowing an army to cover too great an expanfe, is, generally fpeaking, expofing it to ruin; it enables the enemy to force a line in whichever quarter they may judge proper, and, after forcing it, to cut up the feveral parts in detail. Hence, blockades are, with few exceptions, extremely dangerous, as may be better underftood by reference to *environ*, which fee.

When a column is to expand or deploy, or when an augmentation of front is to be made, fuch ought to be done with great promptnefs, and under a heavy fire from each divifion, fo faft as it can arrive at its ftation in the line. By this means, efpecially if the wind be favourable, the whole may be done under cover of the fmoke, and the enemy may be fo rapidly gained upon, as in turn to render it neceffary for him to change pofition; but without great coolnefs and firmnefs, nothing will be effected.

EXPANDING RIGGER, or *Drum*, in *Mechanics*, is a wheel, or rigger, to receive an endlefs rope, which can be enlarged or diminifhed in its diameter, to give a greater or lefs velocity to the rope.

The common expanding rigger is a caft-iron wheel with twelve arms, in each of which a groove is formed, extending nearly from the centre to the circumference, as A A, *fig.* 5. *Plate* XXVI. *Mechanics*. Againft each arm a piece of wood is placed, which has a rebate fitting into the groove, and a fcrew-bolt paffing through both wood and the arm of the wheel; a nut fcrewed upon the bolt faftens the bolt and wood at any place in the groove: each piece of wood has a groove in it to receive the rope which paffes round the wheel. The diameter of this rigger can be altered by loofening the nuts, then placing the pieces of wood all in one circle of the propofed diameter, and faftening them there by the nuts. To facilitate the placing of the pieces of wood in one circle, each arm is divided into inches, and numbered from the centre.

Mr. Andrew Flint, of London, lately received a premium of fifty guineas from the Society of Ats, for two expanding band wheels, or riggers. *Figs.* 5, 6, and 7, are different views of the firft of thefe; A A is a caft metal wheel with twelve arms, each divided by a groove from near the centre to the circumference: thefe grooves receive rebates on the backs of twelve racks *a a*, *figs.* 6 and 7, which have projecting pieces *b*, *b*, with grooves to contain the endlefs rope *d d*. In *fig.* 5. which is a back view of the wheel *e e*, are nuts, which draw up the racks to flide in the grooves without fhake, yet freely to and from the centre: the racks are moved all together by means of a circular plate *d d*, which has a fpiral rib upon it entering between the teeth of each rack, fo that when the plate is turned round, all the racks move to or from the centre at once: the fpiral plate *d d* is fcrewed to an iron crofs, which fits upon the axis *f f*, and is turned round by a pinion *g* of fix teeth, working into a ring of teeth made in the infide of the fpiral plate *d*.

Another method of accomplifhing the fame object is by means of twelve fcrews *h* (*figs.* 8. and 9) pointing to the centre of the wheel; they are are all moved together by means of equal bevelled wheels fixed on them; by this means the fcrews are turned about contrary ways alternately: they muft, therefore, be alternately cut right handed and left handed, that they may produce the fame effect. The fcrews are turned, when the diameter of the rigger is to be altered, by a winch put upon any of the three fquares *h*, *h*, *h*, on the ends of the fcrews. In this machine the number of fcrews muft be even.

Figs. 10, 11, and 12, are drawings of an expanding rigger contrived by the writer of this article: it confifts of two wheels of caft-iron A, A, (*figs.* 10, 11, and 12.) which have fixteen fectorial apertures marked *a*, which leave fixteen arms between them; the arms and the fpaces are exactly equal, and each arm has a triangular piece of wood *b d e*, (*fig.* 12.) fcrewed upon it, by four fcrews going through the arm into the wood, which is alfo kept firm and perpendicular to the face of the wheel, by a rib *f*, (*fig.* 11.) which projects from each arm, and is let into a groove cut in the wood. The wheels have fockets *g*, *g*, (*figs.* 10 and 12.) which are bored out with a very true cylindrical hole to receive the fhaft or fpindle B B of the rigger, which is turned in the lathe to fit the fockets without fhake, yet at the fame time allowing them to move backwards and forwards upon the axis B B. The wheels are put together upon the fpindle facing each other, the wooden triangles of one wheel entering the fpace between the arms of the other, as is fhewn in *figs.* 10 and 12; in this manner it is plain that the points, or rather plane, of interfection of the triangles *b d e* of each wheel, will form a circular groove to receive a rope, which groove can be increafed in its diameter by advancing the wheels towards each other, or diminifhed by fetting them farther apart, as in *fig.* 10. The wheels are prevented from turning on the fpindle by means of a fillet, which is inferted partly into a groove cut in the axis, and partly in another groove made in the focket of the wheel. The wheels may be brought nearer together, or thrown farther apart, by two fcrews *h*, *h*, (*fig.* 12.) which have fockets in one wheel, and are tapped into the other: two equal cog-wheels *i*, *i*, are keyed faft upon the fcrews, and an intermediate cog-wheel *k*, placed loofely upon the main axis between them, caufes both fcrews to turn at the fame time. A more fimple method of altering the diameter is by pufhing the wheels together by hand, and faftening them to the axis by fcrews *e*, *e*, *fig.* 10.

EXPANSION, in *Metaphyfics*, expreffes the idea we have of lafting or preferving diftance, *i. e.* of diftance, all the parts whereof exift together.

Expansion, from the Latin *expando*, in *Philofophy*, denotes the increment of furface or of bulk, of which natural bodies are fufceptible. With refpect to the expanfion of furface, fee the articles Ductility and Gold *Beating*.

Bodies of every kind, as far as we are acquainted with them, are expanded in bulk by heat, and are contracted by cold; and to this law there are very few exceptions, which will be noticed in due time. The expanfions, or the increments of bulk, are not exactly proportional to the increments of heat in the fame body; nor are different bodies expanded alike by the like elevation of temperature. Thus, if a quantity of water be increafed one inch in bulk, by the communication of ten degrees of heat, the communication of twice or thrice as much more heat will not caufe it to expand two or three inches more. Alfo, if a rod of gold, and another fimilar rod of glafs, be heated to the fame degree, their increments of bulk, arifing thereby, will not be equal, the gold expanding more than the glafs.

Of the three principal ftates of natural bodies, *viz.* folids, liquids, and elaftic fluids, the folids are expanded leaft; the liquids are expanded more than the folids, but the elaftic fluids are expanded a vaft deal more than the liquids. The knowledge of the precife quantities of thefe expanfions of bodies is of great ufe in philofophy, in mechanics, and in other fcientific fubjects; hence no pains have been fpared by philofophers to inveftigate and afcertain them; various inftruments have been contrived for that purpofe; innumerable experiments have been inftituted; and a great many ufeful refults have been obtained. Of thefe refults we fhall now endeavour to give a regular and diftinct account.

The inftruments which have been contrived for the purpofe of meafuring the expanfions of folids arifing from an elevation of temperature, are called *pyrometers*. The objects which muft be had in view in the conftruction of pyrometers, are to form a fteady frame, wherein folids of a certain length may be applied either fucceffively, or feveral of them at the fame time, fome contrivance by which thofe metallic bodies may be heated to any required degree, and a mechanifm capable of meafuring the increafe of bulk which is caufed by the heat; and this may be accomplifhed by means of multiplying wheels, by levers, by fcrews, by a microfcopical micrometer, or otherwife. See Pyrometer.

Some of the firft determinations of the expanfion of bodies, that may be confidered as being fufficiently accurate, were made by Mr. Ellicot with a pyrometer of his contrivance. Mr. Ellicot determined the proportional expanfions of feven metallic bodies by the fame elevation of temperature. They are as follows:

Gold.	Silver.	Brafs.	Copper.	Iron.	Steel.	and Lead.
73.	103.	95.	89.	60.	56.	149.

Mr. Smeaton contrived a much better pyrometer, and with it he determined the expanfions of feveral folids. Mr. De Luc alfo contrived a pyrometer of a peculiar conftruction; but Mr. Ramfden's pyrometer is fuperior to any other contrivance of the kind.

The following table fhews, in parts of an inch, how much one foot length of different fubftances is expanded by 180° of heat, Fahrenheit's fcale, between the freezing and the boiling

boiling points of water. To the firſt ſeven ſubſtances, (which were examined in Mr. Ramſden's moſt accurate pyrometer,) there are added the expanſions for a ſingle degree of heat. The others were determined by Mr. Smeaton with his pyrometer.

	Fahrenheit's Scale.	
	By 1°	By 180°.
Standard braſs ſcale, ſuppoſed to be Hamburgh braſs	0.0001237	0.0222646
Engliſh plate braſs in form of a rod	0.0001262	0.0227136
Engliſh plate braſs in form of a trough	0.0001263	0.0227386
Steel rod	0.0000763	0.0137368
Caſt-iron priſm	0.0000740	0.0133126
Glaſs tube	0.0000517	0.0093138
Solid glaſs rod	0.0000539	0.0096944
White glaſs barometer tube		0.0100
Martial regulus of antimony		0.0130
Bliſtered ſteel		0.0138
Hard ſteel		0.0147
Iron		0.0151
Biſmuth		0.0167
Copper hammered		0.0204
Copper eight parts, with tin one part		0.0218
Caſt braſs		0.022[illegible]
Braſs ſixteen parts, with tin one part		0.0229
Braſs wire		0.0232
Speculum metal		0.0232
Spelter ſolder, *viz.* braſs two parts, zinc one		0.0247
Fine pewter		0.0274
Grain tin		0.0298
Soft ſolder, *viz.* lead two parts, tin one		0.0301
Zinc eight parts, with tin one, a little hammered		0.0323
Lead		0.0344
Zinc or ſpelter		0.0353
Zinc hammered half an inch *per* foot		0.0373

Iron, inſtead of being condenſed into a ſmaller bulk, expands in its tranſition from a fluid into a ſolid ſtate; ſo that a quantity of iron occupies more room in the ſolid form than it does in a fuſed ſtate.

Dr. Wollaſton, in order to form ſome eſtimate of the comparative rate of expanſion of platina and palladium, ſays, "I rivetted together two thin plates of platina and palladium, and obſerving that the compound plate, when heated, became concave on the ſide of the platina; I aſcertained that the expanſion of palladium is in ſome degrees the greater of the two. By a ſimilar mode of compariſon I found that palladium expands conſiderably leſs than ſteel by heat." Phil. Tranſ. for 1805.

It muſt be remarked with reſpect to the expanſion of glaſs, that ſometimes glaſs tubes are extended more than ſolid glaſs rods: their dilatation, however, is not conſtant; for tubes of different diameters, or of different ſorts of glaſs, are expanded differently by the like degrees of heat.

Wood is not expanded much longitudinally; that is, in the direction of its fibres, by heat, and this is particularly the caſe with deal and other ſtraight-grained wood. Probably, upon the whole, the longitudinal expanſion of wood is leſs than that of glaſs. It has been obſerved, (eſpecially by Dr. Rittenhouſe, Tranſ. of the American Phil. Society) that very dry and ſeaſoned wood, if not expoſed to a very high or to a very low temperature, will expand in length pretty regularly: otherwiſe its expanſion by heat, and its contraction by cold, are very irregular: for they ſeem to depend partly upon the heat, and partly upon the moiſture, which the wood acquires in certain circumſtances, and is deprived of in others.

It is hardly neceſſary to mention, that the ſolids of the preceding table contract their dimenſions by cooling as much as they are expanded by heating; thus, for inſtance, if a yard length of any particular metallic body, by being heated 100° above the actual temperature of the atmoſphere, be lengthened one fiftieth part of an inch; afterwards, when cooled down to the temperature of the atmoſphere, it will be found to have loſt exactly that fiftieth part of an inch which it had acquired by heating.

From the experiments hitherto made on the expanſions of ſolids by heat, no correſpondence has been obſerved between the expanſions and the quantities of caloric they are capable of abſorbing. The fuſibility of metals ſeems to coincide with the dilatations; platina, the leaſt fuſible of the metals, dilates the leaſt; lead dilates moſt; and the moſt fuſible glaſs is alſo the moſt dilatable. We may therefore conclude with Mr. Berthollet, that bodies are ſo much the more expanſible, the leſs caloric they require to change their conſtitution from ſolid to liquid, and from liquid to gaſes or vapours.

There is a ſubſtance which expands when heated; but does not contract when cooled; and of this ſingular property Mr. Wedgwood availed himſelf for the conſtruction of his ingenious thermometer for meaſuring the higheſt degrees of heat; *viz.* thoſe degrees which exceed the ſcale of the mercurial thermometer. (See Thermometer.) The ſubſtance alluded to is the argillaceous earth or clay, and it appears that the above-mentioned property belongs, more or leſs, to argillaceous bodies of every kind. This property may at firſt ſight appear to be an unaccountable exception from the general law: the difficulty, however, will vaniſh, if it be conſidered that bodies of the argillaceous genus contain a conſiderable quantity of water, and that the contraction of theſe bodies, when expoſed to the action of a ſtrong fire, is in great meaſure due to the eſcape of the water, and hence they do not contract by ſubſequent cooling.

The method of meaſuring the expanſions of fluids is to incloſe them in a certain veſſel, and to meaſure that part of the cavity of the veſſel, which is occupied by the fluid under trial, in different temperatures. It is evident that the ſubſtance of the veſſel is likewiſe expanded by the heat, and of courſe the cavity of the veſſel is enlarged. Therefore, when we find that the bulk of the fluid is increaſed, that increment is only the difference between the enlarged capacity of the veſſel and the increaſed bulk of the fluid. This ſhews the neceſſity of forming thoſe veſſels of ſuch ſubſtances as are leaſt expanſible by heat. Indeed glaſs is the ſubſtance which is univerſally uſed for ſuch purpoſes, both on account of its little expanſibility, and of its tranſparency; beſides its having other uſeful properties. A glaſs veſſel, filled to a certain degree with a liquid, for the purpoſe of ſhewing the expanſions of that liquid in different temperatures, or for the purpoſe of ſhewing the temperature of the correſponding expanſion of that liquid, is called a thermometer; *viz.* a meaſure of the temperature. See Thermometer.

The propereſt ſhape for a thermometer is that of a long

 tube

tube with a narrow bore, having a globular cavity at one end; which, familiarly speaking, may be called a globular glass bottle with a long and narrow neck. The globular cavity, and part of the tube of one of these vessels, is filled with the liquor whose expansion is to be examined, and the vessel is then heated, in consequence of which the liquor, which is contained in it, is expanded, and not being able to extend itself any other way, all the increment of bulk must be manifested in the tube; *viz.* the surface of the fluid will rise in the tube; or, if cooled, it will descend in it. If the same vessel of the above-mentioned shape be successively filled with different fluids, and with each fluid it be exposed to certain degrees of temperature, (which must be determined by an accurate thermometer,) the proportional expansions of the different fluids may thereby be ascertained. The same object may be obtained by filling several such vessels with the different fluids, that are to be examined, and heating or cooling them all at the same time; but in this case the corresponding capacities of the different vessels must be previously ascertained; which may be done by filling all the vessels with the same kind of fluid, and exposing them all to different degrees of temperature; so that the corresponding elevations of the fluid in the different vessels may be marked on the tubes. These vessels are afterwards emptied and filled again with the fluids, &c. Thus the proportional expansions of liquids may be determined; but when the actual or absolute increase of bulk is required, then the capacity of the vessel must be accurately gauged. This measurement of the capacity may be accomplished in the following manner. In the first place weigh the empty glass tube; secondly, fill part of the tube with a convenient fluid, (mercury, for instance, which is the fittest for such purposes); thirdly, measure the length of the tube which is occupied by the mercury, and weigh the instrument a second time; then, by subtracting this second weight from the former, you will have the weight of mercury which fills up a certain length of the cavity of the tube; fourthly, fill the bulb of the vessel entirely with mercury, and weigh the vessel a third time. This weight being subtracted from the first, *viz.* from that of the empty vessel, will leave the weight of the mercury in the bulb. Now, having the weight of the mercury in the bulb, as well as of that which fills a certain length of the tube, the ratio of the former to the latter may be easily determined by simple division. Also the absolute quantity in bulk of the former is obtained from the well known specific gravity of mercury, and from the weight of a cubic inch of distilled water, which (when the barometer is at 29.74 inches, and Fahrenheit's thermometer at 66°) is equal to 252.42 grains Troy; one pound Troy being equal to 5760 of those grains. An English cubic inch of mercury of the specific gravity 13.6 weighs 3443.2 English grains. Instead of mercury, some other fluid may be employed for this purpose; but not so conveniently as mercury. The expansions of a fluid, which are caused by different degrees of heat, may likewise be determined by ascertaining the specific gravity of that fluid in different temperatures; for the specific gravity decreases in proportion as the fluid is expanded, and *vice versâ;* but this method is not capable of as much accuracy as the former.

Liquids differ from each other in regard to their expansibility; some expanding more than others. Also the expansions of the same liquid by equal degrees of heat are not quite regular; and it has been observed that this irregularity is greater when they approach the state of vapour. Upon the whole, mercury has been found to be expanded by heat more regularly that any other fluid; yet its increments of bulk are not perfectly regular. Mr. De Luc, with great care and patience, has endeavoured to ascertain the real expansibility of mercury, or rather the real quantities of heat that are required for expanding mercury arithmetically, *viz.* by equal augmentations. These are expressed in the following table, the first column of which contains the degrees of Reaumur's scale, from five to five, which are equal parts; the second shews the real quantities of heat which are required to raise the mercury to the corresponding degrees, where z is a fixt but unknown quantity; and the third column shews the differences of those quantities. De Luc's Recher. sur les Modif. de la Atmosph. 1772, p. 309.

	Mercurial Thermom.	Real quantities of heat.	Real differences of heat corresponding to the variations of the Mercury in the thermom. from 5 to 5 degrees.
Point of boil. water	80°	$z+80.00$	
	75	$z+75.28$	-4.72
	70	$z+70.56$	-4.72
	65	$z+65.77$	-4.79
	60	$z+60.96$	-4.81
	55	$z+56.15$	-4.81
	50	$z+51.26$	-4.89
	45	$z+46.37$	-4.89
	40	$z+41.40$	-4.97
	35	$z+36.40$	-5.00
	30	$z+31.32$	-5.08
	25	$z+26.22$	-5.10
	20	$z+21.12$	-5.10
	15	$z+15.94$	-5.18
	10	$z+10.74$	-5.20
	5	$z+5.43$	-5.31
Point of melt. ice	0	z	-5.43

From the third column it appears, that the differences of heat requisite to make equal and progressive additions to the bulk of the mercury, though not exactly equal, yet are not very far from the ratio of equality. If the bulk of a quantity of mercury, at the temperature of 32° Fahrenheit's scale, be conceived to be divided into 100,000 equal parts, and then be heated as high as the temperature of boiling water; (*viz.* 212°) its bulk will thereby be increased by 1836 of those parts.

The expansion of water is attended with a singular deviation from the general law; *viz.* this fluid is expanded by heat from about the 40th degree of Fahrenheit's thermometer upwards; but below 40° its bulk is expanded by a farther decrease of heat, or increase of cold; and in fact ice is lighter than water, so as to float upon it; the specific gravity of ice being to that of water nearly as 7 to 8. The bulk of ice is to that of the water, when the ice is melted, as 9 to 8 very nearly. The bulk of water, from its most contracted state at the temperature of 40°, increases continually; but that increase is not very regular; for instance, the increase of bulk from 180° to 212°, is considerably greater than from 40° to 72°. If the bulk of water at 40° be called 1, its bulk at 212° will be 1.04785. Beyond that degree of heat water becomes vapour; *viz.* an elastic fluid; and the formation of this elastic fluid on the sides of the vessel within the water, forms the bubbles, the escape of of which conftitutes the boiling. The bulk of fteam at the boiling point is fomewhat lefs than 1800 times the bulk of the water from which it originated.

The expanfion of freezing water is not owing to the extrication of air; for water deprived of air expands like other water in freezing. Mr. Mairan attributes it to a ftrong tendency the particles of water have to arrange themfelves into ranks and lines, which crofs one another at angles of 60° and 120°. This tendency feems to begin at the temperature of 40°. The expanfion of freezing water has a prodigious force. It is owing to this that in hard frofts timber is burft, plaifter is removed from walls, and even iron mortar fhells filled with water, and accurately ftopped, have been burft by the freezing of the water.

This fingular property of water, *viz.* its expanding from the temperature of 40° downwards, fo as to become lighter and lighter in proportion as it becomes colder and colder, is a moft ftriking inftance of the wifdom of the Creator, and is a property of immenfe confequence to the very exiftence of animals and vegetables. A quantity of water is indifpenfably neceffary to animals and to vegetables at all times of the year. In winter, when the cold air freezes the furface of the water, that effect feldom penetrates lower than two or three feet. Below that depth the water continues fluid, and the cruft of ice itfelf contributes to preferve its fluidity. The heat of the earth, which has been acquired during the fummer, undoubtedly prevents the formation of ice below a certain depth. But if water in cooling had continued to increafe in fpecific gravity, and had ice been actually heavier than water, the heat of the earth would not have been fufficient to prevent the total freezing of all the waters of lakes, feas, rivers, &c. "For," fays count Rumford, "as the particles of water on being cooled at the furface would, in confequence of the increafe of their fpecific gravity, on parting with a portion of their heat, immediately defcend to the bottom, the greateft part of the heat accumulated during the fummer in the earth, on which the water repofes, would be carried off and loft before the water began to freeze; and when ice was once formed, its thicknefs would increafe with great rapidity, and would continue increafing during the whole winter; and it feems very probable that in climates which are now temperate, the water in the large lakes would be frozen to fuch a depth in the courfe of a fevere winter, that the heat of the enfuing fummer would not be fufficient to thaw them; and fhould this once happen, the following winter would hardly fail to change the whole mafs of its waters to one folid body of ice, which never more could recover its liquid form, but muft remain immoveable till the end of time." (7th Effay.)

The following table fhews the expanfions of the principal liquids that have been fubmitted to fuch experiments, according to Mr. De Luc's obfervations. With refpect to this table it muft be underftood that different thermometers (each being filled with a particular fluid, fuch as is mentioned at the top of each column, and each being divided into 80 equal parts between the freezing and the boiling points of water) are placed with their bulbs in the fame veffel full of water, and that the water is gradually heated. Then when the mercurial thermometer ftands at 5°, 10°, 15°, &c. the furfaces of the fluids in the other thermometers will be found at the degrees which ftand on the fame levels; for inftance, when the mercurial thermometer ftands at 40°, the water thermometer will be found to ftand at 20°.5, the fpirit thermometer will be found to ftand at 35°, the oil thermometer at 39°.2, &c.

	Mercury.	Water	Water faturated with falt.	Alcohol.	Alcohol 3 parts, water 1.	Alcohol and water equal parts.	Alcohol 1 part, water 3.	Oil of olives.
Boiling water	80°	80.0	80.0	80.0	80.0	80.0	80.0	80.0
	75	71.0	74.1	73.8	73.7	73.2	71.6	74.6
	70	62.0	68.4	67.6	67.5	66.7	62.9	69.4
	65	53.5	62.6	61.5	61.5	60.6	55.2	64.4
	60	45.8	57.1	55.5	55.8	54.8	47.7	59.3
	55	38.5	51.7	50.3	50.2	49.1	40.6	54.2
	50	32.0	46.6	45.1	44.9	43.6	34.4	49.2
	45	26.1	41.2	40.0	39.7	38.4	28.4	44.0
	40	20.5	36.3	35.0	34.8	33.3	23.0	39.2
	35	15.9	31.3	30.1	29.8	28.4	18.0	34.2
	30	11.2	26.5	25.5	25.2	23.9	13.5	29.3
	25	7.3	21.9	20.9	20.7	19.4	9.4	24.3
	20	4.1	17.3	16.5	16.2	15.3	6.1	19.3
	15	1.6	12.8	12.0	11.8	11.1	3.4	14.4
	10	0.2	8.4	7.9	7.7	7.1	1.4	9.5
	5	0.4	4.2	3.9	3.8	3.4	0.1	4.7
Freezing	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5		4.1					
	10		8.0					

The expanfions of elaftic fluids, fuch as common air, the gafes, and vapours, are more difficultly afcertained; for the expanfions of thofe fluids are occafioned by a diminution of preffure, as well as by an increafe of temperature; and it is difficult to fubject any of thofe fluids to the action of one of thefe caufes only at a time, in order that the effect of each may be duly eftimated.

When common air is acted upon by preffure only, independent of any alteration of temperature, its bulk is found to increafe and to decreafe in the inverfe proportion of the preffure; thus, the air clofe to the furface of the earth is compreffed into the bulk which we experience, by the fuperincumbent atmofphere. If that preffure be increafed, the bulk of the lower air will be contracted, which is manifefted by an augmentation of its weight; if that preffure be diminifhed, the bulk of the lower air will be increafed, as is manifefted by a diminution of its weight. And this expanfion and contraction of the air is exactly but inverfely proportional to the preffure; fo that a double preffure will comprefs it into half the fpace, a treble preffure into one third of the original fpace, &c. The fame thing, *mutatis mutandis*, may be faid of the removal of preffure, and of the expanfion thereby arifing. This elafticity of the air has not been found to be impaired by a long continuance of the preffure; for air has been left during feveral years very much compreffed in proper veffels, wherein there was nothing that could have a chemical action upon it; and afterwards on removing the unufual preffure, and replacing it in the fame temperature, the air has been found to recover its original bulk. It is not known how far a quantity of air may be expanded by removing the preffure, nor how much it may be compreffed by increafing the preffure; for no experiments have as yet been able to afcertain either limit.

The inftrument, in which the expanfion of air is tried, has been called *manometer*, (which fee,) It is a fort of large air thermometer, confifting of a tube five or fix feet long, having a bulb at one end, and being open at the other end. The bore of the tube is about a 20th of an inch in diameter. A fmall quantity of quickfilver is placed in fome

part

part of the cavity of the tube, and the expanfion of the air in the bulb, when heated, forces the quickfilver to move towards the open end of the tube. The degree of heat to which the manometer is expofed is meafured by means of a thermometer; the quantity of expanfion of the air is meafured by gauging the manometer, and making marks on the tube, which may indicate parts of the cavity of the tube that are proportional to the capacity of the manometer; as for inftance 100dths, 1000dths, &c. By placing the manometer horizontal or vertical, either with the bulb downwards or upwards, the air in it may either be left of the natural denfity, or it may be condenfed, or, laftly, it may be rarefied; for when the manometer ftands horizontal, the quickfilver in the tube does not prefs upon the air in the bulb, nor on that of the atmofphere; when the bulb is downwards, the quickfilver preffes upon the air of the manometer, and when the bulb is upwards, the quickfilver preffes againft, and counteracts, in fome meafure, the gravity of the atmofphere. Hence this preffure, and this expanfion of the air within the manometer, may be increafed to any required degree by increafing the quantity of quickfilver within the tube: and thus the expanfibility of common, or of condenfed, or of rarefied air, may be tried. The expanfion of air, by the fame degrees of heat, differs according to its denfity, and to the quantity of moifture it contains; nor are the increments of its bulk proportional to the degrees of temperature.

It appears from Col. Roy's very numerous experiments (Phil. Tranf. vol. 67th) that 1000 parts of air, of the denfity of the common atmofphere, at 0° of heat, become 1484.21 at 212°; *viz.* are expanded 484.21, by 212° of heat.

1000 parts of air loaded with $2\frac{1}{2}$ atmofpheres, are expanded 434 of thofe parts, by 212° of heat.

1000 parts of air preffed only with $\frac{1}{6}$ths of an atmofphere, are expanded nearly 484 of thofe parts by 212° of heat.

1000 parts of air preffed with $\frac{1}{5}$th of an atmofphere, are expanded about 141 parts by 180° of heat; *viz.* from the freezing to the boiling point of water.

"From thefe laft experiments," Col. Roy fays, "it would feem that the particles of air may be fo far removed from each other, by the diminution of preffure, as to lofe a very great part of their elaftic force."

The above-mentioned expanfions of air are by no means regular: *viz.* they are not proportional to the number of the degrees of heat. The maximum of expanfion takes place between 52° and 72: and the minimum is conftantly at the boiling point of water. Moift air expands a great deal more than dry air, efpecially when it approaches the boiling point of water; fo that between 192, and 212°, moift air expands about eight, or nine, times as much as dry air in fimilar circumftances.

The expanfions of gafes may be tried and determined in the fame manner as the expanfion of common air. From a long feries of experiments, Meffrs. Guyton and Prieur deduced a dilatation peculiar to each gas; but Mr. Guy-Luffac has fhewn, that all gafes, without exception, poffefs the fame expanfibility at the fame degree of temperature, and that the prefence of water in gafes occafioned the errors into which his predeceffors had fallen. He is led to conclude from his experiments made on gafes reduced to the utmoft degree of drynefs, that 100 parts of each of the permanent gafes acquire an increafe of $\frac{1}{213}$ by every degree of the thermometer from 0° to 80° Reaumur's fcale. Vapours, he alfo thinks, follow the fame laws of dilatation as gafes, provided the temperature be fufficiently elevated to keep them in the elaftic ftate. Therefore, Mr. Chaptal fays, it may be laid down as a principle, that gafes and vapours are equally dilatable, and equally compreffible; but it will be neceffary to be more particular with refpect to the expanfibility of the vapour of water, upon the elafticity of which numerous natural phenomena, and the action of feveral important machines, depend.

Mr. Schmidt alfo made a feries of experiments upon the expanfibility of air, made as dry as poffible by expofure to hot potafh. He found the expanfion of a quantity of air which meafured one inch at the freezing point, *viz.* at the temperature of 0° Reaumur's thermometer, to expand as below.

Degrees of Reaumur.	Expanfion of one inch.
1	0.0044675
4	0.0178700
8	0.035740
12	0 0536100
16	0.0714800
20	0.0893500
24	0.1072200
28	0.1250979
32	0.1429600
36	0.1608300
40	0.1787000

This table alfo fhews, by its differing from the refults of D'Amontons, De Lue, Lambert, Schuckburgh, Berthollet, and others, that thofe gentlemen operated upon air more or lefs charged with moifture. They alfo took the barometers at different altitudes. In Mr. Schmidt's experiments the barometer was taken at 29,841 Englifh inches. Thefe variations of the rates of expanfibility of moift air, faturated at different temperatures, Schmidt attributes to the variations of the degrees of affinity between air and vapour.

Water heated to the 212th degree of Fahrenheit's thermometer (or thereabout, for the different gravity of the atmofphere occafions a confiderable difference) overcomes the ordinary preffure of the atmofphere and becomes fteam, an elaftic fubftance, the bulk of which at that point is fomewhat lefs than 1800 times the bulk of the water from which it originated. Beyond that point vapour is expanfible in a moft aftonifhing degree; for 30° more of heat (*viz.* the temperature of 242°) will double the elaftic force of fteam; 30° more added to that (*viz.* the temperature of 272°) will render the elaftic force of fteam nearly equal to four atmofpheres; and fo forth. This immenfe expanfibility of fteam, when the heat which produces it is quickly fupplied, is capable of producing prodigious effects. When water is caufed to boil in a veffel upon a common fire, the heat which is communicated cannot convert all the water at once into fteam; but if the quantity of water be fmall in proportion to the heat which can be communicated in a given time, then the converfion of water into fteam is quickened to any degree, and it may be rendered inftantaneous; in which cafe it produces a fudden and violent expanfion, or an explofion. A drop of rain in boiling linfeed oil, falls to the bottom, is inftantly converted into vapour, and occafions dangerous confequences. "It has fometimes," Dr. Black fays in his Chemical Lectures, "happened that a perfon, by carelefsly fpitting into a copper foundery, has occafioned an explofion that deftroyed the whole building." Count Rumford attributes the vaft force of gun-powder to the fudden converfion into vapour of that quantity of water which naturally enters into the compofition of that powder; it being a component of the nitre. Phil. Tranf. for 1797.

Water

Water at the temperature of 212° is converted entirely into fteam, or rather, under the ordinary preffure of the atmofphere, water cannot be heated higher than 212°; but water is gradually converted into fteam or vapour at a much lower temperature. Mr. Pictet inftituted a feries of experiments on the clafticity of pure vapour in low temperatures. He found that a grain of warm water in vacuo evaporates in forty minutes in the temperature of 38° Fahr. under a receiver containing 1452 Englifh cubic inches, but that it did not diffufe itfelf equally in lefs than fix hours and then raifed the hygrometer from 17° to 60°, that is, 43°; and during this whole time the cold under the receiver was conftantly decreafing, though flowly: which decreafe undoubtedly contributed to the diffufion of the vapour. Effais de Phyfique, p. 157.

The beft, or moft extenfive experiments upon the expanfive force of the fteam of water, and of the fteam of alcohol, were made by the Chev. de Bettancourt; and are related by Prony in the fecond volume of his "Architecture Hydraulique;" from which the following compendious fketch is derived.

The fluid with which the experiments were made was confined in a very ftrong copper boiler, being eight inches at its greateft diameter, and fourteen inches in height. The upper part of it was clofed by a cover made of copper, through which paffed three tubes. The firft ferved to introduce the fluid into the boiler, and could be clofed by means of a fcrew. The fecond was occupied by a thermometer, having its ball about two inches above the bottom of the boiler, and the fcale, which was on the outfide, contained from 0° to 110° of Reaumur. To the third was adapted a bent barometer tube, having two lines of internal diameter; the afcending branch of which was 110 inches in length. By means of a lateral cock a communication was eftablifhed between the boiler and an air pump, which ferved to make a vacuum before the fire was kindled in the furnace below the apparatus. This circumftance of evaporation in a vacuum forms an effential difference between the experiments of Bettancourt and thofe made before by Ziegler, and renders them applicable to the theory of the fteam-engine, where the vapour acts in a fpace freed from air.

A vacuum having been made in the boiler, the mercury brought as nearly as poffible to a level in the two branches of the barometric tube, and the thermometer reduced to zero by means of ice, the ice was removed, and a fire was kindled, which was excited gently and with much equality, that the thermometer paffed over about a degree per minute. One perfon then ftood by to obferve the barometer, and another to obferve the thermometer, and each kept a regifter from degree to degree of the preffure and correfponding temperatures; the preffure being expreffed by the height, in French inches, of the columns of mercury, which rofe above the level in the long branch of the barometer.

Thefe obfervations of the expanfive force of the fteam of water furnifh 110 refults, proceeding from degree to degree of the thermometer, and beginning at zero. Thefe refults are contained in the following table, where the degrees of preffure are expreffed in French inches of perpendicular height of mercury, and the temperature is denoted according to Reaumur's fcale. The experiments on the expanfive force of the fteam of alcohol were made by the like procefs, and with the fame apparatus.

Table of the Expanfive Force of the fteam of Water and of Alcohol.

Temperature.	Preffure.		Temperature.	Preffure.		Temperature.	Preffure.	
	Water.	Alcohol.		Water.	Alcohol.		Water.	Alcohol.
0	0.00	0.00	37	2.45	5.55	74	20.60	48.10
1	0.00	0.00	38	2 57	6.00	75	21.75	50.20
2	0.00	0.00	39	2.75	6.45	76	22.90	52.60
3	0.00	0.05	40	2.92	6.90	77	24.15	55.30
4	0.02	0.09	41	3.10	7.35	78	25.50	57.90
5	0.02	0.12	42	3.27	7.82	79	26.67	61.00
6	0.05	0.18	43	3.47	8.37	80	28.00	63.80
7	0.07	0.25	44	3.70	8.92	81	29.60	66.90
8	0.10	0.32	45	3.95	9.48	82	31.30	69.8
9	0.12	0.38	46	4.25	10.15	83	33.00	73.40
10	0.15	0.45	47	4.45	10.80	84	34.60	76.90
11	0.18	0.50	48	4.75	11.50	85	36.45	79.60
12	0.22	0.62	49	5.00	12.20	86	38.10	83.60
13	0.27	0.72	50	5.35	12.35	87	40.00	87.10
14	0.30	0.82	51	5.70	13.75	88	42.20	90.80
15	0.35	0.93	52	6.05	14.60	89	44.30	95.00
16	0.40	1.02	53	6.50	15.50	90	46.40	98.00
17	0.45	1.12	54	6.90	16.40	91	48.40	
18	0.52	1.25	55	7.32	17.65	92	50.50	
19	0.58	1.38	56	7.85	18.85	93	53.00	
20	0.65	1.52	57	8.40	20.00	94	55.30	
21	0.75	1.65	58	8.85	21.20	95	57.80	
22	0.82	1.80	59	9.35	22.30	96	60 50	
23	0.90	1.95	60	9.95	23.70	97	63.40	
24	0.97	2.10	61	10 40	24.80	98	66.20	
25	1.05	2.32	62	11.00	26.10	99	69.00	
26	1.12	2.52	63	11.70	27.40	100	71.80	
27	1.22	2.75	64	12.40	28.90	101	75.00	
28	1.32	2.95	65	13.20	30.60	102	78.20	
29	1.42	3.20	66	13.80	32.00	103	81.00	
30	1.52	3.40	67	14.50	33.50	104	84.00	
31	1.65	3.70	68	15.25	35.10	105	86.80	
32	1.78	4.00	69	16.10	37.20	106	89.00	
33	1.90	4.30	70	16.90	39.40	107	91.30	
34	2.00	4.60	71	17.80	41.30	108	93.50	
35	2.15	4.95	72	18.70	43.50	109	95.60	
36	2.27	5.28	73	19.50	46.00	110	98.00	

The expanfive force of the fteam of water has alfo been determined by Mr. Schmidt, with all the accuracy that the experiments feem to admit of: but the refults which he has not ftated for every degree of the thermometer, do not agree exactly with thofe of Bettancourt. We deem it therefore neceffary to fubjoin thofe refults in the following fhort table, wherein the temperature is expreffed in degrees of Reaumur's thermometer, as in the preceding table, and the expanfive force in French inches of perpendicular altitude of mercury.

Table

TABLE of the Expanſive Force of the pure vapour of Water, according to Mr. Schmidt.

Temperature.	Expanſive Force.	Temperature.	Expanſive Force.
0	0.0	22	1.01
5	0.11	25	1.30
6	0.15	27	1.42
10	0.28	30	1.93
12	0.38	33	2.23
13	0.44	35	2.68
15	0.55	37	3.20
16	0.61	39	3.40
18	0.76	40	3.64
20	0.90	80	28.00

Mr. Dalton has likewiſe endeavoured to determine the expanſive force of the vapour of water; but the reſults of his experiments nearly coincide with thoſe of the preceding tables, which ſuperſedes the neceſſity of ſtating them in the preſent article. See EVAPORATION.

From a careful examination of all the experiments made on this ſubject, Dr. Young has deduced a formula by which the expanſive force of ſteam may be determined for any degree of the thermometer, pretty near the real reſults of the experiments. The formula is as follows:

Let f denote the temperature according to Fahrenheit's thermometer, and e the number of inches in perpendicular height of mercury, which the ſteam is capable of ſupporting; then the formula is $e = .1781\ (1 + .006 f)^7$.

The reader might perhaps expect to find in the preſent article the particulars relative to the expanſions of heat, and of electricity; but the uncertain natures of the fluids, to which the effects of heat and of electricity are attributed, beſides other conſiderations, oblige us to refer him to other parts of this Cyclopædia. See HEAT, CALORIC, and the articles belonging to electricity.

Dr. Gregory, in his Aſtron. p. 407, proves, that a globe of our air, of an inch diameter, if it were removed to the diſtance of a ſemidiameter of the earth, would expand itſelf ſo as to fill all the planetary region as far as, nay, far beyond the ſphere of Saturn. See AIR.

EXPANSUM FOLIACEUM. See FOLIACEUM.

EX PARTE, i. e. *partly*, or of *one part*, in *Law*. A commiſſion ex parte, is that taken out and executed by one part only; where both parties join it is called a joint commiſſion. See COMMISSION.

EX PARTE TALIS, a writ that lies for a bailiff or receiver, who, having auditors aſſigned to take his account, cannot obtain of them reaſonable allowance, but is caſt into priſon. The courſe in this caſe is to ſue this writ out of chancery, directed to the ſheriff, to take four mainpernors to bring his body before the barons of the exchequer at a certain day, and to warn the lord to appear at the ſame time. F. N. B. 129.

EXPECTANT FEE, where lands are given to a man and his wife, and the heirs of their bodies; in which ſenſe it differs from fee-ſimple, where lands are given to a man and his wife in frank marriage, to hold to them and their heirs.

EXPECTANCY, ESTATES IN, are of two ſorts; one created by act of the parties, called a *remainder*; the other by act of law, called a *reverſion*. See theſe articles; and alſo ESTATE and EXECUTORY *Deviſe*.

EXPECTATION, in the *Doctrine of Chances*, is applied to any contingent event, and is capable of being reduced to the rules of computation. Thus, a ſum of money in expectation, when a particular event happens, has a determinate value before that event happens; ſo that if a perſon is to receive any ſum, *e. gr.* 10*l.* when an event takes place which has an equal probability of happening and failing, the value of the expectation is half that ſum or 5*l.* and in all caſes, the expectation of obtaining any ſum is eſtimated by multiplying the value of the ſum expected by the fraction, which repreſents the probability of obtaining it. The expectation of a perſon who has three chances in five of obtaining 100*l.* is equal to $\frac{3}{5} \times 100$ or 60*l.* and the probability of obtaining 100*l.* in this caſe is equal to $\frac{60}{100} = \frac{3}{5}$.

If the obtaining of any ſum requires the happening of ſeveral events that are independent on each other, the value of the expectation of that ſum is found by multiplying together the ſeveral probabilities of happening, and by multiplying the product by the value of the ſum expected. *E. gr.* Suppoſe, that in order to obtain 90*l.* two events muſt happen, one of which has three chances to happen and two to fail, and the other has four chances to happen, and five to fail; the value of the expectation is $= \frac{3}{5} \times \frac{4}{9} \times 90 = \frac{12}{45} \times 90 = \frac{4}{15} \times 90 = \frac{360}{15} = 24$*l.* for if the firſt event had actually happened, the value of the expectation depending ſolely on the ſecond event, would be $\frac{4}{9} \times 90 = 40$*l.* and therefore the happening of the firſt event is the condition of obtaining an expectation worth 40*l.* but the probability of the firſt happening is $\frac{3}{5}$, and the expectation ſought for is evidently worth $\frac{3}{5} \times 40 = \frac{3}{5} \times \frac{4}{9} \times 90 = 24$*l.* The rule will be the ſame if an expectation depends on the happening of one event and the failing of another; and alſo on the failing of two events; and on the happening or failing of any number of events that may be aſſigned. It is here ſuppoſed that the events are independent, or that the happening of one, neither forwards nor obſtructs the happening of the other. But if two events are dependent, *i. e.* if they are ſo connected together as that the probability of either's happening is altered by the happening of the other, the probability of their happening is the product of the probability of the happening of one of them by the probability which the other will have of happening, when the firſt is conſidered as having happened; and the ſame rule will extend to the happening of any aſſigned number of events: thus, in a heap of thirteen cards of the ſame colour, the probability of taking out the ace is $\frac{1}{13}$; and the probability of taking the ace out of another heap of the ſame number is $\frac{1}{13}$; and the probability of both theſe independent events happening will be $\frac{1}{13} \times \frac{1}{13} = \frac{1}{169}$: but the probability of taking the ace firſt out of a ſingle heap of thirteen cards is $\frac{1}{13}$; and that of taking the deuce afterwards is $\frac{1}{12}$; and therefore the probability of both happening is $\frac{1}{13} \times \frac{1}{12} = \frac{1}{156}$. If a perſon has ſeveral expectations on ſeveral ſums, the value of his expectation on the whole is the ſum of his expectations on the particulars: thus, let one event be ſuch, that the probability of obtaining any ſum, *e. gr.* 90*l.* in caſe it happens, may be $\frac{3}{5}$; in which caſe the value of the expectation is $\frac{3}{5} \times 90 = 54$*l.* Let the probability of another event, on which depends a ſecond ſum of 90*l.* be $\frac{4}{9}$, and the value of the expectation in this caſe be $\frac{4}{9} \times 90 = 40$*l.* and the value of the expectation on the whole $54 + 40 = 94$*l.* But if a perſon is to receive 90*l.* once for all for the happening of one or other of the two forementioned events, then the expectation of the firſt event being worth 54*l.* as before, yet the expectation of the ſecond will be different; becauſe this depends on the happening of the firſt, and takes place only in caſe the firſt happens to fail, the probability of which is $\frac{2}{5}$; and on the ſuppoſition of its having failed, the expectation of the ſecond will be 40*l.*; therefore $\frac{2}{5}$ is the meaſure of the probability of obtaining an expectation worth 40*l.*; and conſequently the expectation will be worth $\frac{2}{5} \times 40 = 16$*l.* and the value of the expectation on the whole will be $54 + 16 = 70$*l.* See the farther illuſtration and application of theſe principles and rules in De Moivre's Doctrine of Chances, edit. 3. 1776. See CHANCES and GAMING.

EXPECTATION *of Life*, in the *Doctrine of Life Annuities*, donotes, according to the moſt obvious ſenſe of the term, that particular number of years which a life of a given age has an equal chance of enjoying, or the time which a perſon of a given age may juſtly expect to continue in being. But Mr. Simpſon has ſhewn, that this period does not coincide with what the writers on annuities call the expectation of life, except on the ſuppoſition of an uniform decreaſe in the probabilities of life; and Dr. Price adds, that even on this ſuppoſition, it does not coincide with what is called the expectation of life, in any caſe of joint lives: for two lives of 40 have an even chance, according to Mr. De Moivre's hypotheſis (ſee COMPLEMENT *of life*) of continuing together only $13\frac{1}{2}$ years. According to that hypotheſis, the *probability* that a life aged 40 will continue $13\frac{1}{2}$ years will be expreſſed by $\frac{32.5}{46}$; and this fraction multiplied by itſelf is the probability that two lives of this age ſhall both continue $13\frac{1}{2}$ years; *i.e.* $\frac{32.5}{46} \times \frac{32.5}{46} = \frac{1056.25}{2116}$, equal nearly $\frac{1}{2}$, which repreſents an even chance; but the expectation of two joint lives being (according to the ſame hypotheſis) always a third of the common complement, will be in this caſe $15\frac{1}{3}$ years. Therefore, the expectation of life may ſignify the mean continuance of any given ſingle, joint, or ſurviving lives, according to any given table of obſervations, or the number of years which, taking them one with another, they actually enjoy; ſo that if 46 perſons are alive, all 40 years of age, and one be ſuppoſed to die every year, according to Mr. De Moivre's hypotheſis, till they are all dead in 46 years, half 46 or 23 will be their expectation of life; *i.e.* the number of years enjoyed by them all will be the ſame as if every one of them had lived 23 years, and then died; and ſuppoſing no intereſt of money, the value of an annuity payable for life to every ſingle perſon in ſuch a ſet, would juſt be equal to 23 years purchaſe.

The expectation of life coincides with the ſums of the preſent probabilities, that any given ſingle or joint lives ſhall attain to the end of the firſt, ſecond, third, &c. moments, from this time to the end of their poſſible exiſtence; or (in the caſe of ſurvivorſhips) with the ſum of the probabilities, that there ſhall be a ſurvivor at the end of the firſt, ſecond, third, &c. moments, from the preſent time to the end of the poſſible exiſtence of ſurvivorſhip. From theſe principles Dr. Price has ſhewn how to deduce the demonſtrations of Mr. De Moivre's rules for finding the expectations of lives, which he has omitted; we ſhall here ſubjoin them for the information and amuſement of our mathematical readers. Let $\dot{x}$ ſtand for a moment of time, and n be the *complement* of any aſſigned life; then $\frac{n - \dot{x}}{n}, \frac{n - 2\dot{x}}{n}, \frac{n - 3\dot{x}}{n}$, &c. will be the preſent probabilities of its continuing to the end of the firſt, ſecond, third, &c. moments; and $\frac{n - x}{n}$ the *probability* of its continuing to the end of x time: therefore, $\frac{n - x}{n} \times \dot{x}$ will be the fluxion of the ſum of the probabilities, or of an area repreſenting this ſum, whoſe ordinates are $\frac{n - x}{n}$, and axis x. The fluent of this expreſſion, or $x - \frac{x^2}{2n}$, is the ſum itſelf for the time x; and this, when $x = n$, becomes $\frac{1}{2}n$, the expectation of the aſſigned life, or the ſum of all the probabilities juſt mentioned for its whole poſſible duration. In like manner $\frac{n - x}{n} \times \frac{n - x}{n}$ or $\frac{\overline{n - x}|^2}{n^2}$ is the probability that two equal joint lives will continue x time, and $\frac{\overline{n - x}|^2}{n^2} \times \dot{x}$ will be the fluxion of the ſum of the probabilities; the fluent of which, or $x - \frac{x^2}{n} + \frac{x^3}{3n^2}$, becomes, when $n = x$, $\frac{n}{3}$, or the expectation of two equal joint lives. Again, ſince $\frac{n - x}{n} \times \frac{2x}{n}$ is the probability that there will be a ſurvivor of two equal joint lives at the end of x time, $\frac{n - x}{n} \times \frac{2x}{n} \times \dot{x}$ will be the fluxion of the ſum of the probabilities; and the fluent, or $\frac{x^2}{n} - \frac{2x^3}{3n^2}$ is, when $x = n$, $\frac{1}{3}n$, or the expectation of ſurvivorſhip between two equal lives, which appears to be equal to the expectation of their joint continuance. The expectation of two unequal joint lives found in the ſame way is $\frac{m}{2} - \frac{m^2}{6n}$, m being the complement of the oldeſt life, and n the complement of the youngeſt. The whole expectation of ſurvivorſhip is $\frac{n}{2} - \frac{m}{2} + \frac{m^2}{3n}$; and the expectation of ſurvivorſhip of the oldeſt will be to that of the youngeſt as $\frac{m^2}{6n}$ to $\frac{n}{2} - \frac{m}{2} + \frac{m^2}{6n}$.

From the definition already given of the expectation of life, it follows, that if in a ſociety limited to a fixed number of members, a 28th part of its members dies annually, 28 would appear to be their common expectation of life at the time they entered; and if it were found in any town or diſtrict, where the number of births and burials are equal, that a 20th or 30th part of the inhabitants die annually, it would appear that 20 or 30 was the expectation of a child juſt born in that town or diſtrict.

Having a table of obſervations, ſhewing the number that die annually at all ages out of a given number alive at thoſe ages, it is eaſy to find the expectation for all ſingle lives by the following rule: divide the ſum of all the living in the table at the age whoſe expectation is required, and at all greater ages, by the number in the table of the living at that age, and ſubtract half unity from the quotient, the remainder will be the expectation required.

The reaſon of this ſubtraction may be underſtood by conceiving the recruit neceſſary to ſupply the waſte of every year to be made always at the end of the year, ſo that the dividend ought to be the medium between the number living at the beginning and the end of the year; that is, it ſhould be taken leſs than the ſum of the living in the table at and above the given age by half the number that die in the year; the effect of which diminution will be the ſame with the ſubtraction here directed. This rule may be illuſtrated by taking the ſum of all the living at 20 and upwards in Tab. I. and dividing it by 360, the number living at that age, and the quotient leſs half unity, will be nearly 28.9 the expectation of 20 in Tab. II.

Table I.—Shewing the Probability of the Duration of Life in London, deduced by Mr. Simpſon from Obſervations on the Bills of Mortality in London for 10 Years, from 1728 to 1737.

Ages.	Perſons living.	Decr. of life.	Ages.	Perſons living.	Decr. of life.	Ages.	Perſons living.	Decr. of life.
0	1000	320	27	321	6	54	135	6
1	680	133	28	315	7	55	129	6
2	547	51	29	308	7	56	123	6
3	496	27	30	301	7	57	117	5
4	469	17	31	294	7	58	112	5
5	452	12	32	287	7	59	107	5
6	440	10	33	280	7	60	102	5
7	430	8	34	273	7	61	97	5
8	422	7	35	266	7	62	92	5
9	415	5	36	259	7	63	87	5
10	410	5	37	252	7	64	82	5
11	405	5	38	245	8	65	77	5
12	400	5	39	237	8	66	72	5
13	395	5	40	229	7	67	67	5
14	390	5	41	222	8	68	62	4
15	385	5	42	214	8	69	58	4
16	380	5	43	206	7	70	54	4
17	375	5	44	199	7	71	50	4
18	370	5	45	192	7	72	46	4
19	365	5	46	185	7	73	42	3
20	360	5	47	178	7	74	39	3
21	355	5	48	171	6	75	36	3
22	350	5	49	165	6	76	33	3
23	345	6	50	159	6	77	30	3
24	339	6	51	153	6	78	27	2
25	333	6	52	147	6	79	25	
26	327	6	53	141	6			

Table II.—Shewing the Expectations of Life in London, according to the preceding Table.

Age.	Expectation.	Age.	Expectation.	Age.	Expectation.
0	19.2	27	25.1	54	14.5
1	27.0	28	24.6	55	14.2
2	32.0	29	24.1	56	13.8
3	34.0	30	23.6	57	13.4
4	35.6	31	23.1	58	13.1
5	36.0	32	22.7	59	12.7
6	36.0	33	22.3	60	12.4
7	35.8	34	21.9	61	12.0
8	35.6	35	21.5	62	11.6
9	35.2	36	21.1	63	11.2
10	34.8	37	20.7	64	10.8
11	34.3	38	20.3	65	10.5
12	33.7	39	19.9	66	10.1
13	33.1	40	19.6	67	9.8
14	32.5	41	19.2	68	9.4
15	31.9	42	18.8	69	9.1
16	31.3	43	18.5	70	8.8
17	30.7	44	18.1	71	8.4
18	30.1	45	17.8	72	8.2
19	29.5	46	17.4	73	7.8
20	28.9	47	17.0	74	7.5
21	28.3	48	16.7	75	7.2
22	27.7	49	16.3	76	6.8
23	27.2	50	16.0	77	6.4
24	26.6	51	15.6	78	6.0
25	26.1	52	15.2	79	5.5
26	25.6	53	14.9	80	5.0

Table III.—Shewing the Probabilities of Human Life in Northampton.

Age.	Living.	Decr.	Age.	Living.	Decr.	Age.	Living.	Decr.
0	11650	1340	31	4310	75	65	1632	80
3 mon.	10310	554	32	4235	75	66	1552	80
6 mon.	9756	553	33	4160	75	67	1472	80
9 mon.	9203	553	34	4085	75	68	1392	80
1 Year	8650	1367	35	4010	75	69	1312	80
2 Years	7283	502	36	3935	75	70	1232	80
3	6781	335	37	3860	75	71	1152	80
4	6446	197	38	3785	75	72	1072	80
5	6249	184	39	3710	75	73	992	80
6	6065	140	40	3635	76	74	912	80
7	5925	110	41	3559	77	75	832	80
8	5815	80	42	3482	78	76	752	77
9	5735	60	43	3404	78	77	675	73
10	5675	52	44	3326	78	78	602	68
11	5623	50	45	3248	78	79	534	65
12	5573	50	46	3170	78	80	469	63
13	5523	50	47	3092	78	81	406	60
14	5473	50	48	3014	78	82	346	57
15	5423	50	49	2936	79	83	289	55
16	5373	53	50	2857	81	84	234	48
17	5320	58	51	2776	82	85	186	41
18	5262	63	52	2694	82	86	145	34
19	5199	67	53	2612	82	87	111	28
20	5132	72	54	2530	82	88	83	21
21	5060	75	55	2448	82	89	62	16
22	4985	75	56	2366	82	90	46	12
23	4910	75	57	2284	82	91	34	10
24	4835	75	58	2202	82	92	24	8
25	4760	75	59	2120	82	93	16	7
26	4685	75	60	2038	82	94	9	5
27	4610	75	61	1956	82	95	4	3
28	4535	75	62	1874	81	96	1	1
29	4460	75	63	1793	81			
30	4385	75	64	1712	80	Tot.	299198	11650

Table IV.—Shewing the Expectations of Human Life, deduced from the preceding Table.

Age.	Expect.	Age.	Expect.	Age.	Expect.	Age.	Expect.
0	25.18	25	30.85	50	17.99	75	6.54
1	32.74	26	30.33	51	17.50	76	6.18
2	37.79	27	29.82	52	17.02	77	5.83
3	39.55	28	29.30	53	16.54	78	5.48
4	40.58	29	28.79	54	16.06	79	5.11
5	40.84	30	28.27	55	15.58	80	4.75
6	41.07	31	27.76	56	15.10	81	4.41
7	41.03	32	27.24	57	14.63	82	4.09
8	40.79	33	26.72	58	14.15	83	3.80
9	40.36	34	26.20	59	13.68	84	3.58
10	39.78	35	25.68	60	13.21	85	3.37
11	39.14	36	25.16	61	12.75	86	3.19
12	38.49	37	24.64	62	12.28	87	3.01
13	37.83	38	24.12	63	11.81	88	2.86
14	37.17	39	23.60	64	11.35	89	2.66
15	36.51	40	23.08	65	10.88	90	2.41
16	35.85	41	22.56	66	10.42	91	2.09
17	35.20	42	22.04	67	9.96	92	1.75
18	34.58	43	21.54	68	9.50	93	1.37
19	33.99	44	21.03	69	9.05	94	1.05
20	33.43	45	20.52	70	8.60	95	0.75
21	32.90	46	20.02	71	8.17	96	0.50
22	32.39	47	19.51	72	7.74		
23	31.88	48	19.00	73	7.33		
24	31.36	49	18.49	74	6.92		

We ſhall here ſubjoin ſome other tables, calculated by Dr. Price, on account of their connection with the ſubject of this article.

Proportion of the inhabitants annually dying in

Pais De Vaud	Country Pariſh in Brandenburg	Holy Croſs near Shrewſbury	London	Vienna	Berlin.
1 in 45	1 in 45	1 in 33	1 in $20\frac{3}{4}$	1 in $19\frac{1}{2}$	1 in $26\frac{1}{5}$

Ages to which half the born live.

Pais De Vaud	Country Pariſh in Brandenburg	Holy Croſs	London	Vienna	Berlin.
41	$25\frac{1}{2}$	27	$2\frac{3}{4}$	2	$2\frac{3}{4}$

Proportion of the inhabitants who reach eighty years of age.

Pais De Vaud	Country Pariſh in Brandenburg	Holy Croſs	London	Vienna	Berlin.
1 in $21\frac{1}{2}$	1 in $22\frac{1}{2}$	1 in 11	1 in 40	1 in 41	1 in 37

The probabilities of living one year in

Odds	Pais De Vaud	Country Pariſh in Brandenburg	Holy Croſs	London	Vienna	Berlin.
At birth	$4\frac{1}{4}$ to 1	$3\frac{1}{2}$ to 1	$4\frac{1}{2}$ to 1	2 to 1	$1\frac{1}{5}$ to 1	$1\frac{1}{4}$ to 1
Age 12	160 1	112 1	144 1	75 1	84 1	123 1
25	117 1	110 1	100 1	56 1	66 1	50 1
30	111 1	107 1	96 1	45 1	56 1	44 1
40	83 1	78 1	55 1	31 1	36 1	32 1
50	49 1	50 1	50 1	24 1	27 1	30 1
60	23 1	25 1	26 1	18 1	19 1	18 1
70	$9\frac{1}{2}$ 1	11 1	16 1	12 1	11 1	12 1
80	4 1	6 1	8 1	7 1	7 1	7 1

Expectations of life.

	Pais De Vaud	Country Pariſh in Brandenburg	Holy Croſs	London	Vienna	Berlin.
At birth	57 y'rs	$32\frac{1}{2}$ years	$33\frac{1}{4}$ y'rs	18 y'rs	$16\frac{1}{2}$ y'rs	18 y'rs
Age 12	$44\frac{1}{3}$	$44\frac{1}{2}$	$43\frac{1}{2}$	$33\frac{1}{2}$	$35\frac{3}{4}$	$35\frac{1}{2}$
25	$34\frac{3}{4}$	$35\frac{1}{2}$	35	26	$28\frac{1}{3}$	$27\frac{1}{3}$
30	$31\frac{1}{4}$	$31\frac{1}{2}$	32	$23\frac{1}{2}$	$25\frac{1}{2}$	$25\frac{1}{4}$
35	$27\frac{1}{2}$	28	$28\frac{1}{4}$	$21\frac{1}{2}$	$22\frac{1}{2}$	$22\frac{3}{4}$
40	24	25	$25\frac{3}{4}$	$19\frac{1}{2}$	$20\frac{1}{2}$	$20\frac{3}{4}$
45	$20\frac{1}{2}$	$21\frac{1}{2}$	$23\frac{1}{4}$	$17\frac{3}{4}$	$17\frac{3}{4}$	$18\frac{3}{4}$
50	$17\frac{1}{2}$	18	20	16	16	$16\frac{1}{3}$
55	$14\frac{1}{2}$	15	17	$14\frac{1}{3}$	$13\frac{1}{2}$	14
60	12	$12\frac{1}{4}$	$14\frac{1}{2}$	$12\frac{1}{2}$	$11\frac{3}{4}$	$12\frac{1}{2}$
65	$9\frac{1}{2}$	$9\frac{3}{4}$	$11\frac{3}{4}$	$10\frac{1}{2}$	$9\frac{3}{4}$	$10\frac{1}{2}$
70	$7\frac{1}{2}$	$7\frac{1}{2}$	10	$8\frac{3}{4}$	$8\frac{1}{2}$	$8\frac{1}{2}$
75	$5\frac{1}{2}$	$5\frac{1}{2}$	8	7	$6\frac{1}{2}$	7
80	$4\frac{1}{2}$	$4\frac{1}{2}$	5	5	$5\frac{1}{2}$	6

Dr. Price has applied his reaſoning on this ſubject to the ſolution of a curious queſtion in political arithmetic, or to determine the number of inhabitants in any place from a table of obſervations, or the bills of mortality for that place, on the ſuppoſition that the yearly births and burials are equal. For this purpoſe find by the table the expectation of an infant juſt born; and this, multiplied by the number of yearly births, will be the number of inhabitants.

Were the bills of mortality conſtructed with the leaſt regard to truth, and were a regular account kept of all the perſons who annually migrate from the country, this rule of Dr. Price might be ſafely applied towards aſcertaining the number of inhabitants in London, but in their preſent form the London tables are ſo very incorrect that it can hardly be ſafe to derive any concluſions from them.

It appears from Tab. I. that though an infant juſt born in London has not an equal chance (the probability being $\frac{496}{1000}$) of living three years, his expectation is twenty years, and by Tab. III. that though the expectation of ſuch a child in Northampton is twenty-five, it has only an equal chance of living eight years. This difference proceeds from the greater probability of life in the more mature ages, than in the firſt moments of exiſtence. Were the decrements of life, however, the ſame through every period of it, theſe quantities would always be equal; but as this is not the caſe, neither in the earlier nor the latter ages, the computations founded on ſuch an hypotheſis can in general be of very little uſe. De Moivre's Doctrine of Chances, applied to the Valuation of Annuities, p. 288, &c. Simpſon's Select Exerciſes, p. 253, &c. and particularly Dr. Price's Obſervations on Reverſionary Payments, eſſ. i. vol. ii. or Phil. Tranſ. vol. lix. p. 89. See COMPLEMENT *of Life*, LIFE *Annuities*, MORTALITY, SURVIVORSHIP.

EXPECTATIVE, in the *Canon Law*, a hope founded on a promiſe of obtaining the next benefice that ſhall become vacant, or a right to the reverſion of the next. See BENEFICE.

EXPECTATIVE *Canons*. See CANON.

EXPECTATIVE *Graces*, *Gratiæ Expectativæ*, called alſo *preventions*, were bulls frequently given by the popes or kings for future benefices. The biſhops were exceedingly mortified with them, becauſe they encroached on their privileges; beſides, that ſuch expectatives are odious, as they induce people to wiſh for the death of others.

The uſe of expectatives is very ancient, though it was not near ſo frequent in the firſt ages as afterwards. Originally they were no more than ſimple requeſts made on the part of kings or popes, which the biſhops conſented to with the more willingneſs, as they only preſented to them perſons fit to ſerve the church: but the frequent exerciſe of this privilege made it at length be deemed a matter of obligation and neceſſity.

The council of Trent annulled all expectatives; but the canons relating thereto were never admitted in France, where the right of conferring expectative graces is looked on as one of the regalia.

EXPECTORANT MEDICINES, are thoſe which facilitate the excretion of the mucous diſcharges from the cells and paſſages of the lungs; or *ex pectore*, from the breaſt.

This evacuation muſt be accompliſhed by more or leſs of coughing, which the irritation of the collecting mucus, &c. naturally occaſions. It were, therefore, obviouſly uſeleſs and ſuperfluous to give medicines with a view to excite coughing, (if indeed we were acquainted with any ſubſtance poſſeſſed of ſuch quality,) or to uſe any external means, as the ancient Cnidians are ſaid to have done, for that purpoſe. The principal object, in attempting to facilitate the diſcharge of the contents of the bronchial veſſels and cells, muſt conſiſt in changing the nature of thoſe contents, ſo as to render them thinner, leſs tenacious, and more moveable than before. Whether we are poſſeſſed of any medicines, however, capable of producing ſuch a direct effect, may admit

mit of a queftion. The generality of writers on the materia medica, and of phyficians, fpeak of the utility of fuch medicines as they have termed *attenuantia* and *incidentia*, for this purpofe: but we believe, with Dr. Cullen, that their hypothefis on this fubject is altogether erroneous, and that no fuch medicines exift. The only probable explanation of the action of an expectorant medicine appears to be, that by increafing the fecretion from the exhalent arteries in the lungs, the mucus may be diluted and rendered lefs vifcid and the paffages from the cells may be more fully moiftened with a lefs tenacious fluid. We know that there is a conftant and confiderable exhalation of moifture from the cavity of the lungs: and there are many reafons for believing that this is an excrementitious fecretion, connected with the other excrementitious fecretions, particularly with the perfpiration from the furface of the body. If, therefore, there are medicines difpofed to pafs by perfpiration, it may be prefumed that the fame are difpofed to pafs by the exhalation from the lungs: and this exhalation may not only be increafed, but the mucus, produced by the follicles, may alfo be poured out in a lefs vifcid form, and confequently in a ftate to be more eafily brought up by expectoration.

It would appear, that fome fuch increafe of the thinner fecretion of lungs is produced, by fympathy with the ftomach, when a condition approaching to naufea is induced, and that, therefore, medicines which poffefs an emetic quality, when ufed in fmall dofes, operate in fome degree as expectorants; fuch as the fquill, ipecacuanha, nicotiana, antimony, &c. A full dofe of an emetic feems to produce this effect more completely, and, affords confiderable relief to thofe afthmatic complaints, as they are called, in which the lungs are loaded with a quantity of vifcid phlegm. Many expectorant medicines are mentioned by different writers, fuch as the tuffilago, or colt's foot, enula campana, iris florentina, petafites, &c. which recent experience feems to have rejected, from their failure to anfwer the expectation which thofe writers had excited.

Many other medicines which give relief to coughs have been employed under the appellation of expectorants; but their operation is to be explained upon principles altogether different from that of facilitating expectoration. Among thefe are fpermaceti, liquorice, oil of almonds, and other vegetable and animal oils, various mucilaginous vegetables, fuch as mallow, horehound, &c. all of which give a temporary alleviation to the irritation about the glottis, and thus appeafe the cough, but do not in the fmalleft degree aid the expectoration. See CATARRH.

In the chronic coughs of old people, expectoration appears to be facilitated by the ufe of the ftimulant gums, and of volatile alkali. But perhaps thefe medicines operate indirectly, by fupporting the ftrength of the patients, and thus enabling them to ufe greater mufcular exertion in the act of coughing.

EXPECTORATION, the act of bringing up the mucous and other excretions from the lungs, by coughing, hawking, &c. The word has the fame derivation as the preceding.

EXPEDITATION, in the *Foreft-Laws*, fignifies a cutting out the balls of a dog's fore-feet for the prefervation of the king's game.

Every one that keeps any great dog, not expeditated, forfeits three fhillings and four-pence to the king. In maftiffs, not the ball of the feet, but the three claws, are to be cut to the fkin. Inftit. part. iv. p. 308. "Nullos Dominicos canes abbatis & monachorum expeditari cogat." Chart. Hen. III. "Et fin quieti de efpeditamentis canum." Ex. Mag. Rot. Pip. de ann. 9 Ed. II.

The expeditation was to be performed once in every three years, and was done to every man's dog who lived near the foreft, and even the dogs of the forefters themfelves.

EXPEDITION, the march of an army to fome diftant place, with a view of hoftilities.

Such were the expeditions of Cyrus againft Xerxes, and of Bacchus and Alexander to the Indies.

Expeditions for the recovery of the Holy Land were called croifades.

The fuccefs of an expedition depends on rapid and unexpected movements. An expedition is planned and governed by the following principal maxims, *viz.* fecrecy, if poffible, of preparation, and a concealment of defign, &c.; a juft proportion of the means to the end; a knowledge of the ftate and fituation of the country, which is intended to be the fcene of action, and of the place or object that is to be attacked; the appointment of a commander, poffeffed of thofe abilities, and of that difpofition, which are adapted to the warfare propofed; and the arrangement of the plan of the expedition before it is undertaken or carried into effect. The French ufe the word expedition to exprefs any particular military quality, which an officer or foldier may poffefs. Thus, "cet officier eft un homme d'expedition," that is, this officer is a man of enterprife, or courageous and daring.

EXPENCES, in *Book-keeping*. See BOOK *of Expences*.

EXPENDITORS, in *Law*, are the perfons appointed by commiffioners of fewers, to pay, difburfe, or expend the money collected by the tax for the repairs of fewers, &c. when paid into their hands by the collectors on the reparations, amendments, and reformations ordered by the commiffioners; for which they are to render accounts when required for that purpofe.

Thefe officers are mentioned in the ftatute 37 H. VIII. cap. 11. and other ftatutes. The fteward who fupervifes the repair of the banks and water-courfes in Romney Marfh is likewife called the expenditor.

EXPENSE MAGAZINE, is a fmall receptacle for fuch quantities of ammunition as may be required on emergency, or for the fupply of powder, &c. in that ordinary courfe which enables the proper officers to eftimate with correctnefs what quantity fhould be kept at hand for the purpofe of annual exercife, or for the furnifhing the neighbouring camps, pofts, or batteries, with fuch ftores as may be neceffary for their ufe. Thus we fee, in almoft every fortrefs, various expenfe-magazines built in commodious and fafe fituations, for the exprefs purpofes of enabling the commiffaries, and the ordnance officers, to prevent the defenders of the feveral works in their vicinity from being at a ftand for want of ammunition. Some of thefe little ftores are occafionally built even upon the terre-pleine of the batteries they are to fupply; but we have heard this practice cenfured; for, though it may be true, that owing to their very folid conftruction they may fuccefsfully refift the enemies' fhot, ftill, as they are liable to explode from other accidents, we cannot join an unqualified approval of fuch pofitions. We avail ourfelves of a fuggeftion offered to us, in which we think the foregoing objection is greatly diminifhed, if not totally removed. The fuggeftion is, that in lieu of allowing any expenfe-magazines to be built on a terre-pleine, a ramp fhould be thrown up at the back of every fixth or feventh piece of ordnance on the defences, the interior of which fhould be a magazine of this defcription. The ramp would ferve as a paffage for the perfons employed in conveying the powder to the gunners, and fhould have a door at that fide leaft expofed to enfilades, or to accidental fhots. The entrance might, indeed, be either above or below the ramp; though we are difpofed to recommend the latter; as the delay occafioned by afcending would not be of any confequence in ordinary defences, and would be fully counter-balanced by the fafety with which all the expenfe-magazines might be worked. Poffibly, the fuggeftion might be rather improved if the expenfe-magazines were to be built partly under the refpective ramparts; thereby becoming mines on occafion. (See *Plate* I. *Tactics*, *fig*. 4.)

Againft works of mafonry built upon the terre-pleine, we cannot too powerfully inveigh: the immenfe numbers of fplinters which are generally created by fuch being fufficient grounds for their condemnation. If, however, it is deemed proper to have fmall magazines in fuch fituations, (for there may be localities which afford no alternative,) fuch ought to be funk fo far as to allow the fummits of their arches to be little more than level with the terre-pleine. Being then covered with foil, and well gazoned, (*i. e.* turfed,) they would become ufeful, by caufing fuch fhots as might be fent over the epaulement to throw up, inftead of allowing them to trundle along the terre-pleine. (See ENFILADE.)

The entrances of all magazines of this defcription ought to be towards the back of the battery, and certainly might be rendered fafer by making a few fteps down upon the inner revetement; fo as completely to cover not only the magazine itfelf; but the perfons who might be employed to hand up the cartridges. (See *fig*. 5.)

EXPENSIS *Militum Levandis*, in *Law*, was a writ anciently directed to the fheriff, for levying allowance for the knights of parliament. See PARLIAMENT, and REPRESENTATIVE.

EXPENSIS *militum non levandis*, &c. an ancient writ to prohibit the fheriff from levying any allowance for knights of the fhire upon thofe that hold lands in ancient demefne. Reg. Orig. 261.

EXPERIENCE, a kind of knowledge acquired by long ufe without any teacher.

Experience confifts in the ideas of things we have feen or read, which the judgment has reflected on, to form for itfelf a rule or method.

Authors make three kinds of experience: the firft is the fimple ufes of the external fenfes, whereby we perceive the phenomena of natural things, without any direct attention thereto, or making any application thereof.

The fecond is, when we premeditatedly and defignedly make trials of various things, or obferve thofe done by others, attending clofely to all effects and circumftances.

The third is that preceded by a fore-knowledge, or at leaft an apprehenfion of the event, and determines whether the apprehenfion were true or falfe; which two latter kinds, efpecially the third, are of great fervice in philofophy.

Dr. Campbell, in his "Philofophy of Rhetoric," (vol. i. p. 129, &c.) inveftigates the nature and origin of experience; and obferves, that thofe fources in our natures which give being to it, and confequently to all thofe attainments, moral and intellectual, that are derived from it, are fenfe and memory. The fenfes, both external and internal, are the original inlets of perception; and the articles of information exhibited by them are devolved on the memory. As remembrance inftantly fucceeds fenfation, the memory becomes the fole repofitory of the knowledge received from fenfe; and hence it is the only original voucher extant of thofe paft realities for which we had once the evidence of fenfe. In order to render the knowledge thus acquired and preferved ufeful to us, in difcovering the nature of things and regulating our conduct, a further procefs of the mind is neceffary, and this is affociation. This retention and affociation are called experience. We may here obferve, that though memory gives birth to experience, which refults from the comparifon of facts remembered, the experience, or habitual affociation, remains, when the individual facts on which it is founded are all forgotten. We cannot purfue the reafoning of this ingenious writer in his illuftration of the evidence of experience, which he confiders as one fpecies of moral evidence, (analogy and teftimony being the two others,) and which, in his opinion, is the criterion, if not the foundation, of all moral reafoning whatever, and the principal organ of truth in all the branches of phyfiology, in the largeft acceptation of the term. See TESTIMONY.

EXPERIMENT, from the Latin *experimentum*, is a trial, or practical proof of fomething. In philofophy it means the refult of certain applications, difpofitions, or combinations, of natural bodies, made with fome particular view. Experiments are faid to be mechanical, or chemical, or electrical, or magnetical, &c. according to the fubject to which they more immediately belong. The object of making experiments is to afcertain either certain caufes or certain phenomena; and for the proper attainment of thefe objects care muft be had to inftitute experiments that admit of no equivocal refult, and fo as to anfwer the purpofe in the quickeft and moft direct way. The main object, however, of the inquiry can feldom be determined by a fingle decifive experiment; hence, in moft cafes, it becomes neceffary to divide the queftion into parts, and to afcertain each part feparately by one or more appropriate experiments. When the experiment is fo prefcribed as to decide the queftion without any poffible doubt or equivocation, it has in that cafe frequently been called *experimentum crucis*; meaning a capital or decifive experiment; fuch as fuperfedes the neceffity of inftituting more experiments for the fame purpofe. The origin of the expreffion *experimentum crucis* has probably been derived from its being a kind of torture, whereby the nature of the queftion is, as it were, extorted by force. It has been alfo attributed, though with lefs apparent probability, to the guide or inftruction which it affords, like that of a direction poft, which is fhaped fomewhat like a crofs.

It is not practicable to give any inftructions for the right performance of experiments in general; for not only every fubject, but every particular queftion belonging to any fubject, muft be determined by a peculiar mode of inveftigation. The experimenter can only be inftructed by practice. The nature of the fubject, a ftrict attention to every apparent circumftance, an accurate ftatement of particulars, and an unprejudiced mode of reafoning, will eafily fuggeft a proper train of experiments which the fubject in queftion may admit of. It deferves to be remarked, that though in the inveftigation of any fubject, the philofopher propofes a certain order of inveftigation, (and it is always proper to propofe to onefelf fome fuch plan or train of experiments;) yet it is but feldom that the propofed plan can, or deferves to be ftrictly executed; for the refult of the firft or fecond experiment frequently points out a new track or a more promifing road; in confequence of which, new and different trials muft be inftituted; and it is in the ready adoption of fuch plans as may be more fuited to the laft indications, that the genius of the philofopher is rendered confpicuous.

Such mode may fuffice for the determination of any doubtful point; but when a difcovery has been made and is to be explained

explained to other perfons ; then it is of ufe to fhew the fame refult by different experiments ; for it is not only a fatisfaction to have feveral concurring proofs of the fame propofition ; but it is alfo rendered intelligible to a greater number of readers or hearers ; it being feldom the cafe, that the fame experiment conveys an equal degree of conviction and fatisfaction to the mind of every body.

EXPERIMENTAL Farm, in *Agriculture*, that fort of farm eftablifhment which is chiefly applied to, or calculated for, the purpofe of making experiments, with the view of afcertaining unknown caufes, effects, or refults in the various departments of hufbandry. This is a plan which has often been attempted, both individually and collectively, by numbers of perfons warmly interefted in promoting the improvement of agricultural knowledge ; but hitherto, we believe, without that fort of fuccefs which might naturally be expected. The caufe of which has probably been the want of a due combination of real practical agricultural information with that of the fcientific kind, as without a full comprehenfion of both thefe, in perfons who have the direction and management of fuch eftablifhments, it muft be utterly impoffible that they can be fo highly advantageous as they ought to be. But a writer, who has beftowed much attention on the fubject, feems to fuppofe that there is much doubt of any real benefit being at all produced in this way ; as he confiders both experience and experiment the two means by which facts concerning the art may be afcertained as equally liable to objection. The term *experience* he conceives to denote thofe deductions which a perfon draws as the average refult of practice continued for a confiderable length of time, and which is unqueftionably the fureft guide that can be followed, where the obfervations are fufficiently correct, and the circumftances difcriminated in fo clear a manner as to create no fort of confufion ; ftill where thefe peculiarities are wanting, the conclufions thus drawn may be extremely fallacious. And what increafes the evil in this cafe is, that when conclufions have been once drawn in confequence of an imperfect difcrimination of circumftances, there is fcarcely any chance of eradicating the error ; as the mind, when once accuftomed to think in a certain way, is apt to proceed in the fame ever afterwards ; and that the fame indifcrimination which caufed the firft error will induce a fucceffion of others of the fame fort *ad infinitum*. Unfortunately, too, it happens that in agriculture, things which are capable of affecting the refult of a procefs or operation, are fo jumbled and thrown together into one chaotic mafs, that it is a matter of extreme difficulty even for the moft nice obferver to diftinguifh fuch as are effential, from thofe which are merely accidental, confequently extremely eafy to miftake one for the other. The inaccuracy likewife, which too much prevails in the operations of the farmer, concerning the actual expence of different proceffes, as affecting any particular object ; and all the difficulty of keeping the different produce of different fields feparate, render it, in moft cafes, almoft impoffible for the actual farmer to afcertain, with any fort of precifion, either the expence or the value of the produce of any one of his fields ; confequently the profit or lofs of any operation or procefs is merely gueffed at, not afcertained by the teft of his experience ; in confequence of which he is at liberty, and will of courfe draw the conclufion, which feems moft to confirm his own pre-conceived notion on the head, whatever it may be. Under fuch circumftances experience muft, he conceives, be a very fallacious and imperfect guide. It may, indeed, it is fuppofed, furnifh hints or indications of what ought to be purfued or laid afide and avoided ; but that unlefs facts be afcertained with much greater precifion than it admits of, they muft, it is conceived, afford a very unftable foundation for promoting the fcientific improvement of agriculture.

In confequence of which, experiment, he thinks, has been introduced and adapted, in order to fupply the deficiencies which are thus produced ; but which, though, at the firft fight, it may promife fair to accomplifh fuch purpofes, upon a nearer view has not been found adequate in any material degree. An experiment in this art is, it is conceived, a particular operation, undertaken with the defign of elucidating and explaining fome fact which is involved in doubt or difficulty ; of courfe extreme accuracy, in order to guard againft every circumftance that may unintentionally affect or influence the refult, is an indifpenfable requifite in the conducting of it ; as, unlefs this be the cafe, the fame experiment, under different circumftances, may lead to a variety of conclufions. In general, however, farmers, from their having been but little accuftomed to the nice difcriminations of fcientific inveftigation, are but indifferently qualified to guard againft the fecret influence of caufes, which they have never even fo much as fufpected of having any power upon the refult of their experiment. It is, therefore, contended, that from thefe caufes the experiments made by actual farmers frequently prove extremely defective ; and when amateurs of a higher rank project experiments, the detail of them muft be left to fervants and dependants, who commonly put down at random all the circumftances which their careleffnefs prevented them from noticing ; fo that thefe experiments, though they may affume a more engaging appearance of accuracy, are, in fact, for the moft part, more inaccurate and erroneous than the former. Confequently, with the view of remedying thefe evils, the notion of an experimental farm has prefented itfelf to many perfons as the only means of forwarding the progrefs of fcientific agriculture, and upon a flight view, the benefits that might refult from it have indeed feemed fo obvious, that in feveral diftricts of this country funds have been provided, as has been already hinted, for the fupport of fuch eftablifhments, but on trial they have all found fuch difficulties in the way, as have not hitherto been capable of being furmounted. The chief reafon of which, it is conceived, is, as has been fuggefted before, that of the difficulty of procuring a perfon in every way properly qualified for conducting fuch an undertaking. On thefe grounds, the expectations of the benefits that are to be derived from the eftablifhment of an experimental farm are not by any means fo great as may be fuppofed. It is, indeed, contended, that there are many experiments of the very firft importance in fcientific agriculture, which are totally out of, or beyond the fphere of a farm of this kind. Of this defcription, it is conceived, are all thofe facts which have a relation to the original conftitution of foils, and the infinitely diverfified, though little obvious qualities thefe poffefs in confequence of peculiar impregnations, which they may have derived from the operations of nature or of art. It is fuppofed that an experimental farm, in fo far as this particular is concerned, is precifely the fame as another farm, in which the experimenter, like the farmer, may in time acquire a knowledge of what will fuit his own foil. But if thefe experiments were prefented to the public under the idea that the refults which they afforded fhould be deemed generally conclufive in all diftricts, fuch a decifion would turn out fallacious, as it would foon be found, that, in many other cafes, the refults would be extremely different. Nor is it believed that the practical farmer could derive much advantage from the experimental farm, in what refpects the economical

economical diſtribution or arrangement of the neceſſary buſineſs which is to be purſued in the conducting of the work, which is a branch of the art that is of the greateſt conſequence to be well underſtood by the real farmer, but that is totally incompatible with the complex arrangements and continually varying operations of the experimental farm.

But however true many of theſe remarks may be, there can be little doubt, but that the eſtabliſhment of experimental farms in different parts of the country muſt, under proper management, be attended with great advantage in throwing additional light on different branches and modes of cultivation, as well as in bringing agriculturiſts acquainted with a variety of new and intereſting facts.

When conducted under a proper ſyſtem of management, farms of this kind might readily aſcertain the following important queſtions.

1ſt. What is the beſt mode of cultivating arable land?

2d. What is the beſt ſyſtem for the management of graſs land?

3d. What are the moſt uſeful implements of huſbandry?

4th. What are the moſt profitable breed of animals, and the beſt, and cheapeſt modes of feeding and fattening them? and,

5th. What is the beſt plan for rendering waſte or barren land productive?

All theſe queſtions are evidently to be conſidered in relation to the differences of ſoils, circumſtances and ſituations.

Mr. Arthur Young, in ſpeaking of the eſtabliſhment of a farm of this nature, as being properly an undertaking only fit for a ſovereign, in the fourth volume of his "Annals of Agriculture," remarks, that it would have great effects in promoting agriculture in this country, but in others, where that art is ſtill leſs underſtood, it is abſolutely eſſential to the progreſs of it. And that if, in ſome future age, this art, ſo neceſſary to the welfare of mankind, ſhould receive an attention that has hitherto been denied it, and a farm of this ſort ſhould be eſtabliſhed, the following hints may be found of uſe. It is conceived, that a divided attention to complex queſtions ſhould be avoided; and thoſe great leading objects moſt nearly connected with the deficiencies of the national agriculture demand the firſt exertions to aſcertain. With this view the ſoil of the farm ſhould regulate the plan of it. If it were a ſand one in this country, it ſhould, it is ſuppoſed, be thrown into the Norfolk huſbandry, and the object of theſe experiments would be to examine how far that ſyſtem, by means of carrots, turnip-cabbage, and other new plants, equi-diſtant drilling, manuring for the roots and graſſes inſtead of the wheat, &c. could be improved. And connected with this inquiry would be the collateral one of the breed of ſheep, proper for this ſoil; with other objects too numerous to recite, which are at preſent unaſcertained.

If the ſoil were of the clayey or loamy kind, too wet for turnips, the great objects would, it is ſuppoſed, be, the means of baniſhing ſummer fallows, an inquiry of great inportance; the culture and uſe of cabbages; the modes of draining by hollow cuts and arched lands; the beſt means of converting ſuch lands to meadows, and the proper breed of cattle.

And on a loamy ſoil, ſtrongly inclining neither to clay nor ſand, very intereſting inquiries are to be purſued. Every plant, common on all other ſoils, is to be cultivated on this. The rotations of crops; the culture of potatoes and carrots, and their application to all ſorts of cattle; lucerne, and its uſe in ſummer feeding a dairy of cows, that are ſupported in the winter on the roots, &c. are among the numerous inquiries to be proſecuted on this ſort of ſoil. On chalky ſoils the principal object is, it is ſuppoſed, the culture of ſaintfoin, and the beſt means of converting it to corn and turnips preparatory to a renewal.

But on a peat-moor many dubious points are to be aſcertained; the beſt means of reclaiming, whether by paring and burning, fallow, or mere manuring. The graſſes proper to lay down with; and the means by roots or cabbages of ſupporting the greateſt poſſible ſtock of that breed of cattle and ſheep, which are found by experiment moſt proper for the ſoil; the method of draining, manuring, and giving ſolidity to bogs, &c. Upon all, or either of theſe ſoils, collateral inquiries would ariſe in relation to manures, tillage, inſtruments, &c. and a great variety of doubtful points to be decided in the culture and management of all the plants uſually raiſed on any of them.

A ſmall botanical garden of two or three acres, under a botaniſt, for ſmall experiments upon plants not cultivated but promiſing; and a laboratory for chemical trials on ſoils, manures, and vegetables, would, it is ſuggeſted, be two neceſſary additions to ſuch an eſtabliſhment; and with a ſmith's and wheelwright's work-ſhop would render the whole complete.

The great features of ſuch a plan would, it is ſuppoſed, be of utility; it would, however, be ſuſceptible of no inconſiderable ornament. The lines of the incloſures might be decorated in any imaginable way, provided the contents of the field applicable to uſeful graſs or corn were traced by right lines. Every tract of land, of a conſiderable extent, has ſome broken ground, ſteep ſlopes, water-courſes in glens, or pieces where the plough cannot move with convenience, and where graſs is not an equal object with more level ſpaces; theſe, by a judicious diſpoſition of the ground, might be connected with the margins of the fields, and, by walks being traced through them, might be made highly ornamental and pleaſing. It is ſuggeſted that one of Brown's winding walks, with its uſual accompaniment of ſhrubs and velvet lawn, ſurrounding thirty, forty, or more acres of graſs, is never ſeen, but it brings to the mind the variety ſuch a ſpace is capable of, by being thrown into experiments that yield a food for the mind as well as the eye. Some delicious ſpots, it is true, unite ſo happily in all their parts, melting by an eaſy gradation into ſo rich a harmony of diſtribution, that any change would offend as much as diſſonance in a piece of pleaſing muſic. But ſuch ſpots are rare: in general, the variety of neat and elegant experiments would not injure the effect at all. The Leaſſowes was, it is ſtated, in all its parts, a farm, and much more agreeable to the eye, than if the whole had been lawn. But in the preſent ſyſtem of decorating ground, variety of effect is wanting; ſomething to bring variations to the ſcene, in which the owner ſhall be intereſted. The lawn that was ſmooth yeſterday is ſmooth to day, and the revolution of the ſeaſons that bids the roſe breathe its perfume in June, and wither in November, brings to the eye a ſucceſſion of the ſame images which pleaſe this year, as they pleaſed the laſt, without novelty in the cauſe, or increaſe of pleaſure in the effect. The higheſt decoration of landſcape will not give it the power of variety; it will be the ſame this Auguſt as it was the laſt; it will be gay in ſummer; and dreary in December; its forcible effect is for others not yourſelf; for at every repetition of viewing the colours fade, and what once excited rapture, now brings no other emotion than cold approbation. The beauty of a mere garden-ſcene is like that of a fine face; it moves admiration at firſt, and we feel ourſelves under the enchantment of a ſpell that chains all our ſenſes; but let the enchantreſs ſpeak, and prove herſelf a pretty

pretty fool, the inanity of her converfation breaks the fpell, and fhe is from that moment lefs than a pretty picture, fince no one claims a merit in making her. The beauty of a garden-fcene is much of the fame kind; it holds little converfation with you; it fuggefts no new ideas; it furnifhes no food to an inquifitive mind. If a perfon be told that he may contemplate the works and wifdom of God; and hold converfe with the vegetable and animal creation, he replies, not becaufe he is in a garden, for a nettle is as wonderful a production of divine power as a lily, and the ftructure of a toad an object to philofophize on, as much as a nightingale. Hence the contemplative pleafures of a decorated fcene are not appropriated; they arife from the parts and not the combination; and therefore, in this refpect, might as well not be combined at all. But when the ornamented walks lead you to fomething that offers novel information with evey feafon, when you are in the purfuit of unknown facts, to afcertain which is to promote not your own folitary pleafures and contemplations only, but a fcience intimately connected with the profperity of a nation; when every inclofure is pregnant with inftruction, the field of a purfuit, and confequently of a pleafure; in fuch a cafe, it is not a queftion of an arrangement of a lawn, and water, and fhade, that fhall pleafe the eye for a time; it is not the bloom of a flower, or the bend of a walk, but a fubject where the renovation of the year brings perennial employment for the mind: your landfcape becomes the fource of thought; the eye may be pleafed, but the underftanding is fatisfied; and inftead of modes of duration that have been repeated to fatiety, a novel fcene is created, at once the theatre of private pleafure and public inftruction; where ufeful knowledge is fought, not in vain theories, and indolent fpeculation, but in the vigour and activity of experimental exertion. Compared with fuch an application of a tract of land, what are parks and gardens, fhrubberies and decorated grounds, but fo many baubles to pleafe children; frivolous efforts to fill the eye, but leave the mind vacant. The prince that raifes palaces, and embellifhes the gardens that furround them, may be commended for his tafte, and praifed for his magnificence. Verfailles was called a creation; but had Lewis XVI. eftablifhed fuch a farm as has been defcribed; had the experiments been regiftered and publifhed for the benefit of France; how little would the reputation of that creation now be found, compared with the genuine and never dying fame that would have fprung from a different application of the fame ground. The prince that rears a palace, does what princes have done before him; but he who founds an eftablifhment for the inftruction of his people in the moft neceffary of all arts, does that which none have done before him, and deferves a title more truly valuable than that of *Great*, fo often ill applied to the deftroyers, not the protectors, of humanity; he will enjoy the title of the " Friend of Mankind."

A late writer on modern hufbandry, however, feems to think more favourably of this method of bettering the ftate of agriculture than the author mentioned above, as he confiders it as a mean by which a general fpirit for fuch improvements may be the moft effectually introduced. It is a meafure, he fuppofes, which there is every reafon to believe would be attended with good confequences, in regard to the determining with exactnefs the proper quantities of the different forts of manures that ought to be applied to the different kinds of foils; the forts beft adapted to each; and the effects they produce when applied fingly or in their compound ftate. But the utility of public experimental farms in every county, if put under the direction and management of perfons of extenfive knowledge and experience, fhould not, it is contended, be eftimated by a reference to any particular branch: hufbandry, in all its departments, would be greatly improved in this way; and fhould the period ever arrive when the obftacles that ftand in its way fhall be removed, and proper means be had recourfe to, for diffufing a general knowledge of the beft methods of conducting the various operations connected with that fcience, that which has been fuggefted muft not be overlooked. It is fuppofed that fuch forts of farms would become fo many feminaries, at which youth might be inftructed in the nature, principles, and practice of agriculture, and to which the common farmer might occafionally refort for information, in refpect to the fuccefs of experiments made as it were under his own eye, and on foils, in fituations fimilar to thofe of his own.

And the author of " Rural Economy of the Midland Counties," in fpeaking of the advantages of thefe forts of farms, afks, " what man, whether of the fuperior clafs of yeomanry or tenants, or of a fuperior clafs of tradefmen or others, who are now bringing up their fons to hufbandry, would not, after his fon had gone through a courfe of private tuition, and received the rudiments of inftruction from himfelf or fome profeffional friend, wifh to perfect his education in a public feminary; where he would have not only an opportunity of feeing practice in its higheft ftate of improvement, and of converfing with profeffional men of the moft enlightened underftandings; but where he would be duly initiated in the theory of rural knowledge, in the method of making, regiftering, and obferving the refult of experiments; of afcertaining the inherent qualities, and improving the various breeds of live ftock; where he would fee order and fubordination, and learn the proper treatment of fervants; and among a variety of other branches of ufeful knowledge, the form and method of keeping farm-accounts, and of afcertaining with accuracy the profit or lofs upon the whole, and every part of his bufinefs; confequently of bringing it, as nearly as in its nature it is capable of being brought, to a degree of certainty."

But whatever may be the opinion of fome concerning the utility of public eftablifhments of this nature, we are inclined to believe that they will be found more beneficial when under the direction and management of private individuals who are fufficiently qualified for fuch undertakings, for though they may be far lefs extenfive, they will be much more ufefully conducted from their being lefs fubject to thofe improper checks and controuls, which are continually taking place when a number of perfons are concerned.

EXPERIMENTAL *philofophy*. Pythagoras is faid to have been the firft perfon who called himfelf philofopher, *viz.* a lover of knowledge or wifdom, from the Greek words φιλος, *a friend*, or *lover*, and σοφιας, *knowledge* or *wifdom*; from which appellation the word philofophy was derived, meaning the love of general knowledge; and according as this knowledge relates to the manners, the duties, and the conduct of human beings, confidered in a rational and focial light, or to the phenomena of natural bodies, fo it has been called either *moral philofophy* (from the Latin *mos* or *mores* its plural, which means *behaviour* or *manners*) or *natural philofophy*.

The philofophers of the primitive ages, among the Greeks, Romans, &c. in explanation of the phenomena of nature, fuch as the motions of the celeftial bodies, the rain, fnow, froft, thunder and lightning, the rainbow, the combuftion of fuel, the production of animals and vegetables, and fo forth, generally offered the inadequate fuggeftions of their imaginations, which, though moftly unintelligible, and frequently abfurd in the greateft degree, were neverthelefs received with deference by their fcholars, and were propagated

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with fidelity or diligence from one generation to another. Their acquiefcence refted merely on the authority of the teacher. That thefe explanations were generally inadequate and abfurd, is eafily evinced by obferving that different contemporary philofophers entertained and taught opinions diametrically oppofite to each other, though they related to the very fame queftion; and that fubfequent philofophers have by actual obfervations, and unerring demonftrations, fhewn their fallacy. It may amufe an inquifitive mind to obferve, that whilft the exertions of the early mathematicians, whofe productions have obtained the admiration of fubfequent generations, were ftrictly rational and correct, the inveftigations of their contemporary philofophers were conducted in a manner altogether flovenly and fuperficial. This method of philofophifing prevailed for a very long period, and in confequence of it feveral centuries elapfed, during which the knowledge of nature made no progrefs deferving of notice, excepting a few rare and accidental difcoveries.

The 15th century, which was productive of the greateft events and the moft confequential difcoveries that hiftory can record, feems to have given a new turn to the fubject of natural philofophy. The old tenets began to be doubted, and the energies of the human mind began to manifeft their unfettered powers. In the next century, the incoherent dogmas of the preceding ages were freely combated; the authority of names and fects was difregarded, and in lieu of opinions, the explanation of natural phenomena was referred to the evidence of actual experiments; and this introduced the appellation of *experimental philofophy*, meaning the knowledge of natural powers and natural effects, acquired by means of experiments or trials. The leaft reflection readily fhewed the fuperiority of this new method of philofophifing; but, independent of any other confideration, its eftablifhment is principally due to the fuccefs with which it was attended, and which exceeded even the moft fanguine expectations of its firft promoters; for it was no fooner adopted, than difcoveries of importance were made, old-eftablifhed errors were detected, and the fubject of philofophy affumed an entirely new afpect.

It is undoubtedly true, that in this mode of inveftigation the experiments muft be preceded by hypothefis, or fuppofition; for a man cannot begin to make experiments without the previous formation of a certain plan; but then the plan, the fuppofition, or the hypothefis goes no farther than to propofe fomething, the confirmation or refutation of which is referred to the refult of experiments, affifted by mathematical calculation.

In the 13th century, the neceffary preliminaries for the improvement of natural knowledge began to be made; *viz.* collections of what then prevailed under the denomination of fcientific knowledge, natural knowledge, fecrets of nature, and the like; and the farrago of truths, errors, inconfiftencies, doubts, and perplexities, which thefe works contain, is ftrange indeed. Among the few who effectually began to work in the experimental mode of inveftigation, during that century, friar Bacon held the moft diftinguifhed place. His defire of information was great; his views extenfive; his mind clear and capacious; and he is faid to have fpent about 2000*l.* (a fum very confiderable at that time) in the performance of his numerous philofophical experiments. Baptifta Porta alfo diftinguifhed himfelf for fimilar purfuits in Italy. This inquifitive perfon lived at Naples, and about the year 1560 formed a fociety of fcientific perfons, who met in his own houfe. The great Galileo, who was born in Italy in the year 1564, became famous as a philofopher and a mathematician towards the latter end of that century and the beginning of the next. His genius, fuperior to the prejudices of the times, inveftigated and eftablifhed feveral leading propofitions in natural philofophy; and his fuccefs, his example, and his precepts diffeminated an univerfal ardour for the true mode of inveftigating the powers and the effects of natural bodies. His fucceffor, Torricelli, was not unworthy of a moft diftinguifhed rank amongft the philofophers of the age; and the Torricellian tube, or the barometer, is a magnificent monument of his experimental inquiries.

In England, as we have already mentioned, friar Bacon was the firft promoter of true knowledge; but a great part of the work of philofophical reformation was accomplifhed by another inquifitive genius of the fame name. Francis Bacon, lord chancellor of England, gave a frefh and vigorous impulfe to the progrefs of experimental enquiry. He recorded a vaft number of facts, propofed and executed a great many experiments, and nothing that related to nature feemed to be below his notice.

Thefe early reformers of philofophy, befides other obvious difficulties, were obliged to ftruggle againft, and the fuccefs of their labours was much impeded by, the wrong notions which then prevailed, and which had been long rooted in the minds even of the moft able perfons then living. Galileo was nearly oppreffed by the ignorance and prejudices of the clergy. Crichton, who flourifhed about the latter end of the 16th century, wrote an able book exprefsly againft the vain philofophy of Ariftotle, which had long been read in the fchools. The two Bacons, and other able writers, frequently allude to, and ftrenuoufly endeavour to remove, the wrong notions of their contemporaries, and, in fhort, the demolition of the old defective fabric, proved nearly as laborious as the erection of the new ftructure.

The reform which had been begun by the above-mentioned and other worthy perfons was foon after completed by the extraordinary genius of Newton. This truly great man, like a luminary of the firft magnitude, illuftrated whatever came within the limits of his notice, and his notice was employed in the greateft and moft admired works of the creation. His method was to inftitute experiments, to examine the phenomena with accuracy, and to ground upon them the ftricteft mathematical reafoning. The conviction which fuch rational method conveyed, and the numerous difcoveries with which it was attended, completely exploded the old tenets, and eftablifhed the only true method of inveftigating nature.

The progrefs of experimental philofophy might have been interrupted by the death of a fingle individual; for it does but feldom occur that genius, health, opulence, and other opportunities concur in the qualification of an experimental philofopher; but the danger was in great meafure averted by the inftitution of philofophical focieties, which, by uniting the efforts of feveral ingenious labourers, by furnifhing in great meafure the means of inveftigation, by encouraging improvements, and by recording and propagating the refults, have eftablifhed the progrefs of knowledge in a regular and permanent channel.

The firft fociety of the kind which we find recorded, is that which we have already mentioned at the houfe of Baptifta Porta in Naples, towards the latter end of the 16th century. It was called "Academia Secretorum Naturæ." Next to this, and before the end of the fame century, the Academy, called of the Lyncei, was founded at Rome, and was rendered famous throughout the world principally by the renown of one of its members, the great Galileo. The Academy del Cimento, and feveral other affociations of fcientific perfons, were eftablifhed in the fucceeding, *viz.* the

the 17th century. And amongft thofe affociations the firft rank muft be affigned to the Royal Society of London. This moft learned and diftinguifhed fociety had its origin foon after the middle of the 17th century. A few men of learning began to meet at ftated times in Wadham college, Oxford; and among thofe perfons there were the following confpicuous characters; *viz.* Dr. Ward, Robert Boyle, Dr. Wilkins, fir William Petty, Mr. Matthew Wren, Dr. Wallis, Dr. Goddard, Dr. Willis, Dr. Bathurft, Dr. Chriftopher Wren, and Mr. Rooke. From Oxford this affociation transferred its meetings to Grefham college in London, which took place in the year 1658. There they increafed their number, and foon after the reftoration of Charles II. that fociety received a royal charter, which eftablifhed it into the form that has been continued ever fince; but we muft refer the reader to other articles of this Cyclopædia for the particular account of the Royal Society of London, as well as of other fcientific affociations in this and other countries; and at the fame time we muft proceed to explain the new mode of philofophifing in a manner fomewhat more particular.

The objects of the univerfe, or the natural bodies, which affect our fenfes, become known and ufeful to us by their properties, fome of which affect one of our fenfes, whilft others affect fome other fenfe. Thus we perceive luminous bodies through our eyes, found through our ears, heat or cold by the touch or feel, &c. Some of thefe properties are called general, like gravity and extenfion, becaufe they belong to all bodies; and others, like tranfparency and fluidity, are called particular, becaufe they belong to certain bodies only. The better we become acquainted with the properties of natural bodies, the more extended the fphere of our powers and of our advantages becomes; and it is for the difcovery of thefe properties, either in fimple or in compound bodies, that experimental inquiries are inftituted.

In the acquirement of knowledge, the human being has no other affiftance befides that of his fenfes, and of his reafoning faculty. By the firft he obferves and acquires ideas of felf evident propofitions, or properties of natural bodies; fuch as the human mind cannot diffent from without manifeft violence; by the fecond he is led from one of thefe evident fimple propofitions, to another ftrictly depending upon the firft, then to a third ftrictly depending upon the fecond, and fo on, to the acquifition of fome idea more complex, and lefs apparent at the firft annunciation.

The conftant obfervations of philofophers, with fir Ifaac Newton at their head, and the dictates of plain reafoning, have furnifhed certain axioms and certain rules of philofophizing, the propriety of which is too evident to be objected to.

The axioms of philofophy, or the axioms which have been deduced from common and conftant experience, are fo evident, and fo generally known, that it will be fufficient to mention a few of them only.

1. Nothing has no property; hence

2. No fubftance, or nothing can be produced from nothing.

3. Matter cannot be annihilated, or reduced to nothing.

The propriety of the laft axiom may perhaps be not readily admitted by certain perfons; obferving that a great many things appear to be utterly deftroyed by the action of fire; alfo that water may be caufed to difappear by means of evaporation, and fo forth. But it muft be obferved, that in thefe cafes the fubftances are not annihilated; they are only difperfed, or removed from one place to another, and by being divided into particles very minute, they elude our fenfes, and efcape our immediate notice. Thus, when a piece of wood is placed upon the fire, the greateft part of it difappears, and a few afhes only remain, the weight and bulk of which do not amount to the hundredth part of the weight and bulk of the original piece of wood. In this cafe the piece of wood is divided into its conftituent principles, which the action of the fire drives different ways. The fluid part, for inftance, becomes fteam, the light coaly part either adheres to the chimney, or is difperfed through the air, &c. fo that if, after the combuftion, the fcattered materials were collected, (which may in great meafure be accomplifhed,) the fum of their weights would equal the weight of the original piece of wood.

4. Every effect has, or is produced by, an adequate caufe, and is proportionate to it.

It may in general be obferved, with refpect to thefe axioms, that we only mean to affert what has been conftantly fhewn, and confirmed by experience, and is not contradicted either by reafoning or by any known experiment. But we do not mean to affert that they are as evident as the axioms of geometry; nor do we in the leaft prefume to prefcribe limits to the agency of the Almighty Creator of every thing, whofe power and whofe ends are too far removed from the reach of our underftandings.

Having thus ftated the principal axioms of philofophy, it is in the next place neceffary to mention the rules of philofophizing, which have been formed, after mature confideration, for the purpofe of preventing errors as much as poffible, and of leading the ftudent of nature along the fhorteft and fafeft path to the attainment of true and ufeful knowledge. Thefe rules are not more than four; *viz.*

1. We are to admit no more caufes of natural things, than fuch as are both true and fufficient to explain the appearances.

2. Therefore to the fame natural effects we muft, as far as poffible, affign the fame caufes.

3. Such qualities of bodies as are not capable of increafe or of decreafe, and which are found to belong to all bodies within the reach of our experience, are to be efteemed the univerfal qualities of all bodies whatfoever.

4. In experimental philofophy we are to look upon propofitions collected by general induction from phenomena, as accurately or very nearly true, notwithftanding any contrary hypothefes that may be imagined, till fuch time as other phenomena occur, by which they may either be corrected, or may be fhewn to be liable to exceptions.

With refpect to the degree of evidence which ought to be expected in natural philofophy, it is but proper to remark that phyfical matters are not in general capable of fuch abfolute certainty as the branches of mathematics. The propofitions of the latter fcience are clearly deduced from a fet of axioms fo very fimple and evident, as to convey perfect conviction to the mind; nor can any of them be denied without a manifeft abfurdity. But in natural philofophy we can only fay, that becaufe certain particular effects have been conftantly produced under certain circumftances, therefore they will moft probably continue to be produced as long as the fame circumftances exift; and likewife that they do, in all probability, depend upon thofe circumftances. And this is what we mean by *laws of Nature; viz.* certain effects which are or have been uniformly produced by certain caufes, as far as our obfervations reach.

We may, indeed, affume various phyfical principles, and by reafoning upon them, we may ftrictly demonftrate the deduction of certain confequences. But as the demonftration goes no farther than to prove that fuch confequences muft neceffarily follow the principles which have been affumed;

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the confequences themfelves can have no greater degree of certainty than the principles are poffeffed of; fo that they are true, or falfe, or probable, according as the principles upon which they depend are true, or falfe, or probable.

The foundations of experimental philofophy, as we have already obferved, are the properties of natural bodies, *viz.* of all thofe bodies, either folid or fluid, which in any way affect any of our fenfes: and fince our fenfes are affected by the properties of thefe bodies, *viz.* by their extenfion, colour, hardnefs, tranfparency, &c. we cannot know any more of thefe bodies than what is manifefted to us by fuch properties only as we are able to perceive. Were we furnifhed with other fenfes, we might difcover other properties which would make us more intimately acquainted with the nature of fuch bodies.

Human art has not been able to difcover more fenfes than thofe which every body knows; but it has, in great meafure, improved fome of thofe which we poffefs, and this alone is fufficient to point out the limited nature of our perceptions. Thus, for inftance, the difcovery of the microfcope, and the telefcope, have fhewn us wonders of which our forefathers were utterly ignorant; and the number and variety of thefe wonders have increafed in proportion as the above-mentioned inftruments have been improved. The improvements of thefe inftruments have been fuggefted by the difcoveries that have been made refpecting the refrangibility of light, and the properties of tranfparent bodies, and thefe have been made in confequence of the innumerable experiments that have been inftituted by various intelligent perfons. Thus it appears, that by means of trials and obfervations new facts are afcertained, which, befides their being immediately ufeful to the human fpecies, furnifh, at the fame time, the means of making farther difcoveries; and the treafures of the natural world are far, indeed, from a ftate of exhauftion. Hence the improvements and the difcoveries of experimental philofophy proceed in a kind of increafing geometrical progreffion; unlefs they be impeded by fome extraordinary occurrence.

In contemplating the intimate nature of natural bodies, when our mind goes beyond the bounds of our fenfes, (and our fenfes, even with the affiftance of inftruments and reafoning, are only capable of perceiving a few properties of thofe bodies;) we wander in the boundlefs field of probability and conjecture. Two principal hypothefes have been entertained with refpect to the primitive component particles of bodies. One is, that the particles of each peculiar fpecies of bodies are different from the particles of another fpecies of bodies. Thus the primitive particles of gold are fuppofed to be different from the particles of calcareous earth, different from the particles of water, &c. The other hypothefis is, that there is one kind of primitive or original particles of matter, and that from the different arrangement of thofe ultimate particles, the various bodies arife. Experience fhews that certain bodies, which, at firft fight, appear to be abfolutely different from each other, are, upon further examination, exactly of the fame nature. On the other hand, a vaft number of bodies are fo diftinct from each other, that no art has been able to form one of them from the particles of another; thus gold cannot be converted into a diamond, iron cannot be converted into lead, &c. The former of thefe obfervations feems to favour the fecond hypothefis; the latter feems to favour the firft hypothefis; but it is not in our power to determine the real ftate of the matter.

With refpect to the number of bodies, which, by our not being able to change one of them into the other, are called elementary, or primitive and diftinct, the reader will find fufficient information under the article Element; but it may be remarked in this place, that new bodies are frequently difcovered in proportion as new inftruments, and the improvements of fcience in general, furnifh us with the means of difcriminating them from others; hence we are naturally led to conclude, that moft probably there may exift a vaft number of other bodies, of which we at prefent have not the leaft fufpicion. Some of thefe may perhaps be difcovered hereafter, whilft others may remain utterly unknown to the human fpecies.

The properties of natural bodies, which are the objects of refearch to the experimental philofopher, are either general, or particular. The general properties, which belong to all kinds of bodies, are, as far as we know, not more than fix; *viz.* extenfion, divifibility, impenetrability, mobility, vis inertiæ, or paffivenefs, and gravitation. We have faid that thefe are the general properties as far as we know, becaufe matter in general may poffefs other properties that are not yet come to our notice. And the fame obfervation may be made with refpect to the univerfality of thefe properties: for they are faid to be general, becaufe no body was ever found which wanted any one of them. But mankind are not acquainted with all the bodies of the univerfe, and even feveral of thofe which are known to exift, cannot be fubjected to experiments.

The peculiar properties, *viz.* thofe which belong to certain bodies only, and not to others, are denfity, rarity, hardnefs, foftnefs, fluidity, rigidity, flexibility, elafticity, opacity, tranfparency, the properties of light, the properties of heat, the properties of electricity, the properties of magnetifm, and three other kinds of attraction, (independent of gravitation, of electricity, and of magnetifm,) *viz.* the attraction of aggregation, which the homogeneous parts of matter have towards each other, or by which they adhere together; and fuch is the power by which two fmall drops of mercury, when placed contiguous to each other, rufh, as it were, into each other, and form a fingle drop; the attraction of cohefion, or that power by which the heterogeneous particles of bodies adhere to each other without any change of their natural properties, fuch as the adhefion of water to glafs, of oil to iron, &c.; and the attraction of compofition, or of affinity, which is the tendency that the parts of heterogeneous bodies have towards each other, by which they combine, and form a body, differing more or lefs from any of its components.

It is to be remarked, that of all thefe properties we know their exiftence only, and fome of the laws under which they act; but we are otherwife utterly ignorant of their nature and dependence.

The inveftigation of fome of the above-mentioned properties, whether general or particular, has been carried much farther than the inveftigation of other properties. The refults of thefe inveftigations have likewife been various, both in point of extent and of application. Some of them are fo very extenfive and fo ufeful, as to form the foundations of very important branches of fcience or of art, under peculiar appellations. Thus, upon the mobility and the vis inertiæ of bodies, the doctrine of motion, or dynamics, is grounded, which comprehends mechanics, hydroftatics, or the mechanical properties of fluids, pneumatics, &c. Tranfparency and the properties of light form the important foundation of optics. The attraction of affinity is the foundation of chemiftry, as well as of various arts, and fo forth. Whatever belongs to thefe properties, or to the extenfive fubjects that are grounded upon the fame, will be found under the various articles of their peculiar denominations.

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The phenomena of the univerſe, are the appearances which take place in conſequence of the above-mentioned properties of natural bodies, together (reſpecting ſome of them at leaſt) with ſome original impulſe. The phenomena which take place amongſt the luminous celeſtial bodies, properly ſo called, ſuch as the ſtars, the planets, &c. are examined by a particular ſcience called aſtronomy; the meteors, or the phenomena, which take place within the limits of the terreſtrial atmoſphere, ſuch as ſhooting ſtars, northern lights, halos, rain, fogs, hail, winds, &c. form the ſubject of meteorology. The phenomena that take place upon the ſurface of, or within, the earth, are treated of under the comprehenſive denominations of *vegetation, earthquakes, volcanoes, combuſtion*, &c. all which will be found explained under their appropriate articles.

EXPERIMENTUM Crucis, denotes a capital, leading, or deciſive experiment; thus called, either, becauſe like a croſs or direction poſt, placed in the meeting of ſeveral roads, it guides and directs men to the true knowledge of the nature of the thing they are enquiring after; or as it is a kind of torture, whereby the nature of the thing is, as it were, extorted by violence.

EXPIATION, the act of ſuffering the puniſhments adjudged to a man's crimes, and thus paying off, or diſcharging the debt or guilt; and it is figuratively applied to the pardon procured for the ſins of the penitent by the interpoſition and death of Chriſt.

The Romaniſts hold, that ſouls after death are ſent to purgatory to expiate or atone for their ſins. See Purgatory.

Expiation is alſo applied to ſacrifices offered to the Deity, to implore his mercy and forgiveneſs.

Expiation, *the Feaſt of*, among the Jews, called by our tranſlators the *day of atonement*, was held on the tenth day of Tiſri, or the ſeventh month of the Jewiſh year, anſwering to part of our September and October. It was inſtituted by God himſelf, Levit. xxiii. 27, &c. On that day the high-prieſt, the figure or type of Jeſus Chriſt, entered into the moſt holy place, and confeſſed his ſins; and, after ſeveral ceremonies, made an atonement for all the people to waſh them from their ſins. Lev. chap. xvi. See Scape-*Goat*.

Expiation, among the *Heathens*, denoted a purification uſed for effacing or aboliſhing a crime, averting any calamity; and on a thouſand other occaſions, as purifying towns, temples, and ſacred places, and armies, before and after battle.

It was practiſed with divers ceremonies; the moſt uſual was ablution.

Expiations were performed for whole cities as well as particular perſons. After the young Horatius had been abſolved by the people for the murder of his ſiſter, he was farther purified by ſeveral expiations preſcribed by the laws of the pontiſices for involuntary murders. Dion. Halicarnaſſ.

EXPILATION, from *expilo, I rob*, in the *Civil Law*, the act of withdrawing or diverting ſomething belonging to an inheritance, before any body had declared himſelf heir thereof.

This made a peculiar ſpecies of theft; for there could not properly be a theft in taking a thing not poſſeſſed by any body, or before the inheritance was accepted.

For this reaſon the Roman legiſlature introduced the action of expilation for the puniſhment of this crime.

Beſide this meaning, it was uſed in a more ſpecial manner to ſignify a robbery committed by night; whence an expilator was looked upon as a greater criminal than a common thief.

The expilators were ſo called from their robbing and ſtripping people of their cloaths.

EXPIRATION, in *Phyſiology*, is the act of expelling air from the lungs, produced by a diminution of the cavity of the cheſt. It is oppoſed to inſpiration, in which air is drawn into the cheſt. See Respiration.

Expiration is alſo uſed figuratively, for the end of a term of time granted, or agreed on, or adjudged.

EXPLEES, in *Law*, the rents or profits of an eſtate, &c. See Esplees.

EXPLICATION *of the Subject of a Diſcourſe*, in *Pulpit Oratory*, and in the compoſition of ſermons, comes in the place of narration at the bar, and ſhould be conducted in a ſimilar manner. It ſhould be conciſe, clear, and diſtinct, and in a ſtyle correct and elegant, rather than highly adorned. To explain the doctrine of the text with propriety, to give a full and perſpicuous account of the nature of that virtue or duty which forms the ſubject of the diſcourſe, is properly the didactic part of preaching; on the right execution of which much depends for all that comes afterward in the way of perſuaſion. The great art in ſucceeding in it is, to meditate profoundly on the ſubject, ſo as to place it in a clear and ſtrong point of view. Conſider what light other paſſages of ſcripture throw upon it; conſider whether it be a ſubject nearly related to ſome other from which it is proper to diſtinguiſh it, conſider whether it can be illuſtrated to advantage by comparing it with, or oppoſing it to, ſome other thing; by enquiring into cauſes, or tracing effects; by pointing out examples, or appealing to the feelings of the hearers; that thus a definite, preciſe, circumſtantial view may be afforded of the doctrine to be inculcated. Let the preacher be perſuaded, that by ſuch diſtinct and apt illuſtrations of the known truths of religion, it may both diſplay great merit in the way of compoſition, and, what he ought to conſider as far more valuable, render his diſcourſes weighty, inſtructive, and uſeful. Blair's Lectures, vol. ii. p. 297.

EXPLICATIVE Proposition, in *Logic*. See Complex *Propoſition*.

EXPLICITE, in the *Schools*, ſomething clear, diſtinct, formal, and unfolded.

The will or intention is ſaid to be explicite when it is fully explained in proper terms; and implicite, when it is only to be learnt by deductions and conſequences.

The Jews had not all an explicite knowledge of Jeſus Chriſt, but they had at leaſt an implicite one.

Such a teſtator has declared his will explicitely, *i e.* in formal terms; there is no need to have recourſe to explications.

EXPLOITS, Bay *of*, in *Geography*, a bay of the Atlantic, on the eaſt coaſt of Newfoundland. N. lat. 49° 45′. W. long. 55° 20′.

EXPLOSION. It is a matter of great moment, in military engineering, ſo to load, and indeed to conſtruct, a mine, that it may explode with the greateſt preciſion, and with the maximum effect. A variety of theories has been given upon this ſubject, but it would be out of place to notice the whole of what appertains thereto in this place; therefore we ſhall refer our readers to the word Mine for the particular detail of what relates to this ſubject, contenting ourſelves with now offering a few remarks on the manner in which the exploſion is uſually effected.

It is of the firſt importance to aſcertain, ſo nearly as may be practicable, what depth, and what weight of ſoil is to be removed by an exploſion. This being done, the mine is formed,

formed, by a gallery leading to the chamber in which the powder is to be depofited in a very ftrong cheft, let into a recefs, and firmly fecured in every part. Now, it being the nature of the rarefied air to efcape by that part which may be the weakeft, it is evident, that if a mine is made under a rampart, fo as to be within fix feet of the furface, while all the fides are thicker by far than that meafurement, the explofion will be directed towards that part which is thinneft, and which from that circumftance is called " the line of leaft refiftance."

But, in order to direct the explofion to that part, it will be neceffary to confider whether the foil be every where alike; for if the fuperincumbent portion fhould be part of a large ftratified rock, while the fides are of a loofe, inadhefive fubftance, the latter, though meafuring more in diameter, will give the line of leaft refiftance, which, in fuch cafe, would follow the intenacity, and create a falfe explofion. Hence explofions may be lateral as well as vertical.

It was formerly fuppofed, that the diameter of the entonnoir, or explofion, was equal to double the line of leaft refiftance; but we find that *fix times* that line may be exploded, by allowing a load of 300lbs. of gun-powder, duly concentrated, and fired in the middle of the mafs, for every foot of the line of leaft refiftance. We are not to infer from this, that 300lbs. will be requifite to lift one foot of foil; far from it; for as a cubic foot of excavation will contain only 75lbs. of powder, the above quantity (300lbs.) would require a fpace of exactly four cubic feet; the proportion would therefore be prepofterous. But when we calculate upon large maffes of foil, fuch as thofe prodigious cones thrown out from entonnoirs of great extent, we then find, that, to produce the completeft explofion, an immenfe quantity of powder muft be fupplied.

It is felf evident, that the power of the powder, according to the above fcale, is only computed to that extent which may be neceffary towards the ordinary purpofes of military devaftation; for if we were to contribute, *ad infinitum*, 300lbs. of gunpowder for every foot in the line of leaft refiftance, we fhould be accumulating power only in arithmetical proportion, while the refiftance would be increafing in a geometric ratio: of courfe the power muft be in a regular ftate of comparative diminution, in proportion as the line of leaft refiftance is increafed; and this muft, after a while, occafion the powder to be inert; or, if there fhould be any explofion, it could only follow the track of the train; its ignition to be fure might be felt partially, like that of a flight earthquake, but no fuperficial effects would be obfervable.

It has been already ftated, that the powder muft be lodged in bulk; and that it fhould be ignited at the centre. This may, perhaps, appear fuperfluous; but all military men know, that much powder is blown out of the muzzles of pieces without ever being ignited; and we have a moft remarkable fact, a very recent one indeed, which fhews that, unlefs in bulk, powder is not always fure to be fired *in toto*. The incident alluded to is as follows.

In the month of March of this year, (1809,) a barge was proceeding along the new cut, from Paddington, laden with cafks of fpirits and barrels of gunpowder. One of the crew, it is fuppofed, allured by the former, bored a hole for the purpofe of drawing off a little wherewith to tipple. Unhappily the action of the gimblet fet fire to the contents of that barrel, which the difhoneft navigator had miftaken for one of fpirits. The barrel exploded, and drove eleven other barrels, filled with gunpowder alfo, to the diftance of near a hundred and fifty yards. It is curious, that although the whole of the powder-barrels were together, indeed in contact, only that in queftion exploded.

Vauban gives us the following fcale for exploding foils of various defcriptions. He calculates, or perhaps found from experience, that for a cubic fathom (fix feet) of foil, meafuring in all 216 folid feet, the following proportions of gunpowder were needful.

1. Light earth, mixed with fand,	11lb.
2. Common earth	12
3. Strong fand	15
4. Clay, or fat earth,	16
5. Old, and good mafonry	18
6. Rock	20

In following this calculation, we are to confider the entonnoir to be in diameter equal to only double the line of leaft refiftance; and not according to a maximum explofion.

Explosion, from the Latin *explodo*, is the act of driving out fomething with noife and violence. The caufes, the report or noife, and the other effects of explofions, however infignificant they may appear at firft fight, are neverthelefs, when duly confidered, of great confequence to the human fpecies, and as fuch they have been carefully inquired into by divers philofophers. A variety of experiments have been inftituted for determining the particulars that relate to them, and numerous conjectures have been offered in explanation of thefe concomitant circumftances, which have not as yet been thoroughly inveftigated.

Explofions may be diftinguifhed into natural and artificial. The principal natural explofions are thofe of the atmofpherical thunder, of volcanoes, of earthquakes, and to thefe there may be added the inferior explofions arifing from hard frofts. The artificial explofions are fuch as are produced by the force of fired gunpowder in the various engines in which it is ufed, the explofions produced by other chemical compounds, and the pneumatic explofions; meaning thofe which are produced by the air rufhing into a partial vacuum, by the difcharge of air-guns and the like.

Of all thefe kinds of explofions we fhall now briefly treat, not in the order in which they have been enumerated, as this would prove a ufelefs formality; but in a manner which may be more likely to elucidate the moft interefting part of the fubject; and this undoubtedly is the ftupendous force with which effects, in great variety, are produced in certain explofions.

The firft thing that ftrikes the obferver is the fudden and violent noife of an explofion. It is hardly neceffary to obferve that this noife or report is owing to the intermediation of the air between our ears and the caufe, whatever that may be, of the percuffion which is given to the air. Without that intermediation, or without air, the report could not be heard. But it muft be farther obferved, that the mere introduction of fomething into the ambient air is not the principal caufe of the report. That effect principally depends upon the fudden replacing or collapfing of the air, after its having been removed or rarefied in any particular place. So that in order to account for the immediate caufe of the noife in an explofion, we muft look out for fomething which after having been introduced into the atmofphere, whether flowly or quickly, is afterwards *fuddenly* withdrawn or contracted. A few examples will eafily illuftrate this obfervation.

Take a common fyringe, ftop the aperture of it, then draw the pifton entirely out of its other extremity, and at that moment a report is heard, which is occafioned by the replacing of the air within the fyringe; for in drawing the pifton out of it, the air within the cavity of the fyringe is rarefied,

rarefied, *viz.* a partial vacuum is formed, but as soon as the piston is quite out, the air of the atmosphere suddenly rushes in to supply that deficiency, and produces the noise or the report.

There is an experiment commonly shewn with the air-pump, and a glass vessel open at both ends. To one of the apertures of the glass vessel a wet piece of bladder is tied, and is suffered to become dry. The other aperture of the glass vessel is then placed upon the plate of the air-pump. This done, the air is extracted by working the pump, by which means the glass vessel covered over with the bladder is partially exhausted, and of course the pressure of the atmosphere is in great measure removed from the under surface of the piece of bladder. The atmosphere, then pressing on the upper part of the bladder, and not being counteracted from below, distends the bladder towards the cavity of the vessel, and at last breaks it with a considerable explosion. The reason of which noise is the sudden rushing in of the air.

An air-gun, when discharged, produces a trifling noise, the reason of which is, that after the expulsion of the condensed air from the inside of the instrument, which is impelled against the ambient air, there is no collapsion of the latter; for the condensed air, on coming out of its confinement, expands itself to the tension of the ambient air, and remains in that state; *viz.* without any subsequent contraction.

There are little glass balls, containing a small quantity of water, which are made and sold for diverting experiments, under the name of *glass granades*. A ball of this kind is nothing more than a diminutive glass bottle partially filled with water, and having a longish neck or tail, hermetically sealed. One of these little bottles is stuck with its tail into the tallow or wax of a burning candle, and so that the little ball may be in the flame of the candle. In this situation the heat of the flame converts part of the fluid within the ball into vapour, and when the elasticity of this vapour is sufficient to overcome the resistance of the glass the ball breaks, and produces a smart explosion. The reason of which is, that the condensed vapour, on coming out of the glass, displaces a considerable quantity of air, but being instantly cooled, it contracts, and the air collapses.

A musket loaded with gunpowder, on being fired off, produces a strong explosion. Now the difference between the discharge of such a musket and that of an air-gun is, that though in both an elastic fluid is discharged; yet in the musket the elastic fluid contracts immediately after its coming into contact with the external air: but with the air-gun, the elastic fluid which issues out of it does not contract after its expulsion; hence the report is incomparably louder with the former than with the latter.

An electric spark, especially in the discharge of a Leyden phial or battery, is accompanied with a smart report, in consequence of its suddenly displacing the air from the spot in which it explodes; and of the subsequent collapsing of the air. And that the electric spark really displaces the air, is easily shewn by means of an electrical instrument, called "Kinnersley's electrical air thermometer." In this instrument the spark is taken into a close glass vessel, which by an annexed narrow tube, partially filled with a liquor, indicates the rarefaction or displacing of the air within the vessel. With this apparatus, whenever a spark or discharge of an electric jar is taken within the close vessel, the rising and falling of the liquor within the annexed tube shews that the air is suddenly displaced, and is likewise heated in some degree; for the liquor rises suddenly to a certain degree; and as suddenly descends, not quite to its former station, but to a place a little above it, from which afterwards it descends gently to its original station.

From these facts, and from a vast many more which might here be described, it clearly appears that the sudden introduction of something into the ambient air produces little noise; but that the noise of an explosion is mostly due to the collapsing of the air, which takes place in consequence of the instantaneous contraction of that which has been introduced in it. The noise, *cæteris paribus*, is more or less loud in proportion as a greater or lesser quantity of air is displaced and replaced, and likewise in proportion to the quickness of that operation.

When more reports than one are heard; these are produced either by an equal number of explosions, or by a reverberation, *viz.* by an echo.

The air thus agitated conveys the sound of an explosion, or propagates its own vibrations, to immense distances. The firing of heavy ordnance has been sometimes heard at the distance of 50 or 60, and even more miles. The explosions of volcanoes, or those which accompany earthquakes, have often been perceived at distances much more considerable; but with respect to the extent of this kind of communication, rate of moving, &c. the reader is referred to the article Sound, *propagation of*, and Hearing. We shall, however, in this place, briefly mention an effect of this kind of violent aerial vibration; which it might be wished that such persons as are opportunely situated, would examine with particular attention. The phenomenon is, that the explosion of cannons, and especially of powder magazines, or powder mills, renders the air considerably electrified, and that it electrifies the glasses of windows.

After the noise, or the report, the next step is to inquire into the cause or causes which produce it: *viz.* into the nature of the elastic fluid which, in coming out of any confinement, displaces the circumambient air, and then suddenly gives way to it. Until very lately the immediate cause of most explosions was principally attributed to the generation or extrication of permanently elastic fluids, *viz.* gases; and this is undoubtedly true in a great many cases; but upon a closer examination of the concomitant particulars, the expulsion of these elastic fluids, even in a state of incandescence, was found inadequate to the effects that were experienced in a variety of cases; hence philosophers began to look out for some other agent more active; and though the force of steam was known to be concerned in some kinds of explosions; yet it must be acknowledged, that we are indebted to count Rumford for a masterly examination of this particular point; for which purpose he instituted a long and laborious series of well contrived experiments. His account at large under the title of "Experiments to determine the Force of fired Gunpowder," is contained in the Phil. Trans. for the year 1797, and from that account we shall extract such particulars as may seem sufficiently to illustrate this important part of the subject of explosions. We call it important, because it is the particular from which the causes of natural explosions, such as of volcanoes, earthquakes, &c. may be obviously manifested.

Count Rumford justly says, "The explosion of gunpowder is certainly one of the most surprising phenomena we are acquainted with, and I am persuaded it would much oftener have been the subject of the investigations of speculative philosophers, as well as of professional men, in this age of inquiry, were it not for the danger attending the experiments; but the force of gunpowder is so great, and its effects so sudden and so terrible, that, notwithstanding all the precautions possible, there is ever a considerable degree of danger attending the management of it."

Several able philosophers had, at different times, endeavoured to determine the force of it. "But," count Rumford

ford fays, " the great defideratum, the real meafure of the initial expanfive force of inflamed gunpowder, fo far from being known, has hitherto been rather gueffed at than determined ; and no argument can be more convincing to fhew our total ignorance upon that fubject, than the difference in the opinions of the greateft mathematicians of the age, who have undertaken its inveftigation."

The ingenious Mr. Robins thought, that the force of the elaftic fluid, which is generated in the combuftion of gunpowder, is 1000 times greater than the mean preffure of the atmofphere. Mr. D. Bernouilli reckoned it equal to 10,000 times that preffure.

Count Rumford, in one of his firft experiments, confined gunpowder in a ftrong iron tube, and fired it by heating part of the tube, or rather of an appendage that had been fixed to it. This was done with a view of confining the elaftic fluid, that was generated in the combuftion. " The refult," he fays, " of this experiment fully anfwered my expectations. The generated elaftic fluid was fo completely confined, that no part of it could make its efcape. The report of the explofion was fo very feeble, as hardly to be audible: indeed it did not by any means deferve the name of a report, and certainly could not have been heard at the diftance of twenty paces ; it refembled the noife which is occafioned by the breaking of a very fmall glafs tube."

And farther on, he fays, " It has generally been believed, after Mr. Robins, that the force of fired gunpowder confifts in the action of a permanently elaftic fluid, fimilar in many refpects to common atmofpheric air : which being generated from the powder in combuftion, in great abundance, and being, moreover, in a very compreffed ftate, and its elafticity being much augmented by the heat, (which is likewife generated in the combuftion,) it efcapes with great violence, by every avenue ; and produces that loud report, and all thofe terrible effects which attend the explofion of gunpowder.

" But though this theory is very plaufible, and feems upon a curfory view of the fubject to account in a fatisfactory manner for all the phenomena, yet a more careful examination will fhew it to be defective. There is no doubt but the permanently elaftic fluid generated in the combuftion of gunpowder, *affifts* in producing thofe effects which refult from its explofion ; but it will be found, I believe, upon afcertaining the real expanfive force of fired gunpowder, that this caufe, alone, is quite inadequate to the effects actually produced : and that, therefore, the agency of fome other power muft neceffarily be called in to its affiftance."

This author then proceeds to defcribe a variety of experiments and calculations which prove, beyond a doubt, that the above-mentioned theory is infufficient to account for the effects which are produced by the inflammation of gunpowder ; for he computes, in the ampleft manner poffible, the force of the gas which is generated even in the heat of red-hot iron, by which elevation of temperature air is known to be expanded not much above four times its ordinary bulk. He endeavoured to meafure the force in queftion by the lifting up of a very great weight, and his ingenious experiments were attended with refults fufficiently fatisfactory ; but we muft refer the reader to the above-mentioned paper itfelf for the detail of thefe interefting particulars ; and we muft here only add an abridgment of the latter part of the account, which more immediately relates to the principal object of our prefent enquiry.

" I will finifh," the Count fays, " this paper by a computation, which will fhew that the force of the elaftic fluid generated in the combuftion of gunpowder, enormous as it is, may be fatisfactorily accounted for upon the fuppofition that its force depends *folely* on the elafticity of watery vapour or fteam.

" It has been fhewn by a variety of experiments made in England, and in other countries, that the elafticity of fteam is redoubled by every addition of temperature equal to 30 degrees of Fahrenheit's thermometer.

" Suppofing now a cavity of any dimenfions (equal in capacity to one cubic inch for inftance) to be filled with gunpowder, and that on the combuftion of the powder, and in confequence of it, this fpace is filled with fteam (and I fhall prefently fhew that the water exifting in the powder *as water* is abundantly fufficient for generating this fteam) ; if we know the heat communicated to this fteam in the combuftion of powder, we can compute the elafticity it acquires by being fo heated.

" Now it is certain that the heat generated in the combuftion of gunpowder cannot poffibly be lefs than that of red-hot iron. It is probably much greater, but we will fuppofe it to be only equal to 1000 degrees of Fahrenheit's fcale, or fomething lefs than iron vifibly red-hot in day light."

" As the elaftic force of fteam is juft equal to the mean preffure of the atmofphere, when its temperature is equal to that of boiling water, or 212° of Fahrenheit's thermometer, and as its elafticity is doubled by every addition of temperature equal to 30 degrees of the fame fcale, with the heat of $212° + 30° = 242°$ its elafticity will be equal to the preffure of two atmofpheres ; at the temperature of $242° + 30° = 272°$ it will be equal to four atmofpheres, &c.

" Following up our computations on the principles affumed, (and they are founded on the moft incontrovertible experiments,) we fhall find that at $692° + 30° = 722°$, the elafticity will be equal to the preffure of 131,072 atmofpheres, which is 130 times greater than the elaftic force affigned by Mr. Robins to the fluid generated in the combuftion of gunpowder ; and about *one-fixth* part greater than my experiments indicated it to be.

" But even here the heat is ftill much below that which is moft undoubtedly generated in the combuftion of gunpowder. That the elafticity of fteam would actually be increafed by heat in the ratio here affumed, can hardly be doubted ; it has abfolutely been found to increafe in this ratio in all the changes of temperature between the point of boiling water, (I may even fay of freezing water,) and that of 280° of Fahrenheit's fcale, and there does not appear to be any reafon why the fame law fhould not hold in higher temperatures.

" A doubt might poffibly arife with refpect to the exiftence of a fufficient quantity of water in gunpowder, to fill the fpace in which the powder is fired, with fteam, at the moment of the explofion, but this doubt may eafily be removed.

" The beft gunpowder, fuch as was ufed in my experiments, is compofed of 70 parts (in weight) of nitre, 18 parts of fulphur, and 16 parts of charcoal ; hence 100 parts of this powder contain $67\frac{1}{10}$ parts of nitre, $17\frac{3}{10}$ parts of fulphur, and of charcoal $15\frac{4}{10}$ parts.

" Mr. Kirwan has fhewn that in 100 parts of nitre there are feven parts of water of cryftallization ; confequently in 100 parts of gunpowder, as it contains $67\frac{3}{10}$ parts of nitre, there muft be $4\frac{711}{1000}$ parts of water.

" Now as one cubic inch of gunpowder, when the powder is well fhaken together, weighs exactly as much as one cubic inch of water at the temperature of 55° F. namely 253,175 grains troy ; a cubic inch of gunpowder in its drieft ftate muft contain at leaft $10\frac{927}{1000}$ grains of water ;

for

for it is 100 to 4,711, as 253,175 to 10,927. But besides the water of cryſtallization which exiſts in the nitre, there is always a conſiderable quantity of water in gunpowder, in that ſtate in which it makes bodies damp or moiſt. Charcoal expoſed to the air has been found to abſorb nearly $\frac{1}{8}$th of its weight of water, and by experiments I have made on gunpowder, by aſcertaining its loſs of weight on being much dried, and its acquiring this loſt weight again on being expoſed to the air, I have reaſon to think that the power of the charcoal, which enters into the compoſition of gunpowder, to abſorb water, remains unimpaired, and that it actually retains as much water in that ſtate as it would retain were it not mixed with the nitre and the ſulphur.

"As there are $15\frac{4}{10}$ parts of charcoal in 100 parts of gunpowder, in one cubic inch of gunpowder, (= 253,175 grains troy,) there muſt be 38,989 grains of charcoal; and if we ſuppoſe $\frac{1}{8}$th of the apparent weight of this charcoal to be water, this will give 4,873 grains in weight for the water, which exiſts in the form of moiſture in one cubic inch of gunpowder.

"If now we compute the quantity of water which would be ſufficient, when reduced to ſteam under the mean preſſure of the atmoſphere, to fill a ſpace equal in capacity to one cubic inch, we ſhall find that either that contained in the nitre which enters into the compoſition of one cubic inch of gunpowder, as water of cryſtallization, or even that ſmall quantity which exiſts in the powder in the ſtate of moiſture, will be much more than ſufficient for that purpoſe.

"Though the denſity of ſteam has not been determined with that degree of preciſion that could be wiſhed, yet it is quite certain that it cannot be leſs than 2000 times rarer than water, when both are at the temperature of 212°. Some have ſuppoſed it to be more than 10,000 times rarer than water, and experiments have been made which ſeem to render this opinion not improbable; but we will take its denſity at the higheſt poſſible eſtimation, and ſuppoſe it to be only 2000 times rarer than water. As one cubic inch of water weighs 253,175 grains, the water contained in one cubic inch of ſteam at the temperature of 212° will be $\frac{1}{2000}$dth part of 253,175 grains, or 0.12659 of a grain.

"But we have ſeen that one cubic inch of gunpowder contains 10,927 grains of water of cryſtallization, and 4,873 grains in a ſtate of moiſture; conſequently the quantity of water of cryſtallization in gunpowder is 86 times greater, and the quantity which exiſts in it in a ſtate of moiſture, is 38 times greater than that which would be required to form a quantity of ſteam ſufficient to fill completely the ſpace occupied by the powder.

"Hence we may venture to conclude, that the quantity of water actually exiſting in gunpowder is much more than ſufficient to generate all the ſteam that would be neceſſary to account for the force diſplayed in the combuſtion of gunpowder, (ſuppoſing that force to depend ſolely on the action of ſteam,) even though no water ſhould be generated in the combuſtion of gunpowder. It is even very probable that there is more of it than is wanted, and that the force of gunpowder would be ſtill greater, could the quantity of water it contains be diminiſhed.

"From this computation it would appear that the difficulty is not to account for the force actually exerted by fired gunpowder, but to explain the reaſon why it does not exert a much greater force."

Beſides the common gunpowder, there are ſeveral other chemical compoſitions which are capable of exploding with greater or leſs violence; and the moſt remarkable of theſe compoſitions are, the gunpowder formed with the ſuperoxygenated muriate of ſoda, inſtead of nitre; that preparation of gold which, from its remarkable property, is called fulminating gold; the fulminating ſilver, Howard's mercurial powder, the common fulminating powder, which conſiſts of nitre, potaſh, and ſulphur, &c. The exploſions of almoſt every one of theſe chemical compoſitions is louder than the exploſion of an equal quantity of the common gunpowder; yet when confined in a barrel or other fit inſtrument, few of theſe compoſitions exert a force, or produce an effect equal to that of gunpowder. This, which at firſt ſight may appear to be an inexplicable paradox, will be eaſily underſtood by conſidering, that the ſmartneſs of the report depends in great meaſure on the quickneſs of the inflammation or exploſion; whereas the force of the exploſion is moſtly proportional to the quantity of elaſtic fluid, be it gas or vapour, which is generated, and that the abovementioned chemical mixtures explode quicker than common gunpowder, may be eaſily proved. Let, for inſtance, two trains of equal length be formed upon a ſtone pavement; *viz.* one with the common gunpowder, and another with Howard's mercurial powder, and let one extremity of each train come into mutual contact; ſo that by applying a red-hot iron to that point, both trains may be fired at the ſame time. It will be found that the train of mercurial powder goes off viſibly much quicker than that of gunpowder; for when the former is entirely conſumed, the fire of the latter will hardly have proceeded half way of the whole train.

The exploſion of the gunpowder made with the ſuperoxygenated muriate of ſoda, and Howard's mercurial powder, exert an immenſe force when fired in barrels or other like veſſels. Fulminating gold aud fulminating ſilver explode very readily, eſpecially the latter, which, when once prepared, can no longer be touched; for it will explode, not only when heated a few degrees above the temperature of the atmoſphere, but even when touched with any ſolid body. Yet when either of theſe preparations is confined in a barrel or other like inſtrument, and is inflamed, the force which it exerts is by no means equal to that which one who has heard the noiſe of their exploſions would be led to expect. It is worthy of remark, that, upon the whole, no other compoſition hitherto diſcovered has been found preferable to the common gunpowder, for muſkets, cannons, and other inſtruments of the like nature. Moſt of theſe preparations are conſiderably more expenſive than the common gunpowder; ſome of them are not nearly ſo manageable as the gunpowder, for they will explode by the leaſt touch or grinding, even by the friction of the ſtopple into the neck of the veſſel that contains them; but the principal fault is that very property by which they might be expected to have a ſuperior power; namely, the quickneſs of their exploſion.

There is a certain time requiſite for the motion of the wadding and bullet from the lower part to the muzzle of a gun, and the gradual inflammation of the gunpowder, when uſed in proportionate quantity, ſeems to correſpond with that gradual movement of the bullet, wadding, &c. When the exploding compoſition goes off much quicker than the common gunpowder, that force which is exerted ſpherically all round, and quicker than the time during which the wadding, &c. can get along the cavity of the barrel, frequently breaks the barrel, and endangers the by-ſtanders. We cannot illuſtrate this effect better than by mentioning the common and well-known obſervation, that though an open door may be ſhut by a gentle application of a child's a child's hand, yet if you point a gun, and fire a bullet at it, the latter will make a hole through it without ſhutting, or cloſing it in the leaſt.

Speaking of the force of exploſions, it may naturally be required that we ſhould treat of the force and effects of electrical exploſions. But as the nature of ſuch exploſious cannot be properly underſtood without other particulars relative to the ſubject of electricity, their force and effects will be found deſcribed under the articles which belong to that extenſive ſubject; ſuch as ELECTRIC *Sparks*, LEYDEN PHIAL, FIRE *Balls*, LIGHTNING, &c.

It is in a manner ſimilar to the effects of gunpowder, that water projected upon red-hot or fuſed metal, occaſions a moſt powerful, and moſt dangerous exploſion. In both caſes the water is inſtantly reduced into ſteam, at a high temperature, conſequently of very high elaſticity; hence the force which is exerted is often prodigiouſly great; and there are inſtances recorded of whole founderies having been inſtantly demoliſhed, in conſequence of ſome perſons having inadvertently ſpit upon the liquid metal. If a ſmall quantity of water be poured upon red-hot charcoal, or red-hot glaſs, a hiſſing noiſe is heard; the part which is touched by the water loſes its redneſs, and nothing elſe remarkable takes place, becauſe the above-mentioned ſubſtances are bad conductors of heat, and it is only that part which is touched by the water that communicates its heat to the water, and this is not ſufficient to convert the water ſuddenly into ſteam of very great elaſticity. But metallic bodies are the beſt conductors of heat, and fuſed copper is particularly ſo; hence, when a ſmall quantity of water happens to fall upon a large quantity of that metal, in a ſtate of fuſion, the heat from a great part of the metal ruſhes to the ſpot where the water is fallen, and inſtantly converts it into ſteam of high elaſticity.

The exploſion of a mixture of hydrogen and oxygen gaſes, or of hydrogen gas and common air, does likewiſe exert a conſiderable force, but not to be compared with that of gunpowder. Theſe gaſes, when inflamed, expand conſiderably, but inſtantly after, they contract into an exceedingly narrow compaſs, which occaſions the report; for, by the combuſtion, they are converted principally into water, the bulk of which is leſs than the ten or twenty thouſandth part of the original bulk of the gaſes.

The laſt kind of exploſion we ſhall take notice of, is produced not by the generation or contraction of an elaſtic fluid, but by a ſort of mechanical derangement. Thoſe lumps of glaſs with a long tail, or prolongation, which are well known by the name of Glaſs Tears, or Prince Rupert's Drops, are an inſtance of this kind. If one of theſe drops be held in the hand, and part of the tail is broke, a ſmart kind of exploſion is heard, and the whole is inſtantly converted into powder. In order to underſtand the cauſe of this phenomenon, it is in the firſt place neceſſary to conſider how theſe drops are formed. For this purpoſe the glaſs manufacturers take a quantity of the fuſed glaſs, (about half an ounce of it, and green bottle glaſs is the fitteſt for it,) and drop it in that ſtate of incandeſcence into cold water; the conſequence of which is, that the external part of the lump of glaſs is cooled and rendered ſolid long before the internal part of it. Then when the internal part is cooled, and of courſe contracts its dimenſions, the external part being already cooled and ſettled, cannot follow it, ſo that it remains in a ſtate of ſuſpenſion ſomewhat like an arch; hence, when part of the lump is broken, the key-ſtone, as it were, of the arch, is removed, and the whole aſſemblage of particles is deranged. See GLASS *Tears*, for a more detailed explanation of theſe their properties.

Several other ſubſtances explode and are broken upon analogous principles. Such are glaſs veſſels made for different purpoſes, and eſpecially for electrical machines; alſo large caſt-metal veſſels ſometimes ſpontaneouſly explode and break in the act of cooling. Sir William Hamilton mentions certain volcanic bodies, which he calls *volcanic bombs*, that explode probably on the ſame principle. They were large pieces of lava, which burſt in pieces like bombs as they fell to the ground. Theſe were obſerved in the great eruption of mount Veſuvius, which took place in the year 1779. The cauſe of volcanic exploſions, as well as of thoſe which accompany or precede earthquakes, is moſtly attributed to the action of ſteam; but theſe kinds of exploſions will be found particularly examined under the articles EARTHQUAKE and VOLCANO.

The uſe to which certain exploſions are applied is ſo well known as not to require any particular deſcription. Every body knows the various uſes of ſhooting with gunpowder, eſpecially in military affairs. The blaſting or breaking of rocks, by means of the exploſion of gunpowder, is likewiſe well known. But theſe uſes, together with all the particulars that relate to them, are often mentioned in various other articles of this Cyclopædia; ſuch as GUNNERY, MINING, SHOOTING, &c.

EXPOLITION, in *Rhetoric*, a figure whereby we explain the ſame thing in different phraſes and expreſſions, in order to ſhew it more fully.

Expolition was the favourite figure of Balzac.

EXPONAS VENDITIONI. See VENDITIONI.

EXPONENT, from *expono*, *I expreſs*, in *Arithmetic*. Exponent of a power denotes the number which expreſſes the degree of the power, or which ſhews how often a given power is to be divided by its root before it be brought down to unity.

Thus, the exponent or index of a ſquare number is 2; of a cube, 3; the ſquare being a power of the ſecond degree; the cube of a third, &c.

Exponents are commonly written above, and ſomewhat towards the right-hand of the number or quantity whoſe power they expreſs. Thus, 3^5, a^5, ſignify the fifth power of 3, and of a. See POWER.

EXPONENT is alſo uſed in the ſame ſenſe with index or logarithm.

Thus a ſeries of numbers in arithmetical progreſſion being placed under another ſeries in geometrical progreſſion, are called the exponents, indices, or logarithms thereof. *E. gr.* in the two progreſſions,

Geom.	1,	2,	4,	8,	16,	32,	64,	128,	256,	512
Arith.	0,	1,	2,	3,	4,	5,	6,	7,	8,	9

0 is the exponent, index, or logarithm of the firſt term 1; 5 that of the ſixth, 32, &c.

Hence, unity is to the exponent of a power as the logarithm of the root to the logarithm of its power; conſequently, the logarithm of the power is had by multiplying the logarithm of the root by its exponent; and the logarithm of the root is had by dividing the logarithm of the power by its exponent.

EXPONENT *of a ratio*, is the quotient ariſing upon dividing the antecedent by the conſequent.

Thus, in the ratio 3 to 2 the exponent is $1\frac{1}{2}$, and the exponent of the ratio 2 to 3 is $\frac{2}{3}$. See RATIO.

Hence, 1. If the conſequent be unity, the antecedent is the exponent of the ratio. Thus, *e. gr.* the exponent of the ratio 4 to 1 is 4; and again, the exponent of a ratio is to unity as the antecedent to the consequent.

2. Since in a rational ratio the exponent of a ratio is had by dividing a rational number by another rational, the exponent of a rational ratio is a rational number.

EXPONENTIAL Calculus, *Calculus exponentialis*, is a method of differencing exponential quantities, and of summing up the differences of exponentials. See Calculus.

Exponential *curve* is that which is defined by an exponential equation.

Exponential curves partake both of the nature of algebraic and transcendental ones; of the former, because they consist of a finite number of terms, though those terms themselves are indeterminate; and of the latter, because they cannot be algebraically constructed, or represented by an algebraic equation. Thus $a y = x^2$ is the equation of an algebraic curve; $y = a^x$ is the equation of an exponential curve: this equation $y = a^x$ denotes that any ordinate y is to a constant ordinate assumed equal to 1, as a constant quantity a raised to a power whose exponent expresses the ratio of the abscis x to the line equal to 1 is to the line taken for unit or 1, raised to the same exponent. Let b represent the line $= 1$, and the equation $y = a^x$ (since $y : b :: a^{\frac{x}{b}} : b^{\frac{x}{b}}$), will become $\frac{y}{b} = \frac{a^{\frac{x}{b}}}{b^{\frac{x}{b}}}$. Note, $y = a^x$ is the equation of the logarithmic curve. See Logarithmic. See also Curve.

Exponential *equation*, is that wherein there is an exponential quantity. See Equation, &c.

Exponential *quantity*, is a power whose exponent is an indeterminate or variable quantity.

Exponential quantities are of several degrees and orders: when the exponent is a simple indeterminate quantity, it is called an exponential of the first or lowest degree.

When the exponent itself is an exponential of the first degree, then the quantity is an exponential of the second degree. Thus, z^y is an exponential of the first degree, because the quantity y is a simple flowing quantity; but z^{y^x} is an exponential quantity of the second degree; because y^x is an exponential of the first degree; so also, $z^{y^{x^y}}$ is an exponential of the third degree, the exponent y^{x^y} being one of the second; and universally, the exponential quantity of any degree has for its exponent, the exponential quantity of the degree next preceding it. See Bernouilli Oper. tom. i. p. 182, &c.

EXPORTATION, in *Commerce*, the act of sending commodities out of one country into another.

Exportation is a part of foreign commerce (see Commerce), distinguished by the appellation *active*, or *selling part*, in opposition to *importation*, which is called the *passive*, or *buying part*. It is observed, as a general maxim, that commerce, when active, must produce a flow of riches, the balance being received in money; whereas, if it be passive, treasures will be exhausted, as the balance of trade must continually be made good out of the remaining coin. Hence, plenty of money in any place implies, that the quantity of goods exported far exceeds that of goods imported; and wherever money is scarce, it may be concluded that greater quantities of goods have been imported than exported. See Exchange.

It has been a principal object of commercial policy in almost every country, to encourage exportation, with the exception of a few articles; that of manufactured goods has been promoted with a view of encouraging the internal industry of the country, and that of foreign produce, as a means of drawing wealth from other countries by the profits of the carrying trade. The excess of the value of goods exported beyond that of the imports has usually been considered as a criterion of the profits which a country derives from foreign trade; but this is a fallacious mode of determining this important point, because advantageous foreign trade might long exist, even if the imports constantly exceeded the value of the exports. The laws in force relating to exportation consist principally of prohibitory or restrictive regulations concerning bullion, corn, wool, machinery, and tools used in various branches of the manufactures, the exportation of which, it is thought, might diminish the necessary supply of provisions for the consumption of the country, or enable foreigners to rival valuable branches of its manufactures. The acts relative to the exportation of wool, prohibit the exportation, not only of the commodity itself, but also of live sheep, rams, or lambs, from Great Britain, Ireland, Jersey, Guernsey, Alderney, Sark, or Man, on penalty of the forfeiture thereof, and of the ships conveying them; also 3*l.* for every sheep, &c. and three months' solitary imprisonment of the offender; for a second offence, 5*l.* for every sheep, &c. and six months' imprisonment; except wether sheep for ships' use, put on board by licence of the port-officer of the customs. A limited quantity of wool, however, is allowed to be exported from the port of Southampton to Jersey, Guernsey, Alderney, and Sark.

The duties on exportation, payable in Great Britain and Ireland, were formerly the principal branch of the revenue derived from foreign trade; but they are now of small amount compared with the duties payable on goods brought into the country.

The *official* value of all exports from Great Britain, for three years ending the 5th of January 1809, was as follows:

	British produce and manufactures.	Foreign merchandize.
Year ending 5th Jan. 1807	£.27,402,685	£. 9,124,499
- - - 1808	25,171,422	9,395,149
- - - 1809	26,692,288	7,863,207

The *actual* value of British produce and manufactures exported from Great Britain, agreeably to the prices current, and to the declarations of the exporters, was, in the year ending the 5th of January 1809, £. 40,881,871.

The official value of imports into Great Britain from Europe, Africa, and America, during the same periods, is as follows:

Year ending 5th January	1807	- - £. 25,089,136
- - - - -	1808	- - 25,453,149
- - - - -	1809	- - 23,784,516

The official value of imports into Great Britain from East India and China is as follows:

Year ending 5th January	1807	- - £. 3,746,771
- - - - -	1808	- - 3,401,509
- - - - -	1809	- - not ascertained.

The real value of Irish produce and manufactures exported from Ireland in the year ending the 5th of January 1809, computed at the average prices current, was £. 12,577,517 10*s.* 11*d.*

10*s.* 11*d.* See Customs, and Duty. See alfo Commerce.

Dr. Smith, in his "Nature and Caufes of the Wealth of Nations," ftates and explains the principles upon which the exportation trade is founded. When the produce of any particular branch of induftry exceeds what the demand of the country requires, the furplus muft be fent abroad, and exchanged for fomething for which there is a demand at home. Without fuch exportation, a part of the productive labour of the country muft ceafe, and the value of its annual produce diminifh. The land and labour of Great Britain produce generally more corn, woollens, and hard ware, befides fome other manufactures, than the demand of the home market requires. The furplus part of them muft, therefore, be fent abroad, and exchanged in the manner already mentioned. It is only by means of fuch exportation, that this furplus can acquire a value fufficient to compenfate the labour and expence of producing it. The neighbourhood of the fea-coaft, and the banks of all navigable rivers, are advantageous fituations for induftry, only becaufe they facilitate the exportation and exchange of fuch furplus produce for fomething elfe, which is more in demand there.

When the foreign goods, which are thus purchafed with the furplus produce of domeftic induftry, exceed the demand of the home market, the furplus part of them muft be fent abroad again, and exchanged for fomething more in demand at home. When the capital ftock of any country is increafed to fuch a degree that it cannot be wholly employed in fupplying the confumption, and fupporting the productive labour of that particular country, the furplus part of it naturally difgorges into the carrying trade, and is employed in performing the fame office to other countries. The carrying trade is the natural effect, and fymptom of great national wealth; but it does not feem, fays Dr. Smith, to be the natural caufe of it. Holland had formerly the greateft fhare of the carrying trade of Europe, and in proportion to the extent of its land, and the number of its inhabitants, it was the richeft country in Europe. England, now the richeft country of Europe, has appropriated to itfelf the greateft fhare of this trade. This ingenious writer fuggefts, that, whether the capital, which carries this furplus produce abroad, be a foreign or a domeftic one, is of very little importance. If the fociety has not acquired fufficient capital both to cultivate all its lands, and to manufacture in the completeft manner the whole of its rude produce, there is even a confiderable advantage derived from the exporting of that rude produce by a foreign capital, in order that the whole ftock of the fociety may be employed to more ufeful purpofes.

Dr. Smith farther obferves, in reference to this fubject, that with a view of multiplying gold and filver, in which, it has been commonly fuppofed, the wealth of a country confifts, it neceffarily became the great object of political economy to diminifh, as much as poffible, the importation of foreign goods for home confumption, and to increafe, as much as poffible, the exportation of the produce of domeftic induftry: and, therefore, its two great engines for enriching the country have been reftraints upon importation, and encouragement to exportation. The former were of two kinds, *viz.* reftraints upon the importation of fuch foreign goods for home confumption as could be produced at home, from whatever country they were imported; and reftraints upon the importations of goods of almoft all kinds, from thofe particular countries, with which the balance of trade was fuppofed to be difadvantageous. Thefe different reftraints confifted fometimes in high duties, and fometimes in abfolute prohibitions. Exportation was encouraged fometimes by drawbacks, fometimes by bounties, fometimes by advantageous treaties of commerce, and fometimes by the eftablifhment of colonies in diftant countries. Thus it has been intended to increafe the quantity of gold and filver in any country by turning the balance of trade in its favour. Our author has particularly examined what are likely to be the effects of thefe reftraints and encouragements upon the annual produce of the induftry of a country. According as they tend either to increafe or diminifh the value of this annual produce, they muft evidently tend either to increafe or diminifh the real wealth and revenue of the country. See Exchange, Monopoly, and *Balance of* Trade. Of the encouragements to exportation above enumerated, thofe which are called *Drawbacks* (fee the article) feem to Dr. Smith to be the moft reafonable. Concerning the grant of bounties; fee Bounty,

EXPOSING, the act of fetting a thing to public view.

In the Romifh church, the facrament is faid to be expofed when it is fhewn in public, uncovered, on feftival days, and during the time of plenary indulgences.

Exposing is alfo ufed with a farther latitude; thus, we fay it is prohibited to expofe falfe and clipped money.

Such a houfe ftands very high, and has a delicious profpect; but it is expofed to all the four winds. Such a city being on the frontiers, and not fortified, is expofed to the infults of every party of forces.

Exposing *of Children*, a barbarous cuftom practifed by moft of the ancients excepting the Thebans, who had an exprefs law to the contrary, whereby it was made capital to expofe children, ordaining at the fame time that fuch as were not in a condition to educate them, fhould bring them to the magiftrates, in order to be brought up at the public expence. (Ælian Hift. Var. l. ii. c. 7.) Among the other Greeks, when a child was born, it was laid on the ground; and if the father defigned to educate his child, he immediately took it up; but if he forebore to do this, the child was carried away, and expofed. Pitifc. Lex. Ant. in voc. Expofitio.

The Lacedæmonians, indeed, had a different cuftom; for with them all new-born children were brought before certain tryers, who were fome of the graveft men in their own tribe, by whom the infants were carefully viewed; and if they were found lufty and well-favoured, they gave orders for their education, and allotted a certain proportion of land for their maintenance: but if weakly, or deformed, they ordered them to be caft into a deep cavern in the earth, near the mountain Taygetus, as thinking it neither for the good of the children themfelves, nor for the public intereft, that defective children fhould be brought up. Plutarch takes notice of this law of Lycurgus, and paffes no cenfure upon it.

Many perfons expofed their children only becaufe they were not in a condition to educate them, having no intention that they fhould perifh. It was the unhappy fate of daughters efpecially to be thus treated, as requiring more charges to educate and fettle them in the world than fons.

The parents frequently tied jewels and rings to the children they expofed, or any other thing whereby they might afterwards difcover them, if Providence took care of their fafety. Another defign, in adorning thefe infants, was either to encourage fuch as found them to nourifh and educate them, if alive; or to give them human burial, if dead.

The places where it was ufual to expofe children were fuch as people frequented moft. This was done in order that they might be found, and taken up by compaffionate perfons who were in circumftances to be at the expence of their education. With this intention the Egyptians and

Romans chofe the banks of rivers, and the Greeks the highways.

Dionyfius Halicarn. (Antiq. Rom. l. ii.) informs us, that Romulus obliged the citizens to bring up all their male children, and the eldeft of the females. They were allowed therefore to deftroy all their female children but the eldeft. And even with regard to their male children, if they were deformed or monftrous, he permitted the parents to expofe them, after having fhewn them to five of their neareft neighbours. In Cicero's third book of laws, (cap. 8.) there is a paffage, from which it has been concluded, that the law of Romulus, with regard to the expofing and deftroying of male children that were remarkably deformed, was confirmed by a conftitution of the twelve tables. It appears, from a paffage in Terence, that this inhuman cuftom of expofing and deftroying children, efpecially females, was not uncommon even among parents of the beft character. Sentiments of this kind were publifhed with applaufe on the Roman theatre: and we learn from Seneca (de Ira, l. i. c. 15.) that fo late as in his time, it was ufual among the Romans to deftroy weak and deformed children. "Portentofos fœtus extinguimus: liberos quoque, fi debiles monftrofique editi funt, mergimus."

This unnatural practice was prefcribed and approved even by the more eminent philofophers. Plato (Republ. l. v.) recommends it to be ordered by law that men or women, who are paft the age of having ftrong children, fhould take care that their offspring, if they fhould have any, fhould not come to the birth, or fee the light; or if that fhould happen, that they fhould expofe them without nourifhment. Ariftotle (Politic. l. vii. c. 16.) exprefsly fays, that it fhould be a law not to bring up or nourifh any child that is weak or maimed; and that when the law of the country forbids to expofe infants, it is neceffary to limit the number of thofe who fhould be begotten; and if any one begets children above the number limited by the laws, he advifes to procure abortion before the fœtus has life and fenfe. The practice that has long prevailed among the Chinefe, and that fubfifts among them even to this day, is well known.

EXPOSITION, the act of expofing. See Exposing.

Exposition is likewife applied to the interpretation or explication of an author, or paffage therein. See Exegesis.

Exposition *of deeds*, in *Law*, fhall be favourable, according to the apparent intent; and be reafonable, and equal, &c. Co. Litt. 313.

Exposition, *expofitio*, in *Rhetoric*, is fometimes ufed for divifion. See Division; and fee alfo Exergasia.

Exposition, in *Gardening*. See Exposure.

EXPOSITOR, or Expository, a title which fome writers have given to a leffer kind of dictionaries or vocabularies, ferving to expound or explain the meaning of the obfcure or difficult words of a language.

It is alfo ufed in the fame fenfe with commentary and paraphrafe.

EX POST FACTO, in *Law*, denotes fomething done after another thing that was committed before. An eftate granted may be made good by matter ex poft facto, that was not fo at firft, by election, &c.

EXPOSTULATION, Expostulatio, in *Rhetoric*, a complaint addreffed to a perfon from whom we have received fome injury. It varies according to circumftances.

EXPOSURE, or Exposition, in *Gardening*, the afpect or fituation of a garden wall, building, or the like, with refpect to the fun, wind, &c.

There are four regular kinds of expofures, *viz*, eaft, weft, north, and fouth; but it muft be obferved that among gardeners thefe terms fignify juft the contrary to what they do among geographers.

The gardeners, in effect, do not give the names eaft, weft, &c. to the places where the fun is, but to thofe whereon he fhines; and they confider the manner wherein he fhines, whether as to the whole garden, or fome of its fides.

If they find, that the fun at his rifing, and during the firft half of the day, continues to fhine on one fide of a garden or wall, they call that an eaftern expofure, or eaft wall, &c. and if the fun begin to fhine later, or end fooner, it is not a proper eaftern expofure.

For the fame reafon, they call the weft the fide the fun fhines on the latter half of the day; *i. e.* from noon to night; and accordingly, the fouth, or fouthern expofure, is the place whereon he fhines from about nine o'clock in the morning till night; or which, in the general, he fhines longeft on in the whole day; and the part he fhines leaft on is the north, or fouthern expofure, at what hour foever it begin or end, being ufually from eleven o'clock to one.

The eaftern and fouthern expofures are, by common confent of all gardeners, the two principal, and have a confiderable advantage above the reft. A weft expofure is not much amifs; at leaft, it is better than a northern one, which is the worft of all: each has its inconveniences.

The eaftern, commencing differently at different feafons of the year, and ending about noon, fubjects the trees, &c. to the N.E. winds, which wither the leaves and new fhoots, blow down the fruit, &c. befide that it has little benefit of rains, which come moftly from the weft. Yet does the reverend Mr. Laurence judge the eaft better than the weft-wall for all kinds of fruit; not that it has more hours of fun, or that there are any peculiar virtues in the eaftern rays, but becaufe the early rays of the fun do fooner take off the cold chilly dews of the night.

M. Gentil recommends the eaftern expofure as beft for all kinds of peaches; adding, that they ripen fooneft, grow bigger, are better coloured, and of a finer tafte, than in any other; but Mr. Carpenter reftrains the rule to the early and middle forts; for the backward, he rather choofes a fouthern, or fouth-eaft expofure, which is beft for all late fruits, becaufe the influence of the fun is ftrongeft, and continues longeft.

The weftern, accounted from half an hour paft eleven till fun-fet, is backwarder than an eaftern one by eight or ten days; but it has this advantage, that it receives little damage from the frofts, which melt before the fun comes to fhine upon the fruit, and fall off like dew, without doing any prejudice; fo that it may bear apricots, peaches, pears, and plums; but it is incommoded with north-weft winds in the fpring, as alfo with the autumnal winds, which blow down a great quantity of fruit.

According to Mr. Miller, the beft afpect or expofure for walls in England is the point to the eaftward of the fouth; becaufe thofe will enjoy the benefit of the morning fun, and be lefs expofed to the weft and fouth-weft winds, which are very injurious to fruits in England, than thofe walls which are erected due fouth; the next beft expofure is due fouth, and the next to that fouth-eaft, which is preferable to the fouth-weft. Other walls, however, may be planted with fruit-trees that fuit their feveral expofures.

The northern expofure is the leaft favourable of any in England, as having very little benefit from the fun even in the height of fummer, therefore can be but of little ufe, whatever may have been advanced to the contrary. For although many forts of fruit-trees will thrive and produce fruit in ſuch poſitions, yet ſuch fruit can be of little worth, ſince they are deprived of the kindly warmth of the ſun to correct their crude juices, and render them well taſted and wholeſome. It is therefore to little purpoſe to plant fruit-trees againſt ſuch walls, except it be for fruit intended for baking, &c. in which caſe the fire will ripen and render thoſe juices wholeſome which could not be performed while growing.

In ſuch ſituations, morelli cherries for preſerving may be planted, and white and red currants to come late, after thoſe which were more expoſed to the ſun are gone; and if the ſoil be warm and dry, ſome ſorts of ſummer pears will do tolerably well on ſuch an expoſure, and will continue longer in eating than if they were expoſed to the ſun. But winter pears ſhould by no means be planted in ſuch an aſpect, as has been practiſed by many ignorant perſons, if we find that the beſt ſouth walls in ſome bad years are barely warm enough to ripen them. Duke cherries planted againſt walls expoſed to the north will ripen much later in the ſeaſon; and if the ſoil be warm, will be well flavoured, and continue a month later than others. Miller.

The ſouthern expoſure, accounted from about nine till four, is recommended for peaches, pears, grapes, and plums.

EXPRESS, ſomething that is preciſe in formal terms, or for ſome particular deſign. I told him as much in expreſs terms; he gave me a commiſſion expreſs; he had expreſs orders; a courier was diſpatched expreſs.

We alſo ſay, ſomewhat abuſively, to ſend an expreſs, meaning a courier.

Express *Condition*, *Contract*, *Malice*, and *Warranty*. See the ſubſtantives.

EXPRESSED Oils, are ſuch as are procured from bodies only by preſſing; as the oils of olives, almonds, and the like. See Oil.

Expressed *ſpecies*. See Species.

EXPRESSION, in *Algebra*, denotes the value of a quantity expreſſed or repreſented under an algebraic form: thus, if $x = \sqrt{a^2 + b^2}$, and a and b are known, the value of x is known. See Equation.

Expression, in *Chemiſtry*, *Pharmacy*, &c. the act of expreſſing out, or extracting the juices of oils or plants, fruits, or other matters, by ſqueezing, wringing, or preſſing them in a preſs. This is one of the three modes of obtaining them; the other two being *infuſion* and *decoction*, which ſee. The hard fruits ſhould be well bruiſed, and herbs moderately bruiſed, before expreſſion. They are then to be incloſed in a hair or other bag, and preſſed between wooden plates in the common ſcrew preſs, till the juice ceaſes to run. The expreſſion of oils is performed nearly in the ſame manner as that of juices, by means of iron plates, or the apparatus of an oil-mill, adapted to this purpoſe. The inſipid oils of all unctuous ſeeds are obtained uninjured by this operation, if performed without the aid of heat, which, though it may promote the extraction of the oil, gives it an ungrateful flavour. The oils expreſſed from aromatic ſubſtances generally carry with them a portion of their eſſential oil.

Expression, in *Muſic*, is a quality by which a muſician manifeſts his feeling, and executes with energy all the ideas with which he ought to impreſs the hearer, and all the ſentiments which the compoſer intended to expreſs. There is an expreſſion in compoſition as well as in its execution, and it is by their concurrence that the moſt pleaſing and agreeable effect reſults.

To give an expreſſion to his works, a compoſer ought to ſeize and compare all the relations which can be found between the features of his object, and the productions of his art; in a muſical drama, he ought to know and feel the peculiar caſt of all the characters, in order ſeverally to exhibit them exactly as delineated by the poet; for as a good painter does not throw the ſame light on every figure, neither will the able muſician give the ſame energy to all the ſentiments, nor the ſame force to every figure, but will put each part in its true place, leſs to give it weight, individually, than to contribute to the effect of the whole.

After having well conſidered what a character has to ſay, he meditates how he ſhall ſay it; and here begins the application of the precepts of his art, which is to find the particular language in which the actor would wiſh to make himſelf underſtood.

Melody, harmony, movement, choice of inſtruments and voices, are the elements of the muſical language; and melody, by its immediate connection with the grammatical and oratorical accent, is that which gives a character to all the reſt. So that it is conſtantly from melody that the principal expreſſion ſhould be derived, as well in inſtrumental as vocal muſic.

What a compoſer therefore has to expreſs by melody is tone of voice, with which the ſentiments can beſt be rendered; and care ſhould be taken not to mimic that of theatrical declamation, which is in itſelf only an imitation, but the voice of nature ſpeaking without affectation and without art.

The compoſer will therefore at firſt ſeek a kind of melody which ſhall furniſh muſical inflections the moſt conſonant to the ſenſe of the words, always lowering their expreſſion to the thought, and the thought to the interlocutor's ſtate of mind; for when we are ſtrongly affected, all that we ſay in a manner favours of the general ſentiments which govern us; and we never chide what we love in the ſame tones as we ſhould an indifferent perſon. Our ſpeech is differently accented according to the different paſſions by which we are agitated; ſometimes acute and vehement, ſometimes languid and monotonous, ſometimes varied and imperious, ſometimes ſmooth and tranquil in its inflections. Thence the muſician regulates the choice of keys which he uſes in his melody, and the different places in which he employs voice, keeping it down with ſmall intervals to expreſs the languor of ſorrow and dejection; and ſtraining it with acute ſounds in paſſion and grief; driving it rapidly through all the intervals of the diapaſon in the agitation of deſpair, or the turbulence of diſtracted paſſions. Above all it muſt be remembered, that the charms of muſic conſiſt not only in imitation, but in an agreeable imitation; and that the declamation (or recitative) itſelf to have its full effect, ſhould be ſubordinate to melody; ſo that there is no painting ſentiment without giving it this ſecret charm inſeparable from it, nor touch the heart without pleaſing the ear. And this is ſtill very conformable to nature, which gives to the tone of voice of perſons of ſenſibility, certain touching and delicious inflections, which thoſe who feel nothing never poſſeſſed. Never, therefore, miſtake rough and coarſe for expreſſive, nor harſhneſs for energy. Give not a hideous picture of the paſſion which you wiſh to paint, nor imitate the performers at the French opera, where the voice of paſſion reſembles a complaint of the colic, more than tranſports of love.

The natural pleaſure which reſults from harmony, augments in its turn the moral pleaſure of imitation, in uniting the agreeable ſenſations of chords to the expreſſion of the melody, upon the ſame principle as that juſt mentioned. But harmony does ſtill more; it enforces even the expreſſion in giving more truth and preciſion to melodious intervals; it animates their character, and exactly marks their place in the order of the modulation; it calls back the preceding, announces

announces that which ought to follow, and thus connects the phrafes in the melody, as ideas are linked together by grammar in a difcourfe. Harmony, regarded in this light, furnifhes the compofer with powerful means of expreffion, which efcape him when he feeks expreffion in harmony alone; for then, inftead of animating the accent, he extinguifhes it by his chords, and all the intervals, confounded in a continued crowd of combined founds, offer to the ear only a feries of fundamental chords, which have nothing touching or agreeable in their effect, and often not only fuffocates the melody, but the fenfe of the words. What then muft the harmonift do to fortify the expreffion of the melody, and give it more effect? He will carefully avoid covering the principal found in the combination of chords; he will render all the notes of the accompaniment fubordinate to the vocal part; he will give relief and energy to it by the concurrence of other parts; he will enforce the effect of certain paffages, by the chord of the fharp 7th; he will difguife others by fuppofition or fufpenfion, in making no provifion for them in the bafe; he will gain ftrong expreffions by major difcords, he will referve the minor, for tender fentiments; fometimes he will unite all his parts by fmooth and flowing notes; fometimes he will contraft them with the melody by pointed notes; fometimes he will fill the ear with full harmony, and fometimes enforce the accent by the choice of a fingle interval. He will render prefent and fenfible the chain of modulation throughout, and will make the bafe and its harmony ferve to determine the place of each paffage in the key, in order that no interval or trait of melody fhall be heard, without feeling at the fame time its relation with the whole.

With refpect to rhythm, formerly fo powerful as to give force, variety, and ornament to poetical harmony; if modern languages lefs accentuated and lefs profodic have loft this charm, our mufic can fubftitute another more independent of fpeech in the precifion of meafure, and in the combination of its proportions, whether moving together or feparately in each part.

Quantity in language is almoft wholly loft in notes of mufic; and the mufic, inftead of fpeaking with words, borrows, in fome fort, from the meafure a language apart.

The force of the expreffion confifts in this particular, in the uniting thefe two languages as much as poffible together, in fuch fort, that if the meafure and the rhythm fpeak not in the fame manner, they will at leaft fay the fame things.

Chearfulnefs, which gives vivacity to all our movements, ought to do the fame in mufical meafures. Melancholy locks up the heart, relaxes all our motions, and the fame languor is felt in the melodies which it dictates; but when grief is poignant, or great conflicts are paffing in the mind, fpeech is unequal; it moves alternately with the flownefs of the fpondee and the rapidity of the Pyrrhic, and fometimes fuddenly ftops fhort, as in accompanied recitative; it is on this account, that the moft expreffive mufic, or at leaft the moft paffionate, is commonly that in which the times or portions of each bar, though equal in themfelves, are the moft unequally divided; whereas the image of fleep, of repofe, of peace of mind, require fmall exertion of voice, and are naturally painted with notes of equal length, which move neither quick nor flow.

There is one obfervation which the compofer ought not to neglect, and which is, that the more ftudied and extraneous is the harmony, the flower fhould be the movement, in order that the mind may have leifure to difentangle the difcords, and follow the rapid chain of modulation. Nothing but the laft degree of fury can permit the union of rapid meafures and harfh chords. When the head is diftracted, and the actor, by violent agitation, feems not to know what he fays, this energetic and terrible confufion may be communicated to the mind of the fpectator, and, in like manner, make him lofe his reafon. But if the compofer is not inflamed and fublime, he will only be coarfe and cold; if he does not throw the audience into a delirium, he runs a great rifk of a failure: for he who lofes his reafon is only mad in the eyes of thofe who preferve it, and infanity is no longer interefting.

Though the greateft force of expreffion is derived from the combination of founds, the quality of their tone is not indifferent in the effect. There are voices fo ftrong and fonorous as to impofe by their force; others thin, flexible, and fit for execution; others again fo touching and delicate as to penetrate the heart by foothing and pathetic ftrains. In general, treble voices and acute are fitteft to exprefs tendernefs and affection; bafes and baritones for intemperate paffion and choler; but the Italians have banifhed bafes from their ferious operas, as a part, of which the melody is too rude and boifterous for the heroic ftyle, and have fubftituted in their ftead tenors, of which the melody has the fame character, with a more agreeable effect. They employ bafe voices in the grotefque and ridiculous parts of their comic operas with more propriety.

Inftruments have alfo their peculiar expreffions, proportioned to their quality of tone, force, and compafs. The flute is tender, the hautbois cheerful, the trumpet military, the horn fonorous, majeftic, and proper for grand expreffions. But there is no inftrument of more varied expreffion, and more univerfally ufeful, than the violin. This admirable inftrument is the foundation of every orcheftra, and can furnifh a great compofer with all the effects which mean muficians vainly feek in a multitude of different inftruments. The compofer ought to be acquainted with the fingerboard of the violin, to confider the fhifts, and know how to write arpeggios, by diftinguifhing the open from the ftopped ftrings, and to choofe and make ufe of keys according to the different characters they have upon that inftrument.

It is in vain for the compofer to attempt to animate his orcheftra, if the ardour which ought to reign in it does not inflame the performers. The finger who only fees notes in his part, is not qualified to feize the expreffion of the compofer, nor to give one of his own to what he fings, if he has not well comprehended the fenfe. He muft underftand what he reads before he can make it comprehended by others; and it is not enough to be poffeffed of general fenfibility, if not particularly energetic in the language we fpeak. Let him begin therefore by thoroughly underftanding the character of the melody which he has to execute, its expreffion of the words, the diftinction of its phrafes, the accent which it has in itfelf, that which it requires in the voice of the finger, the energy which the compofer has given to the poet, and that which in his turn he can give to the compofer. Let him refign his whole powers, then, to all the enthufiafm which thefe confiderations fhall have infpired; he fhould exprefs every thing as completely as if he were at once the poet, compofer, actor, and finger, and he will then have all the animation which it is poffible for him to give to the work which he has to execute.

In this manner he will naturally embellifh with tafte and delicacy airs that are only elegant and graceful; with fpirit and fire, fuch as are animated and gay; with fighs, the tender and pathetic; and with all the agitation of forte and piano, fuch as are expreffive of rage and fury. Whenever the mufical and oratorical accents are united (as in arie parlanti), wherever the time fhall be ftrongly marked, and ferve as a guide to the accents of the melody; wherever the ac-

companiment

companiment and the voice ſhall ſo agree in their effects as to form only one melody, and the hearer, deceived, wholly attributes to the voice the paſſages which the orcheſtra embelliſhes; and, finally, wherever ſober ornaments, judiciouſly applied, manifeſt the abilities and facility of the finger, without diſguiſing and injuring the melody, the expreſſion will be ſweet, agreeable, and animated; the ear will be delighted, and the heart affected; nature and art will at once concur in pleaſing the hearer, and there will reign ſuch a coincidence between the words and the muſic, that the whole will ſeem to proceed from one delicious language, which can ſay every thing, and always pleaſe.

This is more a diſſertation than an article of a dictionary, but theſe are the ſentiments of the citizen of Geneva, to moſt of which in muſic we readily ſubſcribe, as he is ever more reaſonable and conſiſtent in ſpeaking of that art than on any other ſubject. His views concerning dramatic muſic are always ſo ingenious, elevated, and refined, that we cannot reſiſt tranſlating him. Though we fear that the French, with all their preſent rage for Italian muſic and Italian expreſſion, will not adopt them; and the Italians themſelves, in their moſt happy moments of conception, have been ſucceſsful from inſtinct and enthuſiaſm, more than precepts or reflection.

Expression, in *Oratory*, denotes the manner of delivering or conveying one man's ideas to another. Accordingly it denotes that felicity of diſcriminative energy in the reader, ſpeaker, or reciter, by which the characteriſtic beauties or peculiarities, whether of language, ſentiment, or paſſion, in a compoſition or oration, are forcibly and happily illuſtrated, and the various ſhades and tranſitions of ſtyle, ſignification, feeling, and alluſion, in ſuch compoſition or oration, are diſtinctly and intereſtingly marked. Expreſſion in this, as in every other art, is one of the chief conſtituents of excellence; and contradiſtinguiſhes the elocutioniſt of taſte and genius, from the mere mechanical reader or declaimer. It depends chiefly upon that quickneſs and vitality of perception which may be regarded, in ſome degree, as an original gift of nature, and on that prompt and perfect ſympathy between the perceptive faculty and the executive organs, which it is the higheſt glory of art and practical exerciſe to produce.

Expression is more particularly uſed for the elocution, diction, and choice of words in a diſcourſe. See Elocution.

It is not enough that a poet or orator have fine thoughts, he muſt likewiſe have a happy expreſſion. Defects in the expreſſion ordinarily ariſe from defects in the imagination: abundance of the beauties of the ancient writers are annexed either to expreſſions which are peculiar to their language, or to relations, which, not being ſo familiar to us as to them, do not give us the ſame pleaſure.

Expression, *diverſifying of*, in *Rhetoric*. See Diversifying.

Expression, in *Painting*, principally conſiſts in the repreſentation of thoſe attitudes of the body, and variations of the countenance of men, which always accompany and denote the immediate influence of the paſſions of their minds. Beſides this more important uſe of the word, it is uſed in painting to ſignify the repreſentation of any object by a mode of execution agreeable to its nature, its character, and the ſituation it holds in the work. When wrought with juſt ſenſe and propriety in theſe reſpects, it is ſaid to be *well expreſſed*. We will firſt conſider it in the former and more uſeful ſenſe.

The paſſions which influence the conduct of men have each a general character of expreſſion, by look or geſture, attached to them in the whole race of mankind; and they are alſo marked in individuals by peculiarities, ariſing from the temperament and conſtitutional habits with which each of them is endowed by nature.

To ſeize and repreſent with energy theſe characteriſtics of the paſſions of the mind, and accompany their repreſentation without diminiſhing its force, with the varieties appropriate to the individual perſonages introduced into a picture, is the eſſence, the ſoul of art. The ſlighteſt ſketch poſſeſſing this quality, acquires an intereſt uninſpired by, and far above, that excited by the moſt highly and excellently wrought pictures which are void of it.

Very few painters, amongſt the immenſe numbers of thoſe who lay claim to the name, have been happy enough to obtain a ſuper-eminent degree of expreſſion in their works; indeed it is a taſk of extreme difficulty to overcome, requiring the ſoundeſt ſenſe to ſelect the knowledge of it, and the greateſt ability in art to repreſent it when underſtood. The man who aims at it, beſides being an ever active obſerver, ſhould poſſeſs great ſuſceptibility of mind to enter into the feelings of others, and thus draw, as it were, from himſelf: yet that ſuſceptibility ſhould be under the regulation of ſound diſcernment, and cool diſpaſſionate judgment, to enable him to diſcriminate the fictitious repreſentations of paſſion, from thoſe natural unartificial actions, and looks, dictated by, and ariſing from, genuine feeling: and in his continued obſervations upon the actions and aſpects of men under their influence, he ſhould be careful to ſeparate thoſe points which identify a peculiar paſſion, and diſtinguiſh it from others that are nearly allied to it.

Artiſts endowed with very conſiderable talents have failed in two different ways in their endeavours to embelliſh their works with this valuable quality. Some, by an over-anxious deſire to give ſtrength and energy to their expreſſions, have carried them into artifice and bombaſt: others, on the contrary, wiſhing to unite the beautiful with the pathetic, have only rendered their works inſipid and unintereſting in expreſſion; and it appears that he who is obliged to labour to produce it, who does not work from a clear comprehenſion of the characteriſtic lines of an expreſſion in its ſimpleſt and moſt undiſguiſed ſhape, can never effect the repreſentation of it to any degree of perfection, and the beholder of his works will ſtill leave them unimpreſſed with any portion of the ſenſation the real paſſion is calculated to produce; the only true teſt of the value of works of art, as far as relates to expreſſion.

"By tedious toil no paſſions are expreſt,
He who conceives them ſtrongeſt paints them beſt."

The power of rendering, or producing expreſſion in painting, is, next to grace and elegance, the leaſt communicable talent of thoſe requiſite to form a perfect painter. He who attempts to obtain it, if not originally gifted by the great Author of nature with a peculiar propenſity to obſerve and imbibe the leading features which conſtitute its excellencies, follows a phantom that will for ever elude his graſp. If, however, he happily poſſeſſes that inclination, he may obtain ſome aſſiſtance in his purſuit of it from the works of others, which will ſhorten his labour, but will not lead him to the ultimate point of his deſire; to that, the ſtudy of nature can alone effectively induce.

We allude to ſome general rules given by artiſts who have communicated the reſult of obſervations made in their endeavours to obtain an underſtanding of the expreſſion of the paſſions of the mind, in the countenances and actions of men; and they are by ſome, whoſe names authorize reliance upon their obſervations, particularly Lionardo da Vinci, Trattata de la Pittura, and Le Brun's Paffions. They have pointed out and illuftrated thofe actions of the countenance and figure which moft ftrongly defignate the reigning influence of particular paffions.

Thefe rules, however, go only a fhort way in a general view of the fubject; much lefs do they comprize what is requifite, when the multitudinous varieties of expreffion in the almoft infinitely varying countenances and habits of men of all degrees are taken into confideration. How, indeed, can it be poffible to direct the means of obtaining with certainty that which is in itfelf fo infinitely divifible, as the courfe of the feelings and dictates of the ungovernable heart of man, and his correfponding actions and turns of feature?

It is in having afcertained and eftablifhed the features of the more ftrong and leading paffions, that thefe general rules are found ufeful. We learn from them, that the influence of exceffive joy or laughter draws all the features of the face upwards; that grief reverfes that order, and draws them downwards. Violent anger diftorts them, and enlarges their appearance, particularly the eyes and noftrils; and the action of the body is violent, with quick and fhort motions. Defire enforces an eager advancing action towards its object, and the eyes and mouth are fomewhat expanded. Acute pain is generally expreffed by a mouth fomewhat opened and drawn back, the eyes raifed, and partly covered by the upper eye-lid; and the eye-brows drawn clofely together, wrinkling the forehead. Fear is denoted by expanded eyes and mouth, the eye fixed upon the exciting caufe, the hair elevated and thickened, the colour livid, and the figure drawn back as if attempting to retire from the object which caufes the alarm. The effects of the fenfation of fcorn or hatred on the figure and countenance are marked by the mouth being clofed firmly, and the lips drawn down at the corners; whilft the elevation of the noftril caufes the middle of the upper lip to rife; the forehead is ftrongly preffed, and the brow falls over the eyes, which exprefs the paffion beft when they are turned fideways, towards the object, with the body inverted from it. Awe, or veneration, produces a general inclination of the body, and the head ftill more fo, towards the object exciting it.

Under one or other of thefe paffions and expreffions all the feelings of our minds are more or lefs ranged; and of courfe will participate more or lefs of the indications of them, according to the excitation they meet with: therefore, fo far the general rules will be of ufe in their reprefentation. But mankind, from their various modes of education, their habits, and manners, accompany thefe fenfations, when excited in them, by peculiarities which it is of the utmoft importance to the painter juftly to difcriminate, and be careful not to give that action to one, which, in propriety, belongs to another; not to attach the vulgar action of an uncultivated clown, to the dignified character of a man of rank and liberal education.

Befides remarking the expreffive characters of the ftronger paffions, great attention is requifite to be paid to the phyfiognomical expreffion of the countenance, and of the figure (if one may fo fpeak); the influence of which is daily felt and acknowledged. Though our information upon that fubject is much thwarted by the effect of education and reflection, yet its bafis is juft and firmly fixed, as every day's experience proves. Perfons whofe features and general forms correfpond, are found to be correfpondent alfo in character; that is, in their natural propenfities: one of two, thus fimilarly formed, may have cultivated his mind more than the other, and education and fociety may have taught him to mafk or difguife his inclinations; but nature is ftill true to herfelf, and the fame general difpofition remains. Nay, it goes ftill further; young perfons not naturally addicted to vice, being drawn by accident or early affociation to continue in the practice of indulgence, acquire, in procefs of time, a change of feature and expreffion, in great meafure fimilar to that form ufually indicative of the vice or paffion indulged in, where it is implanted by nature.

In this, therefore, we have a ground of expreffion which is well worthy, indeed very neceffary, to be carefully attended to by thofe who aim at perfection in the art of painting. They ought to make themfelves acquainted with the forms that belong to the peculiar inclinations and different degrees of capacity of mind in the perfons they chufe to bring forward in their works, of whatever clafs they may be. They fhould not put into the face of a man of mild character any of the features indicative of warm paffions; in fuch an one the eye fhould not have an eager look; the noftrils fhould not be large, or inflated; all the lines fhould be fmooth, and have little variation of form. And, on the contrary, when the figure of one whofe difpofition is naturally hot and impetuous is introduced, he fhould not have a fmooth ftraight forehead; which is indicative of mildnefs and fuavity; his nofe fhould not be ftraight; nor his mouth gently undulating, of a mild pleafing character: though he may not be in the act of exerting his natural impetuofity of character, yet he fhould have the appearance of one who would be eafily roufed to that feeling and expreffion. A man of great fenfe and intellect fhould not be reprefented with the features that characterize imbecility; nor the weak, and undecided character, have the forms denoting fenfe and intellectual power; and it fhould be conftantly remembered, that though every paffion, every fentiment of the mind, has its peculiar expreffion; every particular perfon has his peculiar mode of expreffing it.

In reprefentations of the paffions, 'tis not form alone which is required to perfect the work: though that indeed yields a very ftrong impreffion of it, yet its effect is greatly heightened when a proper tone of colour is fuperadded. By colour we judge of health or ficknefs, of youth and age, as well as by form. The fallow hue of melancholy is proverbial. It is well known how anger affects the hue of the countenance; in fome it produces a violent flufh of blood, and confequent rednefs of colour, even almoft to blacknefs: in others a pallid hue denotes it, or a change from one to the other rapidly fucceeding. The malignant paffions are generally accompanied in their expreffions by a pallid tone of colour: and the more noble fentiments by the reverfe. A man performing a benevolent action feels a degree of fatisfaction which affects his countenance; his eyes exhibit his fentiments by their livelinefs, and his mouth by its gentle curves at the corners, whilft his cheeks bear (what is perfectly underftood fo as to be admitted a common phrafe) the cheerful glow of humanity ftampt on them. Clearnefs of complexion, and colour in the cheeks, indicate youth and health; fallownefs, and the lofs of the ruddy hue of colour, ficknefs and age. The inhabitants of the town, and of the country, exhibit the fame diftinctions; as alfo the ftudious man and the fportfman. Independent of the individual hue of the character reprefented, one general tone over the whole picture fhould prevail, correfpondent to the fubject. Thus, if it be one of a grave caft, the tone of colours fhould be low, yet rich; and though harmonious not monotonous. If, on the contrary, the fubject is gay, the hues of the colouring fhould be bright and cheerful, and greatly diverfified; and every part of the picture fhould affift in expreffing the nature of the fubject chofen for reprefentation.

It is attention to this point which gives to painting its real value, its intrinfic worth; and feparates it from the more

more vulgar or merely mechanical arts. Hence it becomes of moral utility, and its power is not furpaffed by the poetic, or other effufions of the pen, in the force and vivacity of the impreffions it is calculated to produce. Of this there are many notices given to us in hiftory. Alexander is faid to have trembled and grown pale on feeing a picture of Palamedes betrayed to death by his friends: it bringing to mind the remembrance of his treachery to Ariftonicus. It is alfo related of an Athenian courtezan, that in the midft of a riotous banquet, cafting her eye on the portrait of a philofopher marked with the happy character of virtue and temperance; fhe was ftruck with fo lively an image of her own unworthinefs, that fhe inftantly went home and became an example of temperance. In both thefe cafes, to the truth of the expreffion muft be afcribed the force with which the pictures wrought upon the obfervers; and produced the powerful impulfe related.

It appears, indeed, to have been the principal object of attention with the ancient Greeks, and very naturally fo; for in the beginning of an art, before any rules for regulating its efforts were adopted. the artift's attention muft of courfe have been folely directed to relating his ftory; and whatever affifted in effecting that, was preffed into the fervice. Firft of all, we are told, the efforts were fo rude it was neceffary to explain them: afterwards labels were placed as iffuing from the mouths of figures; and other means of giving the ideas, fuppofed to occupy their minds, were adopted, till at laft the artifts arrived at the perfection of imitations of nature; and by giving their figures the actions and expreffions appropriate to their fituations, caufed them to tell their own ftory, and imprefs all its intereft on the beholders, without any extraneous aid. Unhappily, excepting the few pictures found at Herculaneum, and thofe are of a trivial kind, we have none of their works in this art to judge of the degree of perfection they arrived at in this moft important point of it; but we have the teftimony of many authors, fome of whom fpeak as eye-witneffes, by whom we are led to believe, on convincing grounds, that their beft pictures were full fraught with this beft of good qualities; and there is no reafon to doubt the truth of the report, when we fee the fculpture of the fame period which remains to us, fo rich in poffeffion of it.

In their ftatues, which were principally of gods, a great degree of minutiæ of expreffion does not appear to have been the object of their attention, as far as relates to the paffions, the reprefentation of which they feem properly to have regarded as degrading to the dignity of a divinity. A calm unruffled ftate of mind appears in their countenances, and governs their looks and actions, but each has its appropriate character. What can be more dignified and majeftic than the countenance of the Jupiter? Yet the line which its air, partaking fomewhat of feverity, infpires, is fo blended with mildnefs, that it produces implicit confidence and veneration. The Apollo Belvedere has alfo the dignity of the godhead fhining in it; but lefs impofing and overpowering, of a milder character, and the expreffion of his figure and action is perfect; no one doubts the intent of it for an inftant; and this juft difcernment, and imprefs of character, run through the whole clafs of ftatues of the primary deities of the Greeks. The Venus, the Bacchus, the Hercules, &c. have each their diftinctive line of character without paffion, whofe influence they are fuppofed to be exalted above, whilft in the lower orders, the fauns and nymphs, and rural deities, are no lefs properly marked with characteriftic features and actions. In the figure of Laocoon deftroyed with his fons by ferpents, the authors (who were three) have exhibited a moft powerful extent of feeling and power in expreffion, remaining almoft unrivalled in fubfequent productions; the agony of pain and diftrefs of mind are fpread over the whole work which chills the beholder with horror.

Correfpondent with this powerful effect is that related of and attributed to their pictures. Pliny fays of Ariftides, "that he infufed into his pictures all the paffions of the foul." It is faid, "that Parrhafius, in his picture of Philoctetes, had renewed the pains of the hero, as feen in his parched deep funk eyes, and the tears which flowed from them;" (Anthol. lib. 4.) and the epigrammatift concludes with a handfome compliment to the painter, blaming him "for not allowing the fufferings of Philoctetes to end with his life." Philoftratus, Vita Apollonii. cap. 10. fays, fpeaking of the Ajax of Timotheus, "we cannot do juftice to the picture where Ajax is reprefented diftracted, unlefs we previoufly form in our minds the image of his condition. The picture of "Medea contemplating the Murder of her Children," by the fame painter, was the fubject of numerous epigrams (Anthologia); fo that it muft have been very powerful to excite fo much emulation among the wits to celebrate it. It was faid to reprefent in her face, fury mixed with pity of the innocence of her children, who were reprefented fmiling at the dagger in her hand. Ovid fays, "her crime was confeffed in her eyes." Plutarch fays of Lyfippus the painter, that he was ingenious as well as fublime; that from the flight inclination of the neck natural to Alexander, he invented a fublime expreffion; making him look up to the heavens with manly boldnefs, and commanding majefty. The fame author (in Timoleon) praifes the paintings of Nicomachus "for their juft expreffion," comparing them "to the poetry of Homer in grace and facility:" and Apelles in this point affirmed himfelf fuperior to other painters, though inferior in fome others of lefs importance. It is needlefs to repeat the well known ftory of Timanthe's picture of the Sacrifice of Iphigenia, and of his artifice in hiding the face of the father, having exhaufted the force of expreffion in the beholders; commendations and imitations of it are met with every where; and of his ingenious contrivance to convey an idea of the immenfe fize of a Cyclops, by drawing fome Satyrs meafuring his figure with a thyrfus; and Pliny remarks of him on this occafion, that "in all his works there is more underftood than is marked, and though his execution be mafterly, yet his ideas exceed it."

Whatever allowance be made for the zeal and ftrength of terms with which perfons at all times defcribe thofe things, than which they are unacquainted with any thing better, and which muft have been the cafe in the early periods of art, the writers not being fo learned in it as the painters who made it their continual ftudy; yet we cannot refufe belief to a wonderful extent of power in rendering expreffion among the Greek painters, accompanied, as (it has been before obferved) thefe defcriptions of it are, by the actual effect in fculpture. It is more aftonifhing that it fhould ever have been loft fight of; yet that was the cafe, and on the revival of the art of painting the old original futile means of labels, &c. were had recourfe to, till the gradual advance of learning and propriety of fentiment again reftored it in the 15th century to the juft imitation of the impreffions of nature. Maffaccio was among the firft who thus advanced it, but it was Lionardo da Vinci who firft perfected its claim to intereft over the mind, though, perhaps, in none of his works fo completely as in his reprefentation of the Laft Supper, painted on the walls of the refectory of the Dominican convent at Milan, where it fhone for a period, unrivalled in truth and vigour of expreffion.

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It repreſents the moment wherein our Saviour has juſt ſaid to his diſciples "One of you ſhall betray me." Each figure has intelligence beaming from it; each individual exhibits a full report of what paſſes within his boſom. How tranquilly, yet how fully does our Lord diſcloſe this forerunner of his approaching miſeries, that one of thoſe whom he had loved and cheriſhed ſhould become treacherous, and turn his bounty to his ruin; and with what propriety is he thus repreſented tranquil, yet dignified! ſo conſiſtent with his high character and office! With what eagerneſs does the impetuous Peter apply to the well deſignated meek and humble John, to learn the name of the culprit that would betray ſo good a maſter! while that conſcious culprit, hearing the requeſt, ſtarts backward with alarm, fearing the conſequences of ſuch a diſcloſure. Theſe are repreſentations ſo powerful, that it needs but the regard of a moment to comprehend all ſaid, and to be ſaid, to complete the whole intereſt of the ſtory. The timid heſitating Thomas, at a ſmall diſtance from Peter, preſſes his hand on the other's ſhoulder, to urge him to make the requeſt his own timidity prevents him from doing himſelf. The next of the apoſtles, whoſe peculiarities hiſtory hath not ſo fully recorded, are repreſented in great variety of actions and expreſſions correſponding with, and juſtly originating in, the incredible circumſtance juſt announced to them. One, with his hands preſſed on his boſom, riſing, aſſerts his innocence; another ſtarts with ſurpriſe, and, in the pious conſciouſneſs of ſinful weakneſs, ſeems to demand "Lord, is it I?" One calmly, yet earneſtly, liſtens to the reſult of the queſtion urged by Peter: others, in contraſt with him, ſeem to argue together if it be poſſible ſuch iniquity could dwell with man, and in ſo doing declare their own innocence. Anxiety is depicted as diſturbing every breaſt, yet the peculiarities of each are preſerved with the moſt juſt diſcrimination; and all appear ſo impreſſed with nature, that while it is recognized as the offspring of that great man's genius, the mere imagination of his mind, it has the appearance of a portrait of the actual ſcene. It is now unfortunately much injured by time and cleaning, being painted in oil, and not, therefore, adhering to the wall ſo perfectly as freſco.

To become able to produce a work of this ſurpriſing power in expreſſion, Lionardo ſays of himſelf, that he loſt no opportunity which the occaſions of life afforded him, of ſtoring up remarks upon the nature of its action in men. He paid much attention to anatomy, and is ſaid to have attended executions, not only to watch the looks and actions of the ſufferers, but alſo to obſerve how the different perſons compoſing the crouds of ſpectators were affected. The common occurrences of life are every day affording the attentive and ingenious artiſt leſſons on this head; and he will ſucceed, accordingly as he is intelligent and active in obſervation of them; or if he neglects to improve his mind by them, is inattentive and unfeeling to them, he can never become equal to the taſk of repreſenting them.

Michael Angelo was alſo a powerful promoter of this high quality in works of art, but his expreſſion is of a grand and more myſtic nature than Lionardo's, and it is Raffaelle alone that has approached in his own way the ſuperior excellencies of the work we have above deſcribed. "We ſtand in awe of Michael Angelo," ſays M. Fuſeli, "while we embrace Raffaelle, and follow him wherever he leads us." He has not ſucceeded well where he has attempted the ſublime. His gods are not even heroes, and his heroes are common vulgar men, except in a few inſtances; but where tenderneſs, and the amiable qualities of human nature have been his ſubject, he is not behind his great forerunner. Nor in the relation of his ſtory is he ever deficient; ſometimes, indeed, as has been obſerved on the Cartoon of Ananias ſtruck dead, under the word Energy, in *Painting*, he combines the paſt events on which it depends, and the future, to which it leads. His Cartoons of "St. Paul preaching at Athens;" the "Healing the Lame Man at Lyſtra;" "Elymas ſtruck blind," are inſtinct with feeling and expreſſion: they are but ſlightly finiſhed, and lack the extreme perfection of Lionardo's work; however, from the high degree of character to which Raffaelle has carried ſome of his heads, in his picture of the "Transfiguration," 'tis fair to ſuppoſe he could have perfected theſe, if the nature of the works (being only examples for tapeſtry) had required it. In comparing the reputation of Raffaelle to Lionardo da Vinci in this reſpect, it ſhould not be forgot that he was only 36 years old when he died, and the latter was 49 or 50 when he painted the aſtoniſhing work of the "Laſt Supper." Had Raffaelle lived to an advanced age, it is probable he would have ſurpaſſed even him. The ſimplicity and fullneſs with which he deſcribes, or effects, the relation of his ſubject, is beautifully inſtanced in the Cartoons of "St. Paul and Barnabas healing the lame Man at Lyſtra," and the conſequent adoration paid to them. The apoſtles are raiſed upon ſome ſteps above the croud, and thus diſtinguiſhed, as well as by the attention of all being directed to them. The reſtored cripple is known from the reſt, by his eager demonſtrations of gratitude and adoration; by his united and uplifted hands and animated looks, addreſſed to his reſtorers, and by the crutches now become uſeleſs, and fallen at his feet to the ground. An aged man bending forwards, lifts with one hand the garments of the healed man, to view the limb now become perfect, and ſimply by the uplifting of the other, expreſſes his admiration of the cure ſo miraculouſly effected. It is the ſimplicity of the means Raffaelle uſes, which gives ſo much the appearance of nature to his expreſſions: no one, on ſeeing the works, doubts but that he ſhould have employed the ſame means; the art is loſt ſight of. The effect of the pictures of Raffaelle, in point of expreſſion, on the artiſt who obſerves them, is much the ſame as Garrick's acting the character of a clown is ſaid to have had upon a countryman, who completely loſt ſight of the actor, and criticiſed only the ſentiments, in which, by the by, he complimented the author alſo, by ſtating that he ſhould have done the ſame himſelf. Yet it is a fact, that no point in art is ſo difficult to attain as this true ſimplicity of character with effect. Perhaps the moſt beautiful piece of expreſſion in painting known to the world, is Raffaelle's head of the Madonna della Sedia, now in Paris. The ſweetneſs of ſentiment conveyed by the mouth is completely undeſcribable: no picture has been ſo frequently copied, none ſo rarely imitated.

Titian has frequently ſucceeded in rendering expreſſion in his works, though it is not his general characteriſtic. His picture of St. Peter Martyr, before alluded to, (ſee Execution, in *Painting*,) is almoſt perfect in this, as well as in moſt other points. Indeed, when taken in the whole, we cannot help conſidering this as the moſt perfect picture in the world; poſſeſſing more of every good quality than any other we are acquainted with. It has ſtrongly the character of expreſſion, both in form, and correſpondent tone of colour. No man of feeling regards it, but with an inſtantaneous ſentiment of ſeriouſneſs; ſomewhat, indeed, of horror is inſpired by the firſt view of it; particularly by the figure of the monk who is running away, and who eyes the proffered palm of martyrdom itſelf with horror. In direct oppoſition to him is the figure of the ſaint; who, ſuffering under the power of the

the aſſaſſin, (in whoſe perſon nought but the ſentiment of brutality prevails,) turns his eyes towards the angels deſcending with the palm and crown, and hails the viſion of future glory. The hue of the picture, we have ſaid, is ſerious, and it is alſo rich and deep in colour; 'tis the effect of that hue which prevails at twilight, and is moſt judiciouſly choſen as ſuitable to the affecting nature of the ſubject. Raffaelle has employed it in his portrait of Leo X. with the cardinals Roſſi and Medici attending him. Here the ſubject was grand, and its effect is increaſed by the deep and ſerious tone of the colouring.

Pouſſin has, in ſeveral inſtances, been very happy in the expreſſion of his ſubject. One of his pictures we will mention as a very excellent model of it; 'tis the Judgment of Solomon, a picture bad in its colour, in its compoſition, and execution, but fraught with the quality we are now conſidering. The king is ſeated upon his throne, ſurrounded by his attendants, and has juſt given the command to divide the living child. A ſoldier is proceeding to execute the order, and this gives occaſion to the admirable diſplay of diverſity of feeling in the by-ſtanders. An old man ſeems coolly to reaſon with himſelf if the king can intend the performance of ſo cruel a ſentence. Another looks earneſtly forward with the vacuity of aſpect ſo commonly produced by ſurpriſe. A woman turns away her head to avoid the ſight, and her child clings to her ſide alarmed. A ſoldier regards the ſcene with a countenance fraught with pity, another turns from it with diſguſt. Whilſt the wicked, abandoned woman, who had ſlain her own child, ſeeks the deſtruction of her neighbour's alſo; the real mother implores, with an earneſtneſs never to be too much admired, the preſervation of her child; rather willing to diſown, than to ſee it deſtroyed. The expreſſion of the action of the king is completely that of conviction to whom the child belongs; he almoſt ſeems to exclaim, now I ſee the right, now I know to whom to give the award. Pouſſin has alſo in this inſtance added another uſeful indication of character in the attire of the woman, no leſs different in mind, than in habit. He has given to the vicious creature that negligence in dreſs which is too often indicative of a general habit of idleneſs and neglect; whilſt he has dreſſed the other with decent care, and propriety.

This great painter has in another picture exhibited the force of colour in rendering expreſſion, almoſt independent of form: 'tis in his picture of the deluge; one of a ſeries of four pictures meant to repreſent the four ſeaſons of the year. It is almoſt entirely of one hue. The compoſition conſiſts of little more than a large portion of ſky and water; the latter in the lower part of the picture falling in a cataract. In the diſtance is the ark, ſcarcely diſcernible through the thickneſs or dullneſs of vapour, through which the ſun is with difficulty alſo ſeen, of a reddiſh hue. In the loweſt corner of the picture is a family, conſiſting of a man, his wife, and child, endeavouring to climb from a boat upon a rock, on which a ſerpent glides along; and a little farther towards the centre are ſeen the heads of a man and horſe juſt ſinking in the water. With theſe ſlight materials has Pouſſin wrought a picture which is completely overpowering in its melancholy effect. It is ſaid that Rouſſeau would ſit enwrapt in ſilence over it for hours, gratified with the ſenſations it inſpired.

Another maſter, whoſe attempts to render expreſſions have been ſometimes very ſucceſsful, is Guido Rheni; but he ſeldom goes farther than the characters of ſaints in pious ejaculations, Magdalens in the moment of contrition, and Ecce Homos. Of the latter, there is one of ſuper-excellent perfection, in the poſſeſſion of B. Weſt, eſq. a head only, but full of feeling; ſurely "never was ſorrow like unto his ſorrow," may be as juſtly applied to the painting, as to the ſufferings of the divine original. There is an ancient painting of a Satyr's head, now in the Barberini palace at Rome, which is eminently diſtinguiſhed by expreſſion of character.

There are but few among the large maſs of the Italian and French painters who have ſucceeded in their efforts (to any pre-eminent degree) in giving expreſſion to their works in its more exalted ſenſe. Ludovico Carrache, and Domenichino have ſometimes effected it, but rarely, and Annibal Carrache ſtill leſs frequently, notwithſtanding his immenſe power in execution. Among the Flemings, Jan Stein, and Oſtade, hold the principal places. The former particularly is exceedingly happy in characterizing the aſpects and manners of that claſs of men he undertook to paint, and he does it with great freedom and eaſe. Oſtade is more laboured in his manner, but perfect in his finiſh in the confined ſcale in which he exerted himſelf. Rubens has ſometimes ſucceeded to a high degree in this quality, but, in general, the expreſſions of his figures in ſerious ſubjects are too violent, and outſtep the modeſty of nature. In the gayer ſcenes, where nymphs and fawns are fancifully indulging their humours, his power is complete; they live and breathe with all their native gaiety and animation; and in expreſſing the characters of beaſts, either calm or enraged, not even Snyder has ſurpaſſed him. Vandyke rarely appears to have felt it in his hiſtorical pictures; but in ſome of his portraits he is extremely happy. His Cardinal Bentivoglio is a perfect inſtance of expreſſion in this branch of art. His picture of lord Strafford and his ſecretary at Wentworth-houſe, Yorkſhire, is another; but the idea is taken from Titian; whoſe portraits are maſter-pieces of identical character and expreſſion, and the prototype of Vandyke's excellence. In this reſpect, ſir Joſhua Reynolds is no leſs happy than either of them: prints from whoſe pictures are in ſo many hands, and ſo generally known, that it is needleſs to exemplify the aſſertion by further remark, yet we cannot decline mentioning the picture of Mrs. Siddons in the character of the Tragic Muſe, as a very happy inſtance of his power.

Rembrandt, though ſeldom happy in repreſenting the purity of expreſſion in his figures, yet ſometimes effects it; but his great characteriſtic is the truth with which he gives expreſſion in the ſecondary ſenſe we have affixed to it, as regarding painting. To imitate the peculiarities of nature was his delight. He ſeized and expreſſed, with the greateſt truth, the moſt extraordinary effects of the illumination of objects, and gave it its greateſt poſſible brilliancy and force. In a different line, Netſcher and Metzu were highly ſkilful in the exact expreſſion of the nature of the objects they choſe to repreſent. Silks, furs, carpets, metals, &c. all are expreſſed by them with the greateſt truth, and in a free, broad ſtyle of execution, particularly by the former. Teniers, and in ſhort almoſt all the painters of the Dutch and Flemiſh ſchools, have exhibited great ability in expreſſing the character of natural objects. But to this ſtudy they ſacrificed attention to expreſſion in its more elevated and uſeful province.

Not ſo our inimitable Hogarth. Though he took the common ſcenes of nature as his field of action; and was not unſkilful in imitating the natural effect of objects; yet with him this meaner talent was of ſecondary conſideration. By his pencil he inculcates leſſons of morality, and no lectures from the pulpit are more effectually ſtrong and convincing, than thoſe conveyed by his pictures. Witneſs the Rake's, and the Harlot's Progreſs; where the evils attendant on vice, and the bleſſings which a courſe of virtue is calculated to produce, are ſo powerfully exemplified. With what force has he ſatirized pride and luxury in his Marriage-a-la-Mode; bigotry, ſuperſtition, and folly, in many of his other works!

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and no one has ever expreffed identical character more ftrongly than he has. The figure of the exhaufted rake in the breakfaft-fcene of the Marriage a-la-Mode, has never been furpaffed in truth and force. We could enlarge with pleafure upon his value in this point of view, but content ourfelves with recommending his works with the excellent comments upon them by Mr. J. Ireland, to the perufal and obfervation of our readers; and are proud to have fo excellent an exemplar of the value of expreffion in painting as Hogarth, whofe talents were native, unindebted to foreign fchools, in praife of whom to conclude our obfervations on this very important point.

EXPROBATION, Exprobatio, in *Rhetoric*, is the reproaching a perfon with ingratitude, and unmindfulnefs of fome particular benefit conferred upon him.

EXPUGNATION, in *Military Language*, the taking of any place by affault.

EXPULSION, the act of driving a man by force out of a city, community, or the like.

Expulsion is alfo ufed for the act of driving out a foreign body with violence from the place it was in.

The uterus has the chief office in the expulfion of the fœtus: if the expulfion of the fœtus happen very foon after conception, it is called a *falfe birth*. See Delivery, Foetus, and Labour.

EXPURGATION, in *Aftronomy*, is ufed by fome authors for that ftate or action of the fun, wherein, after having been eclipfed and hid by the interpofition of the moon, it begins to appear again.

Later aftronomers call this emerfion, not expurgation.

EXQUIMA, in *Zoology*, the name of a fpecies of monkey common on the coaft of Guinea, of which Ray enumerates two or three varieties. See Simia.

EXSIBIDANTES, in *Antiquity*, a kind of hiffers, who, in the theatre, and other public auditories, ufed to make a noife with their feet, and even fometimes beat the feats with battons.

EXSICCATION, formed of *ex* and *ficcus*, *dry*, in *Chemiftry*, *Pharmacy*, &c. the act of drying up or evaporating the moifture of a thing. For this purpofe two methods are ufually employed: in one of which the humidity is evaporated by heat, and in the other it is imbibed or abforbed by fubftances adapted to the purpofe. Bodies combined with, or diffolved in a fluid, require the firft mode, and to fuch as are only fuperficially blended with it, the fecond mode is applicable. Vegetables are commonly exficcated by the natural warmth of the air, though the affiftance of artificial heat is often very ufeful. By a moderate fire the more tender flowers may be foon dried without any confiderable lofs, either of their odour or lively colour, which would be injured, if not deftroyed, by a more flow exficcation in the air. Some plants, particularly thofe of the more acrid kind, lofe their virtues by this procefs.

EXSORS Particula. See Particula.

EXSUCCATIO, a word ufed by fome *Chirurgical Writers*, to exprefs an enchymofis, or fuggillation.

EXSUFFLATION, a ceremony obferved in baptifm, by which the candidate was fuppofed to renounce the devil. See Baptism.

EXTACY, Εξςασις, a rapture, or removal of the mind out of its natural ftate and fituation; or a tranfport, whereby a perfon is hurried out of himfelf, and the office of his fenfes is fufpended. See Enthusiasm.

Extacy, in *Medicine*. See Ecstasis.

EXTANT, fomething that ftill fubfifts, or is in being. It is but part of the hiftory of Livy, of the writings of Cicero, Cæfar, &c. that are extant, the reft are loft. We have nothing extant of Socrates, though he wrote a great deal.

EXTEMPORANEOUS Prescription. See Prescription.

Extemporaneous *Playing*, flights in *Mufic*, on a harpfichord, or piano forte, have many appellations; as toccata, toccatina, *Ital.* prelude, capriccio. On the organ it is called a voluntary.

There have been organifts, whofe abilities in unftudied effufions on their inftruments have almoft amounted to infpiration, fuch as Sebaftian Bach, Handel, Marchand, Couperin, Kelway, Stanley, Worgan, and Keeble, feveral of whom played better mufic extempore, than they could write with meditation.

EXTEND, in the *Manege*. To extend a horfe, is an expreffion ufed by fome to import the fame with making a horfe go large. See Large.

Extend, in *Military Language*. When the files of a line, or the divifions of a column, are to occupy a greater fpace of ground, they are faid to extend their front or line.

Extend, in *Law*. See Extending.

EXTENDENDA Terra. See Terra.

EXTENDI Facias, in *Law*, a writ of extent, whereby the value of lands is commanded to be made and levied, &c. Reg. Orig. See Extent.

EXTENDING, in a *Legal Senfe*, fignifies the valuing of lands and tenements of one bound by ftatute, &c. and who hath forfeited his bond at fuch an indifferent rate, as that by the yearly rent the obligator may in time be fully paid his debt. See Extent.

EXTENSION, in *Philofophy*, is one of the general and effential properties of matter; the extenfion of a body being the quantity of fpace which the body occupies, the extremities of which limit, or circumfcribe, the matter of that body. It is otherwife called the *magnitude*, or *fize*, or *bulk* of a body.

A quantity of matter may be very fmall, or fo as to elude the perception of our fenfes, fuch as a particle of air, a particle of water, &c.; yet fome extenfion it muft have, and it is by the comparifon of this extenfion, that one body is faid to be larger than, equal to, or fmaller than, another body. The meafurement of a body confifts in the comparifon of the extenfion of that body with fome determinate extenfion, which is affumed as a ftandard, fuch as an inch, a foot, a yard, a mile; hence it is faid, that a body is a foot long, or three inches long, &c.

The extenfion of a body is meafured three different ways; or a body is faid to have length, breadth, and thicknefs. Thus an ordinary fheet of writing paper is about 16 inches long, about 14 inches broad, and nearly one hundredth part of an inch thick. Either of thefe dimenfions might be called the length, or the breadth, or the thicknefs; but, by general cuftom, the greateft extenfion is called the length, the next is called the breadth, and the fhorteft is called the thicknefs. The outfide of a body, its boundary, or that which lies contiguous to other bodies that are next to it, is called the *furface* of that body, and this furface has two dimenfions only, *viz.* length and breadth; but it has no thicknefs, for if it had, it would not be the outfide of the body; yet a furface by itfelf cannot exift. In mathematics, however, furfaces are mentioned, and are reafoned upon, abftractly from matter. But in thefe cafes the furfaces exift in the imagination only, and even then our ideas have a reference to body, for our fenfes cannot perceive a furface without a body.

As a furface is the outfide or boundary of a body, fo a line

line is the boundary of a finite furface. Suppofe, for inftance, that a furface is divided into two parts, the common boundary of the two parts is called a line; and this has one extenfion only, *viz.* it has length.

The beginning, or the end of a line, or the interfection of two lines which crofs each other, is called a *point*, and this has no dimenfions; or, according to the mathematical definition, a point is that which has no parts or magnitude. Thus, if you divide a line into two parts, the divifion or boundary between the two parts is a point.

Our fenfes are only capable of perceiving bodies which have three dimenfions; or rather the furfaces of bodies, which furfaces have two dimenfions, but a furface cannot be reprefented nor perceived without a body, and of courfe neither a line nor a point can be perceived without a body. In the ftudy of geometry, and in a variety of other branches, furfaces, lines, and points are reprefented upon paper, or upon fomething elfe; but in thofe cafes, the paper or that fomething elfe is the body whofe furface we perceive, and the furface of a particular figure is circumfcribed, not by real lines, but by a narrow flip of furface, which is fufficient to direct our reafoning with refpect to the geometrical properties of lines and furfaces. Thus alfo when points are reprefented by themfelves, the marks are not real points, but very fmall portions of the furface of a body.

There is a cafe in which extenfion is often faid to be perceived without the exiftence of a body, and this is the extenfion between two bodies. But, upon confideration, it will eafily be comprehended, that we may perceive the two bodies, and that they are feparate from each other; but we cannot perceive any thing pofitive between them. So that in this cafe the word extenfion is ufed in a figurative manner, as if fome other body exifted between the two bodies.

The particular extenfion, whether under the name of inch, foot, yard, metre, league, &c. with which other extenfions are compared, or by which they are meafured, are eftablifhed only by the common confent or agreement of perfons of a certain nation, or profeffion, and are ufed as ftandard meafures by them only. Hence, the meafures of different nations, though fometimes they have the fame name, do, however, differ confiderably from each other. Great endeavours have been made by divers ingenious perfons, at different times, for the purpofe of determining an unalterable univerfal ftandard of meafures; but thofe endeavours, and the fucceffes with which they have been attended, will be found defcribed under the article STANDARD *of Meafures.*

Extenfion is ufually defcribed as confifting in the fituation of parts beyond parts, with which fome authors cavil, maintaining, that we can conceive abfolute extenfion without any relation to parts.

If a man confider the diftance between two bodies abftractedly, and without any regard to bodies which may fill that interval, it is called fpace; and when he confiders the diftance between the extremes of a folid body, it is called extenfion.

Extenfion is frequently confounded with quantity and magnitude; and, for what we can perceive, without much harm, the thing fignified by them all appearing to be the fame; unlefs we admit a diftinction made by fome authors, that the extenfion of a body is fomething more abfolute, and its quantity and magnitude more refpective, or implying a nearer relation to much and little. See QUANTITY, MAGNITUDE, MASS, and MATTER.

The infinite divifibility of extenfion has been a famous queftion in all ages. It is not eafy to reconcile the doctrine of mathematicians on this head with the tenets of fome philofophers. They who hold that all extenfion and magnitude are compounded of certain *minima fenfibilia;* and that a line, for inftance, cannot increafe or decreafe, but by certain indivifible increments or decrements only, muft, confiftently with themfelves, affirm, that all lines are commenfurable to each other, contrary to the tenth book of Euclid, who demonftrates that the diagonal of a fquare is incommenfurable to its fide. But if all lines were compofed of certain indivifible elements, it is plain one of thofe elements muft be the common meafure of the diagonal and the fide. This is a gordian knot which none of the philofophers have yet thought fit to untie.

Bifhop Berkeley obferves, that the infinite divifibility of finite extenfion, though it is not exprefsly laid down either as an axiom or theorem in the elements of geometry, yet is throughout the fame every where fuppofed, and thought to have fo infeparable and effential a connection with the principles and demonftrations in geometry, that mathematicians never admit it into doubt, or make the leaft queftion of it. (See DIVISIBILITY.) And as this notion is the fource from whence do fpring all thofe amufing geometrical paradoxes, which have fuch a direct repugnancy to the plain common fenfe of mankind, and are admitted with fo much reluctance into a mind not yet debauched by learning; fo is it the principal occafion of all that nice and extreme fubtility which renders the ftudy of mathematics fo difficult and tedious. Hence, fays he, if we can make it appear, that no finite extenfion contains innumerable parts, or is infinitely divifible, it follows, that we fhall at once clear the fcience of geometry from a great number of difficulties and contradictions which have ever been efteemed a reproach to human reafon, and withal make the attainment thereof a bufinefs of much lefs time and pains than it hitherto hath been.

Every particular finite extenfion, which may poffibly be the object of our thought, is an idea exifting only in the mind, and confequently each part thereof muft be perceived. If therefore, fays this author, I cannot perceive innumerable parts in any infinite extenfion that I confider, it is certain they are not contained in it; but it is evident, that I cannot diftinguifh innumerable parts in any particular line, furface or folid, which I either perceive by fenfe, or figure to myfelf in my mind; wherefore, I conclude they are not contained in it. Nothing can be plainer to me than that the extenfions I have in view are no other than my own ideas; and it is no lefs plain, that I cannot refolve any one of my ideas into an infinite number of other ideas; that is, that they are not infinitely divifible. If by an infinite extenfion be meant fomething diftinct from a finite idea, I declare I do not know what that is, and fo cannot affirm or deny any thing of it. But if the terms extenfion, parts, and the like, are taken in any fenfe conceivable; that is, for ideas; then to fay a finite quantity or extenfion confifts of parts infinite in number, is fo manifeft a contradiction, that every one at firft fight acknowledges it to be fo. New Theory of Vifion, § 54, 55. Analyft. § 31.

On the other hand, it is obferved by an eminent mathematician, that geometricians are under no neceffity of fuppofing that a finite quantity or extenfion confifts of parts infinite in number, or that there are any more parts in a given magnitude than they can conceive or exprefs: it is fufficient that it may be conceived to be divided into a number of parts equal to any given or propofed number; and this is all that is fuppofed in ftrict geometry concerning the divifibility of magnitude. It is true, that the number of parts into which a given magnitude may be conceived

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to be divided, is not to be fixed or limited, becaufe no given number is fo great but a greater than it may be conceived and affigned: but there is not therefore any neceffity for fuppofing that number infinite; and if fome may have drawn very abftrufe confequences from fuch fuppofitions, they are not to be imputed to geometry. Geometricians are under no neceffity of fuppofing a given magnitude to be divided into an infinite number of parts, or to be made up of infinitefimals; neverthelefs, they cannot fo well avoid fuppofing it to be divided into a greater number of parts than may be diftinguifhed in it by fenfe in any particular determinate circumftance. But they find no difficulty in conceiving this; and fuch a fuppofition does not appear to be repugnant to the common fenfe of mankind, but on the contrary to be moft agreeable to it, and to be illuftrated by common obfervation. It would feem very unaccountable not to allow them to conceive a given line, of an inch in length for example, viewed at the diftance of 10 feet, to be divided into more parts than are difcerned in it at that diftance; fince by bringing it nearer, a greater number of parts is actually perceived in it. Nor is it eafy to limit the number of parts that may be perceived in it when it is brought near to the eye, and is feen through a little hole in a thin plate? or, when by any other contrivance it is rendered diftinct at fmall diftances from the eye. If we conceive a given line that is the object of fight to be divided into more parts than we perceive in it, it would feem that no good reafon can be affigned why we may not conceive tangible magnitude to be divided into more parts than are perceived in it by the touch; or a line of any kind to be divided into any given number of parts, whether fo many parts be actually diftinguifhed by fenfe, or not. In applying the reafonings and demonftrations of geometricians on this fubject, it ought to be remembered, that a furface is not confidered by them as a body of the leaft fenfible magnitude, but as the termination or boundary of a body; a line is not confidered as a furface of the leaft fenfible breadth, but as the termination or limit of a furface; nor is a point confidered as the leaft fenfible line, or a moment as the leaft perceptible time; but a point as a termination of a line, and a moment as a termination of a limit of time. In this fenfe they conceive clearly what a furface, line, point, and a moment of time is; and the poftulata of Euclid being allowed and applied in this fenfe, the proofs by which it is fhewn, that a given magnitude may be conceived to be divided into any given number of parts, appear fatisfactory; and if we avoid fuppofing the parts of a given magnitude to be infinitely fmall, or to be infinite in number, this feems to be all that the moft fcrupulous can require. See Maclaurin's Treatife of Fluxions, art, 290, 291.

Dr. Reid, in his "Inquiry into the Human Mind, on the Principles of Common Senfe," endeavours to obviate the difficulties fuggefted by Berkeley, by overturning the fyftem of ideas eftablifhed by Mr. Locke. According to his theory, it is abfurd to deduce from fenfation the firft origin of our notions of external exiftence, of fpace, motion, and extenfion, and all the primary qualities of bodies; they have, he fays, no refemblance to any fenfation, or to any operation of our minds, and therefore they cannot be ideas either of fenfation or reflection; nor can he conceive how extenfion, or any image of extenfion, can be in an unextended and indivifible fubject like the human mind.

Extension, in the *Ancient Mufic*, according to Ariftoxenus, was one of the four parts of the melopœia, which confifted in fuftaining certain founds longer than their quantity ftrictly required. We call thefe binding-notes, and fometimes perhaps tempo rubato. See Compass.

Extension *of Fractured Limbs*. See Fracture.

EXTENSOR, in *Anatomy*, a name given to thofe mufcles which have the ufe of extending or making ftraight thofe parts to which they are attached.

Extensor *brevis digitorum pedis*; calcaneo-fus-phalangettien commun, is a thin and flat mufcle, placed on the fuperior or convex furface of the foot. Poffeffing a fomewhat quadrilateral figure behind, it divides into four flat tendons in front. It arifes from the upper and front part of the os calcis, and from the ligament which connects that bone to the aftragalus. Thence its fibres are continued obliquely forwards and inwards, and divide into four fecondary fafciculi, (of which the two innermoft are the largeft,) giving origin to the fame number of tendons; which, in paffing over the metatarfus, crofs thofe of the extenfor longus, and terminate in the toes. The firft, on the infide, is attached to the upper furface of the metatarfal extremity of the firft phalanx of the great toe: the three fucceeding tendons become intimately attached to the external edge of the correfponding tendons of the extenfor longus, and are connected at the firft joints of the toes, as well as thofe of the latter mufcle, with the tendons of the lumbricales and interoffei. They extend over the fecond phalanges, and are inferted in the third.

Covered on its external furface by the tendons of the extenfor longus and peroneus tertius, and by the aponeurofis of the back of the foot, this mufcle lies upon the anterior phalanx of the tarfus, upon the metatarfus, and the phalanges.

It extends and elevates all the phalanges of the toes, at the fame time turning them rather outwards.

Extensores *carpi radiales*. See Carpi.

Extensor *carpi ulnaris*. See Carpi.

Extensor *communis digitorum manus*; epicondylo-fus-phalangettien commun; extenfive digital; a mufcle belonging to the fingers, fituated on the pofterior or dorfal furface of the fore-arm, hand, and fingers; elongated, fomewhat rounded and flefhy above, and divided into four tendons below.

It arifes above, by means of a tendon common to it with the furrounding mufcles, from the external condyle of the humerus; is connected internally to a tendinous partition, which feparates it from the extenfor of the little finger, externally to a fhorter feptum placed between it and the extenfor carpi radialis brevior, and pofteriorly to the fafcia of the fore-arm. The fibres, uniting together obliquely from thefe origins, form a mufcle, at firft thin, and afterwards more confiderable, which is divided, towards the middle of the fore-arm, into four portions, united at firft by cellular fubftance, then feparating, and giving origin to the fame number of tendons. Thefe at firft are connected by a loofe cellular fubftance, pafs together with the tendon of the indicator under the annular ligament at the back of the wrift, and in a fuperficial groove of the radius, furrounded by a burfa mucofa, then diverge towards the fore fingers, and become completely flattened. They are often fplit longitudinally, and are united to each other, at the back of the hand, by crofs flips of tendon and their aponeurofes. At the firft joints of the fingers the broad thin tendons of the extenfor communis are joined, on either fide by the tendinous expanfions of the lumbricales and interoffei, and completely cover the articulation. They divide, at their extremities, into three portions, the middle of which are inferted in the fecond phalanges of the fore-fingers; while the lateral divifions, running along the fides of thefe phalanges, are inferted clofe together into the third.

This mufcle is covered by the aponeurofis of the fore-arm, the annular ligament and ſkin. It covers the ſupinator radii brevis, the extenſors of the thumb and fore-finger, the carpus, metacarpus, interoſſei muſcles, and poſterior ſurface of the phalanges.

The annular ligament at the back of the fore-arm conſiſts of a broad, thin, and flat, but ſtrong fibrous expanſion, extended from the outer part of the carpal extremity of the radius, over all the extenſor tendons at the back of the wriſt, and connected to the end of the ulna, and to the os piſiforme. It confines the tendons to the ſurface of the bones. Thoſe of the common extenſor are ſurrounded, as they paſs under it, by a ſynovial membrane, in which we may diſtinguiſh a cavity containing the membranes completely iſolated, and a ſuperior and inferior cul de ſac, where the membrane is reflected over the tendons. The ſynovial membranes of the firſt joints of the fingers are cloſely connected to the tendons of the extenſor communis, where they paſs over thoſe joints.

This muſcle extends the different joints of the fingers; and afterwards, or if the fingers are bent by their flexors, it extends the wriſt upon the fore-arm.

Extensor *indicis*. See Indicator.

Extensor *longus digitorum pedis*; peroneo-tibi-ſus-phalangettien commun; grand extenſeur; is a long, thin muſcle, flattened laterally, and placed at the outer and anterior part of the leg, and upper part of the foot. It ariſes above from the external tuberoſity of the tibia, from a ſmall aponeurotic ſeptum which ſeparates it from the tibialis anticus, and from the anterior ligaments of the peroneo-tibial articulation; behind from five or ſix inches of the upper and anterior part of the fibula; before, at its upper part, from the aponeuroſis of the leg; and externally, from a broad aponeurotic ſeptum, which ſeparates it from the two peronei. The ſuperior fibres deſcend perpendicularly, the inferior ones more and more obliquely, to end in a common tendon at firſt concealed in the ſubſtance, but, from the middle of the leg, occupying the anterior edge of the muſcle. It divides into three or four portions, which paſs together behind the annular ligament: below which part we always ſee four ſeparate tendons diverging over the convexity of the foot, aſſuming a broad and flattened form, and croſſing the direction of the tendons of the extenſor brevis, in their paſſage to the four ſmaller toes. At the firſt joints of the toes theſe tendons are connected to thoſe of the extenſor brevis, and of the lumbricales and interoſſei, as in the hand, and they have ſimilar inſertions to thoſe of the extenſor communis digitorum, which ſee.

In the leg, this muſcle, on its inner ſurface, is ſeparated above by the anterior tibial veſſels from the tibialis anticus; lower down it is contiguous, on the ſame aſpect, with the extenſor proprius hallucis: externally it is in contact with the peronei; and the aponeuroſis of the leg covers it on the front. At the ankle it runs in a peculiar cavity of the ſtrong tranſverſe annular ligament, which binds it firmly down in its place. Here the tendons are ſurrounded by a ſynovial membrane. In the foot it is covered by the ſkin, and covers the extenſor brevis and phalanges.

This muſcle extends the toes, and afterwards bends the ankle joint. If the foot be fixed to the ground, it may either maintain the leg erect upon the foot, or carry it forwards.

Extensor *longus pollicis pedis*; or *proprius*; peroneo-ſus-phalanginien du pouce; thin, elongated and flattened in its form, it lies on the inſide of the preceding muſcle. It ariſes from the inner and anterior part of the fibula, and neighbouring portion of the interoſſeous ligament, for a ſpace of five or ſix inches, beginning about two inches below the upper end of the fibula. Its fibres paſs obliquely downwards and forwards, parallel to each other, and joining a tendon which runs along their anterior edge, conſtitute a ſingle penniform muſcle. The tendon goes behind the annular ligament, in a peculiar burſa mucoſa, runs along the inner edge of the metatarſus, and paſſing over the firſt, terminates in the ſecond phalanx of the great toe. Sometimes a ſmall portion of its tendon is inſerted in the firſt phalanx.

This muſcle is placed between the tibialis anticus, the anterior tibial veſſels and nerves being however interpoſed, and the extenſor longus digitorum. On the front it is covered by the aponeuroſis of the leg, the annular ligament, and the integuments. Its tendons lie on the lower end of the tibia, the tarſus, metatarſus, and phalanges of the great toe, and is cloſely connected to the ſynovial membrane of the firſt joint of that toe.

It extends the two joints of the great toe, and acts upon the foot in the ſame manner as the preceding muſcle.

Extensor *major pollicis*. See Extensores *pollicis*.

Extensor *minor pollicis*. See Extensores *pollicis*.

Extensor *oſſis metacarpi pollicis*. See Extensores *pollicis*.

Extensores *pollicis*; are three muſcles belonging to the three bones of the thumb.

Extensor *primi internodii*; extenſor oſſis metacarpi pollicis; abductor pollicis longus of Albinus; cubito-radi-ſus-metacarpien du pouce; grand abducteur du pouce; is a muſcle of an elongated, thin, and flattened form, ſituated obliquely on the back of the fore-arm. It ariſes above from the ulna, below the ſupinator radii brevis; from the interoſſeous ligament; and from the radius juſt below the inſertion of the ſupinator brevis. The fleſhy fibres unite together from theſe origins to form a flattened faſciculus at firſt ſmall, but afterwards larger, which croſſes the fore-arm obliquely from above downwards, and from the radial towards the ulnar ſide. Towards the lower extremity of the radius it terminates in a tendon, which runs in a ſmall groove on the outer ſide of the carpal extremity of the bone. Here it is ſurrounded by a hollow burſa, common to it with the tendon of the next muſcle. It is inſerted, generally by means of ſeveral more or leſs diſtinct portions, into the radial ſide of the carpal end of the firſt phalanx of the thumb. One of theſe portions is often connected with the abductor pollicis.

It is covered, in its fleſhy portion, by the extenſor carpi ulnaris, extenſor ſecundi internodii, extenſor proprius auricularis, and communis digitorum; and it covers the radius, ulna and interoſſeous ligament. Its tendon is covered by the aponeuroſis of the fore-arm, and covers the extenſores carpi, the radius, radial artery, and joint of the wriſt.

It extends the firſt bone of the thumb, when that has been bent towards the palm of the hand. It carries the thumb away from the other fingers; and it may move the whole hand towards the radius.

Extensor *ſecundi internodii*; extenſor minor pollicis; cubito-ſus-phalangien du pouce; is an elongated and ſlender muſcle, ſituated cloſe to the former, and lying on its ulnar edge. Ariſing from the interoſſeous ligament and radius, it croſſes the direction of the fore-arm, like the former, and forms a ſlender tendon, which cloſely accompanies that of the preceding muſcle. It paſſes along the firſt, and is inſerted in the ſecond phalanx of the thumb. It is covered by the extenſor tertii internodii, proprius auricularis, and digitorum communis, by the aponeuroſis of the fore-arm, and the integuments. It lies upon the bones of the fore-arm and the interoſſeous ligaments, the extenſores carpi radiales, the

joint

joint of the wrift, and the firft bone of the thumb. It extends the firft and fecond joints of the thumb, and carries it into the ftate of abduction. It may draw the whole hand towards the radius.

Extensor *tertii internodii*; extenfor major pollicis; cubito-fus-phalangettien du pouce; is an elongated and flender mufcle, placed clofe on the ulnar edge of the former, and following the fame general direction. It arifes from the middle third of the pofterior furface of the ulna, and a very little from the interoffeous ligament; and croffes the fore-arm obliquely towards the thumb. Surrounded by a hollow burfa, it runs along a peculiar groove of the radius, being placed about an inch on the ulnar fide of the preceding tendons. It paffes along the ulnar fide of the firft phalanx of the thumb; is connected with the infertion of the preceding tendon in the fecond phalanx, and terminates in the third. Situated at its origin between the bones of the fore-arm and interoffeous ligament, and the extenfor communis, proprius auricularis, and carpi ulnaris, it afterwards runs in its peculiar groove: it is then fub-cutaneous, and lies on the extenfores carpi, joint of the wrift, and bones of the thumb. It extends all the joints of the thumb, and at the fame time rather carries it towards the fingers. It will alfo act as an extenfor of the wrift.

Extensor *proprius auricularis*, or digiti minimi; epicondylo-fus-phalangettien du petit doigt; is a thin, flender, and elongated mufcle, fituated in the firft or fuperficial layer of the back of the fore-arm, and placed clofe along the ulnar fide of the extenfor digitorum communis. It arifes above by means of the common tendon, from the external condyle of the humerus; on the outfide, from a feptum, which feparates it from the extenfor communis; on the infide, from one interpofed between it and the flexor carpi ulnaris; and behind, from the aponeurofis of the fore-arm. It gives origin to a flender tendon, which paffes in a feparate canal of the annular ligament, and forming the tendon which the little finger receives from the extenfor communis, is inferted together with it into that finger. On the fore-arm, this mufcle is covered by the fafcia, and covers the fupinator brevis, the extenfors of the thumb, and the indicator. The extenfor communis lies on its outfide, and the extenfor carpi ulnaris on the infide. Its tendon is furrounded by a tendinous fheath, lined with a fynovial membrane, at the wrift; and afterwards is covered by the integuments lying on the laft metacarpal bone, and on the phalanges of the little finger. It extends the little finger, and afterwards moves the wrift in the fame direction; it will carry the little finger rather in the direction of abduction.

Extensor *proprius pollicis pedis*. See Extensor *longus pollicis pedis*.

Extensor *tarfi minor*, a name given by Douglas to the plantaris, which fee.

Extensor *tarfi furalis*, or magnus; a name under which Douglas claffes the gaftrocnemius and foleus. See thofe words.

EXTENT, or Extendi Facias, in *Law*, fometimes denotes a writ or commiffion to the fheriff for the valuing of lands and tenements; fometimes the act of the fheriff or other commiffioner upon this writ; and fometimes the eftimate or valuation of lands, *per proprios viros;* which, when taken at the utmoft value or extent, furnifh our extended, or rack-rents. Fleta. lib. ii.

This is a fpecies of *execution* (which fee) upon fome profecutions given by ftatute; as in the cafe of recognizances or debts acknowledged on ftatutes-merchant, or ftatutes-ftaple; upon forfeiture of which, the body, lands, and goods may be all taken at once, to compel the payment of the debt. And by ftatute 33 Hen. VIII. c. 39. all obligations made to the king fhall have the fame force, and of confequence the fame remedy to recover them, as a ftatute-ftaple; though, indeed, before this ftatute, the king was entitled to fue out execution againft the body, lands, and goods of his accountant or debtor. (3 Rep. 12.) And his debt fhall, in fuing out execution, be preferred to that of every other creditor, who hath not obtained judgment before the king commenced his fuit. The king's judgment alfo affects all lands, which the king's debtor hath at or after the time of contracting his debt, or which any of his officers, mentioned in the ftatute 13 Eliz. c. 4. hath at or after the time of his entering on the office; fo that, if fuch officer of the crown alienes for a valuable confideration, the land fhall be liable to the king's debt, even in the hands of a *boná fide* purchafer; though the debt due to the king was contracted by the vendor many years after the alienation. (10 Rep. 55, 56.) Whereas judgments between fubject and fubject reverted, even at common law, no farther back than the firft day of the term in which they were recovered, in refpect of the lands of the debtor; and did not bind his goods and chattels, but from the date of the writ of the execution: and now, by the ftatute of frauds, 29 Car. II. c. 3. the judgment fhall not bind the land in the hands of a *boná fide* purchafer, but only from the day of actually figning the fame; which is directed by the ftatute to be punctually entered on the record; nor fhall the writ of execution bind the goods in the hand of a ftranger, or a purchafer (Skin. 257.); but only from the actual delivery of the writ to the fheriff or other officer, who is therefore ordered to endorfe on the back of it the day of his receiving the fame. Blackft. Comm. book iii.

EXTENUATION, the act of diminifhing or leffening the bulk or fubftance of a thing, efpecially of the human body. Fevers, agues, long abftinences, &c. occafion great extenuations or emaciations.

Extenuation is alfo a figure in *Rhetoric*, oppofite to the hyperbole. The Greeks call it λιτότης.

EXTERIOR *Polygon, Talus*. See the fubftantives.

EXTERMINATION, formed of *ex* and *terminus*, *boundary*, the act of extirpating, or totally deftroying a people, race, family, &c.

The Jews have been exterminated out of Portugal, the Moors out of Spain, the Albigenfes out of France, &c. Philip the Fair of France, to be revenged on the Knights Templars, took a refolution, in 1307, to exterminate them.

Extermination, or *Exterminating*, in *Algebra*, is ufed for taking away. Thus algebraifts fpeak of exterminating furds, fractions, and unknown quantities out of equations. See Maclaur. Algebr. part i. chap. 12, where we have fome general theorems for the exterminating unknown quantities in given equations. See Equation.

EXTERNAL, or Exterior, a term of relation, applied to the furface or outfide of a body; or that part which appears or prefents itfelf to the eye, touch, &c. In which fenfe it is oppofed to *internal* or *interior*.

The fenfes are divided into external, which are thofe whereby we perceive ideas, or have the perception of external objects; as feeing, hearing, &c. and internal. See Sense.

External is alfo ufed to exprefs any thing that is with-outfide a man, or that is not within him, and particularly in his mind. In which fenfe we fay external objects, &c.

The exiftence of an external world, *i. e.* of bodies and objects out of the mind, is a thing which has been greatly called

called in queftion by Dr. Berkeley and others. See Existence, Body, and Quality.

External *Angles*. See Angles, *external.*

External *Denomination, Ear, Modes, Place.* See the fubftantives.

EXTERNUS Auris, in *Anatomy*. See Ear.

Externus *Cubitæus*. See Cubitæus.

Externus *Duvèrni*, a name given by Douglas to one of the mufcles of the ear, called by Cowper and others obliquus auris, and by Albinus externus mallei. See Ear.

Externus *Gaftrocnemius, Iliacus.* See the fubftantives.

Externus *Mallei.* See Ear.

Externus *Orbiter, Pterigoideus, Vaftus, Rectus Capitis,* See the feveral articles.

EXTINCTION, the act of extinguifhing, that is, of putting out, or deftroying, fire, flame, or light.

The Ariftotelians account for the extinction of fire from the principle of contrariety; thus, fay they, water puts out fire, becaufe the qualities of water are contrary to thofe of fire, the one being cold and moift, and the other hot and dry. But how far this will go, may appear hence, that fire is extinguifhed by hot water as readily as cold; nay, even by oil, earth, &c.

Some of the moderns offer two more plaufible caufes of extinction; *viz.* diffipation, as when the next immediate fuel of the flame is difperfed and blown off by too forcible a wind; and fuffocation, when it is fo compreffed, that its free motion cannot be maintained; as happens upon throwing water, &c. thereon. Various preparations and engines have been contrived for extinguifhing accidental fires. See Fire.

Boerhaave denies that there is properly any fuch thing as extinguifhing of fire; it is a body *fui generis*, of an immutable nature, and we can no more extinguifh or deftroy it than we can create it.

Extinction, in *Chemiftry* and *Pharmacy*, is when a metal, mineral, or the like body, after having been heated red-hot in the fire, is plunged in fome fluid, either to foften or temper its acrimony, as tutty in rofe-water; or to communicate its virtue to the liquor, as iron or fteel to common water; or, laftly, to give it a temper, as in the extinction of fteel in water, or fome other preparation.

EXTINGUISHER, Self-acting, is a contrivance whereby a candle can be extinguifhed at any given time after being lighted. There are feveral ways by which this can be effected. The moft fimple is placing the candle in a veffel of water, with fuch a length above the furface as will burn as long as a light is wanted; of courfe when the candle burns down to the water it will be extinguifhed.

Figs. 10 and 11, *Plate* XII. *Mifcellany*, reprefent two neat mechanical contrivances for the above purpofe; in *fig.* 10, *a a* is a brafs clip, formed of two pieces, and jointed together by the pin, *b*, by means of a fliding ring, *d*; this clip can be clofed round the candle fo as to fix firmly thereto; the pin, *b*, has a joint in the upper end to receive a crooked lever, *e*, which has a conical extinguifher faftened at the other end of it. This extinguifher is held up from falling upon the candle, by means of a fmall wire, *f*, which is bent fideways at the end, and thruft into the candle, at the place where it is intended to be put out; as the tallow is confumed, it becomes fo foft as to be unable to fuftain the preffure of the wire, *f*, which therefore flies forward, and the extinguifher falls upon the candle. It muft be obferved that the wire, *f*, muft only be put into the tallow, but not in the wick, as it might not then fall down quickly.

Fig. 11 is another extinguifher, invented by Mr. J. J. Hawkins, and placed in his mufeum of mechanical inventions: *a a* is a pair of nippers, made of tinned iron plate, and jointed in the middle; between the outer ends a piece of watch-fpring is fixed, which caufes the ends, *b*, to clofe upon the candle, and thus hold the extinguifher on the candle. The centre-pin of the joint is long enough to ferve for the centre of another clip, *b b*, which is exactly fimilar to the lower one, except that inftead of the bow to embrace the candle, two wires, *e*, *e*, are fixed to the ends, to fhut the extinguifher, which is compofed of two flat plates, *f*, *f*, which open and fhut upon the joint, *g*. The fpring between the ends of the nippers, *b*, *b*, has a conftant tendency to clofe the extinguifher, but is prevented from fhutting by the candle. When the candle burns away, it becomes foft at the place where the extinguifher bites the fpring, then fhuts it up, and puts out the light.

EXTINGUISHMENT, in *Law*, is ufed for a confolidation. Thus, if a man, having a yearly rent due to him out of my lands, afterwards purchafe the fame lands; both the property and rent, becoming confolidated, or united in one poffeffor, the rent is faid to be extinguifhed.

So, where a man has a leafe for years, and afterwards buys the property, there is a confolidation of the property, and an extinguifhment of the leafe.

But if a man have an eftate in land merely for life or years, and hath a higher eftate in a fee-fimple, in the rent, this rent is not extinguifhed, but in fufpence for a time; for, after the term, the rent fhall revive. (Terms de Ley.) See Release.

So alfo, if there be lord mefne and tenant, and the lord purchafe the tenancy, the mefnalty is extinct.

Likewife by purchafing of lands wherein a perfon hath common appendant, the common is extinguifhed. (Cro. El. 594.) A releafe of common in one acre, is an extinguifhment of the whole common. Shower's Rep. 350.

And where a perfon hath common of vicinage, if he inclofes any part of the land, all the common is extinct. (1 Brownl. 174.) If a man hath a highway appendant to land, and afterwards purchafeth the land wherein the highway is, the way is extinct: though it is held, that a way of neceffity to a market or church, or to arable land, is not fo extinguifhed. 11 Hen. VII. 25 Co. Litt. 155.

Extinguishment *of a copyhold* takes place on any act of the copyholder's, which denotes his intention to hold no longer of his lord, and amounts to a determination of his will. (Hutt. 81. Cro. Eliz. 21. 1 Jon. 41.) As if a copyholder in fee accepts a leafe for years of the fame land from the lord, or accepts an affignment of a leafe made to another from the leffee, his copyhold is extinct. (Moor. 184. 2 Co. 166. Godb. 11. 101.) A copyhold eftate is extinct whenever it becomes not demifeable by copy. Coke's Copyholder, 62. See Copy-hold.

Extinguishment *of debt* happens in a variety of cafes. Thus, if a creditor accepts a higher fecurity than he had before, or accepts a bond for a legacy, the firft debt or legacy is hereby extinguifhed.

Extinguishment *of liberties.* If liberties and franchifes granted by the king, fuch as felon's goods, waifs, ftrays, wrecks, &c. (9 Rep. 25.) come again to the crown, they are extinct in the crown, and the king is feifed of them *jure coronæ*: but if liberties of fairs, markets, or other franchifes, and jurifdictions, be erected, and created by the king, they will not be extinguifhed, nor their appendances fevered from the poffeffion. 9 Rep. 25.

Extinguishment *of fervices.* If the lord purchafes or, accepts any part of the tenancy, out of which an entire fervice is to be paid or done, the fervice becomes thereby extinct; unlefs it be for the public good, or homage and fealty, ſealty, which are not ſubject to extinguiſhment. (6 Rep. i. 105. Co. Litt. 149.) If the lord and another perſon do purchaſe the lands out of which he is to have ſervices, they are extinct; alſo by ſeverance of the ſervices a manor may be extinguiſhed. Co. Litt. 147. 1 And. 257. See Tenure.

Extinguishment *of ways.* See Extinguishment.

EXTIRPATION, formed of *ex* and *ſtirps, root,* the act of pulling up, or deſtroying, a thing to the very roots.

Among the prayers of the Romiſh Jubilee, there is one for the extirpation of hereſy.

Extirpation. This word, in *Surgery,* ſignifies the eradication of any diſeaſe, tumour, &c. by ſome manual operation, whether done with a cutting inſtrument, with cauſtic, with a ligature, or any other means.

Thus, the generality of tumours are extirpated with a knife; but ſome, which claſs as excreſcences, or warts, are frequently extirpated with cauſtic, or with the ligature. The extirpation of polypi in the noſe is, for the moſt part, accompliſhed with forceps, by which ſuch tumours are pulled, or rather twiſted off.

The art of extirpating encyſted tumours with adroitneſs conſiſts in diſſecting the parts, ſurrounding the tumour, without wounding the cyſt. If the latter accident occur, the contents frequently flow out, the cyſt collapſes, and the continuance of the diſſection is attended with more difficulty. It is a great point to remove every particle of the cyſt, and, hence, it is ſatisfactory to take it out entire, that is, without wounding it. When any portion remains behind, the wound will frequently not heal, in conſequence of fungous granulations, ariſing from the diſeaſed part. Unleſs the ſwelling be large, a ſingle inciſion through the ſkin is ſufficient; but, in other inſtances, it is advantageous to make two cuts in this manner ( ); firſt, becauſe it facilitates the removal of the tumour; ſecondly, becauſe it prevents a redundance of ſkin, which would take place, if none were removed, and would greatly retard the cicatrization of the wound.

After the operation, the edges of the wound are to be brought together with ſticking plaſter, and a compreſs and bandage are to be applied.

When the breaſt is affected with any diſeaſe of an incurable nature, the ſurgeon can ſometimes extirpate the malady by cutting away the whole of the diſeaſed parts.

If the diſeaſe be of a ſcirrhous or malignant nature, ſome particularity in the mode of operating is requiſite. The ſurgeon ought, in this caſe, not to be content with merely removing parts, which are palpably and viſibly diſeaſed, but he ſhould alſo endeavour to remove a certain quantity of the ſubſtance, which is in the immediate circumference of the diſeaſe. In ſcirrhus, every ſurgeon knows the propenſity of the ſkin to be affected, and the frequent extenſion of white morbid bands into the ſurrounding adipoſe ſubſtance. Theſe facts greatly confirm the propriety of making a free removal of the ſkin, whenever it is in the leaſt diſcoloured, puckered, adherent to the ſwelling beneath, or in any way altered; and of taking away a good deal of the fat, in which ſcirrhous tumours are ſometimes involved. When there are no reaſons for ſuppoſing the diſeaſe of the breaſt to be any thing elſe than a mere ſarcomatous enlargement, the removal of the ſkin muſt certainly be conſidered unneceſſary. When cancer recurs, the ſkin is the firſt part in which it uſually makes its appearance, and the ſkin of the nipple in particular. Hence, many ſurgeons always make it a rule to remove the latter part, when it is judged proper to take away any of the integuments.

The operation is uſually performed as the patient is in a ſitting poſture, well ſupported by pillows and aſſiſtants.

The pectoral muſcle is to be made tenſe by keeping the arm back, by means of a ſtick, placed tranſverſely behind the back, in front of the two arms.

If none of the integuments are to be removed, a ſtraight inciſion is to be made through them; the tumour is to be regularly diſſected all round from the circumjacent parts; and, laſtly, its baſe is to be detached from its connections, from above downward, till the whole is ſeparated.

This is the mode of removing all ſimple tumours, which are not of a malignant nature, and which are not of an immenſe ſize.

When the tumour is of a malignant nature, and adherent to the ſkin and pectoral muſcle beneath, the operator is to remove, at leaſt, an inch or two of the fat on every ſide of the diſeaſe. The portion of the ſkin intended to be taken away muſt be included in two ſemi-circular inciſions, which meet thus ( ) at their extremities; and when the baſe of the tumour is to be detached, the ſurface of the pectoral muſcle, wherever it is adherent to the tumour, is alſo to be removed.

It is ſufficiently obvious, that the advantage of making the inciſion in the above manner conſiſts in enabling the ſurgeon to bring the edges of the wound together after the operation, ſo as to form a ſtraight line, and unite by the firſt intention.

The mere magnitude of a tumour frequently renders it highly judicious to take away a portion of the ſkin in the above method. If ſome were not removed, the diſſection of the tumour would be exceedingly tedious; and, after the operation, the looſe undiſtended ſkin would lie in folds, and form, as it were, a large pouch for the lodgment of matter.

The tumour being removed, the ſurgeon ſhould examine the interior of the wound, in order to aſcertain that no indurated part is left behind. If any hardneſs ſhould be felt, it is proper to remove it. The ſurgeon ſhould alſo examine the ſurface of every ſcirrhous tumour, immediately after it is taken out, for the purpoſe of knowing whether any of the white bands, ſhooting into the ſurrounding fat, have been divided; for, in this caſe, ſome portions have been left behind, and ought to be taken away. Their ſituation may eaſily be known, by conſidering the poſition of the tumour before the operation.

When the diſſection of a ſwelling will occupy a conſiderable time, it is always judicious practice to tie every large artery as ſoon as it is divided. This remark is not meant to comprehend veſſels of ſuch a diameter, that though they bleed when firſt cut, they do not emit blood afterwards, ſo as to require a ligature. It was Deſault's invariable method, in cutting out tumours, to tie every large artery before he continued the diſſection.

When a tumour of the breaſt has been entirely detached, and the hemorrhage ſuppreſſed, the ſtick confining the arm backward is to be removed. Then if there are any diſeaſed glands in the axilla, it is a very excellent plan to tie the pedicles, by which they are attached on the ſide towards the axilla, before attempting to cut the tumours completely away. It would be extremely difficult, after taking off the gland, to tie the little ſhort artery which enters the ſwelling, almoſt immediately after it has quitted one of the thoracic arteries. The bleeding alſo, in conſequence of the ſhortneſs of the veſſel, and vicinity of its orifice to the thoracic arteries, would be exceedingly profuſe, ſeeming rather to arife from a wound of the latter veffels than of a fmall branch.

The celebrated Default ufed to purfue the practice above recommended; and fir Charles Blicke has long been in the habit of obferving the fame rule, in the numerous operations which he has performed with the utmoft benefit to the afflicted, and well deferved honour to himfelf.

When the operation is finifhed, the fkin of the wound is to be relaxed, and the edges of the incifion brought together with ftrips of adhefive plafter. Proper compreffes and bandages are next to be applied. Should the operation have been the removal of a difeafed breaft, the neareft arm fhould be kept completely at reft in a fling, as whenever it moves, it occafions a difturbance of the pectoral mufcle, and, of courfe, of the wound. (Firft lines of the "Practice of Surgery," by Samuel Cooper.)

For the mode of extirpating a difeafed teftis, fee CASTRATION.

The method of effecting the extirpation of polypi is to be defcribed in the article POLYPUS.

Some obfervations are offered, under the head EXOSTOSIS, on the fubject of extirpating tumours of the bones. The way in which a difeafed eye ought to be cut out, will be hereafter explained. See EYE, *Extirpation of*.

For an account of the plan of extirpating certain excrefcences, fee EXCRESCENCE.

EXTIRPATIONE, in *Law*, a judicial writ, either before or after judgment, that lies againft a perfon, who when a verdict is found againft him for land, &c. doth malicioufly overthrow any houfe, or extirpate any trees upon it. Reg. Jud. 13. 56.

EXTISPEX, formed of *exta*, and *fpicere*, of *fpicio*, or *infpicere*, *I view*, *confider*, in *Antiquity*, an officer who viewed and examined the intrails of victims; in order to draw prefages from them as to futurity.

This kind of divination, called extifpicium, was much in vogue throughout Greece, where there were two families, the Jamidæ and Clytidæ, confecrated, or fet apart, peculiarly for it.

It appears to have been very ancient, and was probably derived from the ancients. Vitruvius, cap. 4. lib. i. gives the following plaufible account of its origin. He fays that the ancients infpected the livers of thofe animals which frequented the places where they intended to build or encamp; and if they commonly found that the liver, to which they attributed fanguification, was injured, they concluded that the waters and nourifhment collected near fuch places were not wholefome.

In Italy, the firft extifpices were the Etrurians or Tufcans; among whom, likewife, the art was in great repute. Lucan gives us a fine defcription of one of thefe operations in his firft book.

EXTORTION, in *Law*, denotes generally any oppreffion under colour of right; and it is ufually applied to fignify an illegal manner of wrefting any thing from a man, either by force, menace, or authority: *e. g.* if an officer, by terrifying another on pretence of his office, or "by colour of his office," takes more than his ordinary fees or dues, he commits, and is indictable for, extortion.

So the exacting of unlawful ufury, winning by unlawful game, and, in fine, all taking of more than is juftly due, by colour or pretence of right, as exceffive tolls in millers, exceffive prices of ale, bread, victuals, wares, &c. come under extortion.

Crompton fays, that wrong done by any man is properly a trefpafs, but exceffive wrong is extortion; which is moft properly applicable to fheriffs, mayors, bailiffs, and other officers, who, by colour of their office, greatly opprefs and wrong the king's fubjects, by taking exceffive reward, or fees, for executing their office: and extortion has been deemed more odious than robbery, becaufe it carries an appearance of truth; and is often accompanied with perjury in officers, &c. by violating their oaths of office. The diftinction between bribery and extortion feems to be this: the former offence confifts in the *offering* a prefent, or receiving one if offered; the latter, in *demanding* a fee, or prefent, by colour of office. Extortion by the common law is feverely punifhed, on indictment, by fine and imprifonment, and removal of officers from the offices in which the crime was committed. By the ftat. 3 Edw. I. inferior officers of juftice, &c. guilty of extortion, are to render by c. 26. double, and by c. 30. treble, value; and there are divers other ftatutes for punifhing extortions of fheriffs, bailiffs, gaolers, clerks of the affife, and of the peace, attornies and folicitors, &c. ftats. 23 H. VI. c. 7 & 9. 33 H. VIII. c. 24. 29 Eliz. c. 4. 1 Jac. I. c. 10. 9 & 10 W. III. c. 41. 10 & 11 W. III. c. 23. 3 Geo. I. c. 15. 17 Geo. III. c. 26. § 6. In cafes of extortion, there muft be a pofitive charge, that the charged perfon did it *extorfivé*, or *colore officii*. The place where it was committed muft be fet down in the declaration; the fum extorted particularly fpecified, and the indictment or information muft ftate the full particulars by fpecifying the time, &c. Againft attornies for extortion, action may be brought, and the party aggrieved fhall have treble damages and cofts; but information will not lie on the ftat. 3 Jac. I. c. 7. Sid. 434. 4 Nelf. 822.

EXTRA-*Conftellary Stars*. See SPORADES.

EXTRA-*judicial*, fomething done out of the proper court, or the ordinary courfe of law. As when judgment is given in a caufe, or cafe, not depending in that court where fuch judgment is given, or wherein the judge has no jurifdiction.

EXTRA-*mundane fpace*, is the infinite empty void fpace, which is by fome fuppofed to be extended beyond the bounds of the univerfe, and confequently in which there is really nothing at all.

EXTRA-*parochial*, a place out of the bounds of any parifh; or privileged and freed from the duties of a parifh.

EXTRACT, in *Chemiftry*. The term extract, as ufed in chemical nomenclature, has been borrowed from the pharmaceutical difpenfatories, where it has long been applied to a great variety of fubftances which have little other agreement than in the mode of preparation, which confifts in extracting by water, or any other menftruum, the foluble part of certain parts of vegetables, and infpiffating this folution by heat to a thick confiftence, or fometimes to entire folidity.

The term extract, therefore, in its original and pharmaceutical fenfe, only refers to the mode of preparation, and not to the nature of the fubftance prepared; and hence much confufion and uncertainty have prevailed in the attempts of chemifts to define the nature of the fubftance to which this term fhould in ftrictnefs be limited.

All the pharmaceutical extracts are extremely compounded, for being prepared either by water or alcohol, of courfe every thing foluble in thefe liquids would be confounded in the general mafs. Hence we find in one or other, and fometimes in a fingle extract, mucilage, fugar, tannin, gallic acid, refin, gluten, feveral neutral falts, and other ingredients. But along with thefe there always is found a confiderable quantity of a brown tenacious fubftance, often with a bitter tafte, and poffeffing a number of chemical properties, which entitle it to be confidered as a peculiar fubftance, ſtance, and to which the term extract, or extractive principle, has been given.

The diſtinguiſhing properties of this ſubſtance have been laid down with much ability by Vauquelin, in his memoir on the extractive principle (Journal de Pharmacie, p. 132.) and in his reſearches on the ſap and native juices of trees (An. Chem. tom. 31.) and alſo by Fourcroy in an elaborate and excellent analyſis of the cinchona of St. Domingo. An. Chem. tom. 8 & 9.

We ſhall firſt notice the experiments of Vauquelin, which being made on the native juices of plants, the extract already in ſolution, and unaltered by the heat requiſite in artificial decoction, is probably in a purer ſtate.

When the ſap of any tree is firſt drawn it is always colourleſs, or nearly ſo, but when inſpiſſated by heat, however moderate, it always aſſumes a brown colour, and in the proceſs of evaporation a certain though ſmall quantity of pulverulent brown inſoluble matter falls down. If this is collected ſeparately before the juice is entirely inſpiſſated, and treated with muriatic acid, one portion diſſolves with effervеſcence, and is found to be chiefly carbonat of lime, and an inſoluble part remains, which is conſidered by this excellent chemiſt as extract altered and oxygenated during the evaporation. If the concentrated ſap is now ſlowly evaporated to dryneſs, it yields a brown extract, ſtrongly deliqueſcent, and of a pungent ſaline taſte. This entire extract is always extremely compounded, containing in fact all the ſoluble ingredients of the original juice. Gallic acid, when preſent, is detected by a ſolution of iron; tannin, by a ſolution of iſinglaſs; ſalts of lime, by oxalic acid; ſugar, by the taſte, and by its ſoon acquiring the vinous fermentation. The entire extract alſo always contains acetous acid, partly in exceſs and partly united both to lime, potaſh, and ammonia, and hence when a few drops of ſtrong ſulphuric acid are poured upon any extract, copious vapours of pungent acetic acid are given out; and if this is done with large quantities, and in cloſe veſſels, acetic acid may be obtained pure. It is probably owing to the preſence of theſe neutral acetites, that all the inſpiſſated native juices attract moiſture ſtrongly from the air, and hence too their great diſpoſition, to mould and change by keeping.

Ammonia alſo is detected in moſt inſpiſſated juices of plants by the pungent vapours of this alkali, that are perceived on the addition of quick-lime, but in the natural ſtate the ammonia is more than neutralized by the acetous acid, as all the ſoft extracts redden betimes.

Extractive matter (meaning by this term the pure extract) appears to form a great portion of the colouring matter of vegetables. If to any liquid containing extract a ſolution of alum be added, a copious coloured inſoluble precipitate is produced, conſiſting chiefly of alumine in intimate combination with extractive matter, and the ſupernatant liquor remains clear and nearly colourleſs. The ſame proceſs takes place in dyeing, the alum being firſt fixed on the cloth as a *mordant*, as it is called. The ſolutions of tin poſſeſs this power of precipitating coloured extract as an inſoluble powder in a ſtill more ſtriking manner. That of the other metallic ſalts produce a ſimilar precipitate of extract, combined with the metallic oxyd.

The experiments of Fourcroy on the cinchona have been detailed at length under that article, to which we refer our readers. It may be obſerved in this place, that the facts relative to the ſubject of extract were, ſhortly, that the decoction of cinchona during evaporation depoſited a quantity of black matter, inſoluble in cold water, but which moſtly was diſſolved in alcohol, leaving however a portion of a red powder of a peculiar nature, which the author of the experiments conſiders as extractive matter, changed by union with oxygen, and thereby rendered inſoluble in water or alcohol. The appearance of this powder, and its inſolubility in water, might at firſt lead to the ſuppoſition that it was reſin, but its equal inſolubility in alcohol refutes this idea.

The preciſe nature of this inſoluble matter, which is depoſited on the evaporation of all vegetable infuſions or decoctions, is hitherto not known, and ſeveral objections to the opinion of its being merely *oxygenated extract* may be adduced, which we have already detailed under the article Cinchona.

On the whole, however, we may ſafely admit, that there is a peculiar ſubſtance found in almoſt all ſoluble matter of vegetables, and particularly in the common circulating juices, to which the term extract, or pure extractive principle, has been given, and which has the following diſtinguiſhing properties.

In its natural ſtate in the ſap of trees it is colourleſs, or nearly ſo; but when the ſolution is heated and inſpiſſated, it always acquires a deep colour, which is generally brown or fawn, with various ſhades, and by the ſame proceſs its ſolubility in cold water is diminiſhed.

It is in its natural ſtate equally ſoluble in alcohol as in water, by which circumſtance it is diſtinguiſhed both from pure mucilage and reſin.

It is inſoluble in ether.

It has a very ſtrong affinity with alumine, and with metallic oxyds, and when combined with ether it becomes inſoluble in water, alcohol, and many other menſtrua. By deſtructive diſtillation it is reſolvable into carbon, oxygen, and hydrogen, and a ſmall proportion of azot.

Much variety is found in the properties of ſmell, taſte, and colour, in the various extracts, and we are ſtill totally ignorant how far theſe varieties may depend on other admixtures, or whether there are different ſpecies of extract; and in general we may add that this ſubſtance appears to be one which moſt eaſily enters into intimate combination with all the other ſoluble vegetable principles, and, conſequently, can hardly by any known means be obtained pure, as it exiſts in the vegetable itſelf, and unchanged by the proceſſes of analyſis.

Extract, in *Pharmacy*. The greater number of pharmaceutical extracts are made by boiling the ſubſtance (in coarſe powder) in water, ſtraining the decoction, boiling it down till it is conſiderably concentrated, then gently drying the reſidue in a ſtove, or ſlow oven, to the requiſite conſiſtence.

A few of the extracts are made with alcohol inſtead of water, or with a mixture of the two; the ſubſtance being firſt digeſted with the alcohol, and the tincture, thus prepared, ſtrained off; the reſidue then boiled with water, and the decoction poured off, and both the decoction and tincture mixed, and evaporated ſlowly.

The purely ſpirituous extracts are alſo called reſins, and are always evaporated to dryneſs, when they remain hard brittle maſſes, with a vitreous fracture, reſoluble in alcohol, and in all eſſential characters reſembling the natural reſins.

In preparing the extracts by water the decoctions are uſually directed to be ſet aſide for ſome hours, that any ſediment may be depoſited, which laſt is to be rejected. But this is obviouſly a bad practice, as in many caſes much of the medicinal property of the plant reſides in this reſidue which ſubſides from the hot decoction on cooling.

Another ſpecies of extracts is the inſpiſſated juices of plants. Several powerfully medicinal plants, ſuch as the hemlock, are ſucculent vegetables, which, when ſtrongly

expreſſed,

expreſſed, yield a large quantity of a green turbid juice, which (after ſeparating the mere fragments of the plant) only requires to be inſpiſſated by a very gentle heat, to form the extract in the form in which it is uſed.

All the extracts, except thoſe made by alcohol, are liable to ſpoil by keeping. This is particularly the caſe with the inſpiſſated juice of the ſucculent plants, being compoſed of materials all extremely liable to fermentation, and being kept in a conſtant tendency to deliqueſcence by the neutral acetites which they contain. Therefore they muſt be kept in cloſe veſſels, but with every care the moſt important of them loſe their medicinal quality in no great length of time.

Extract, in *Matters of Literature*, denotes a ſhort abridgment of a book or paper, or of ſome of the matters thereof. The journals, nouvelles, bibliotheques, memoires, and other monthly reviews, or quarterly accounts of the affairs of learning, conſiſt principally of extracts of the moſt material paſſages, doctrines, &c. found in the ſeveral books publiſhed in that time.

Extract *ab Eccleſia*. See Restitutione *Extracti*.

EXTRACTA Curiæ, in our *Old Writers*, the iſſues or profits of holding a court, ariſing from the cuſtomary fees, &c.

EXTRACTION, in *Pharmacy* and *Chemiſtry*, an operation, whereby eſſences, tinctures, &c. are drawn from natural bodies. See Extract.

Extraction, in *Surgery*, is the drawing from, or out of the body, any thing fixed in it, as a thorn, or bullet, in the fleſh, a tooth from the jaw, &c. Surgeons ſpeak alſo of the extraction of a ſtone from the bladder, a cataract from the eye, foreign bodies from the œſophagus, extraneous ſubſtances from wounds, &c. For a deſcription of the methods of extracting a ſtone from the bladder, ſee Lithotomy.

The operation of extracting the cataract is explained in the article Cataract.

Extraction, or *Deſcent*, in *Genealogy*, denotes the ſtock, or family, which a perſon is deſcended from.

In ſome military orders, chapters, &c. a candidate muſt make proof of the nobility of his extraction before he is admitted.

Extraction *of Roots*, the method of finding the roots of given numbers, or quantities. See Root.

The ſquare, cube, and other powers of a number, or root, are formed by multiplying the given number into itſelf a greater or leſs number of times, as the power required is higher or lower. See Power.

This multiplication compounds the powers; and the extraction of the roots decompounds them again, or reduces them to their principles or roots. So that the extraction of the root is to the multiplication of the power, what the analyſis is to the ſyntheſis.

Thus, 4, multiplied by 4, produces 16; which is the ſquare of 4, or the factum of 4, by itſelf; and 16 multiplied by 4, makes 64, which is the cube of 4, or the factum of 4 by its ſquare. Such is the compoſition of powers.

Again, the ſquare root of 16 is 4, becauſe 4 is the quotient of 16 divided by 4; and the cube root of 64 is likewiſe 4, as 4 is the quotient of 64 divided by the ſquare of 4. Such is the extraction of roots.

Hence to extract the root out of a given power, is the ſame thing as to find a number, *e.gr.* 4, which being multiplied a certain number of times into itſelf, produces the given power, *e.gr.* 16 or 64.

For the extraction of ſquare and cube roots, it is neceſſary to have the ſquares and cubes of all the digits in readineſs; as exhibited in the following table.

Roots	1	2	3	4	5	6	7	8	9
Square	1	4	9	16	25	36	49	64	81
Cube	1	8	27	64	125	216	343	512	729

To extract the ſquare root out of a given number.—1. Divide the given number into claſſes, of two figures a-piece; and include each claſs between two dots, commencing with the place of units, and proceeding to the left in integers, and to the right in decimals; the root will conſiſt of ſo many parts or figures as you have claſſes. By the way obſerve, it may happen, that for the laſt claſs on the left hand there ſhall be only one figure left.

2. Then the left-hand claſs being the ſquare of the firſt figure of the root ſought, look in the table of roots for the ſquare root anſwering to that number; or, if that ſquare number be not preciſely there, to the next leſſer number: this root write down for the firſt figure of the quotient; and ſubtract its ſquare from the left-hand claſs. To the remainder bring down the next claſs toward the right.

3. Write down the double of the quotient figure under the left-hand figure of the ſecond claſs; and ſeek how oft this duple is contained in the figure over it: the quotient gives the ſecond figure of the root.

4. Write the ſame quotient under the right-hand figure of the ſame claſs, and ſubtract the product of the whole number underwritten, multiplied by the ſecond figure of the root, from the number over it, as in diviſion.

5. The operation being repeated according to the third and fourth ſteps, *i. e.* the remainder being ſtill divided by the double of the root as far as extracted; and from the remainder ſubtract the product of the laſt diviſor, having the laſt found figure of the quotient added to it, multiplied by this figure, you will have the root required.

E. gr. To extract the root of 99856, point it after the following manner, 99856: then ſeek a number, whoſe ſquare ſhall equal the firſt figure 9, *viz.* 3, and write it in the quotient; then having ſubtracted from 9, 3 × 3, or 9, there will remain 0; to which ſet down the figures as far as the next point, *viz.* 98, for the following operation. Then, taking no notice of the laſt figure 8, ſay, How many times is the double of 3, or 6, contained in the firſt figure 9? Anſwer, 1. Wherefore, having written 1 in the quotient, ſubtract the product, of 1 × 61, or 61 from 98, and there will remain 37, to which connect the laſt figures 56, and you will have the number 3756, in which the work is next to be carried on. Wherefore, alſo neglecting the laſt figure of this, *viz.* 6, ſay, How many times is the double of 31, or 62, contained in 375 (which may be gueſſed at from the initial figure 6 and 37, by taking notice how many times 6 is contained in 37)? Anſwer 6; and writing 6 in the quotient, ſubtract 6 × 626, or 3756, and there will remain 0; whence it appears, that the buſineſs is done, the root coming out 316.

```
 .  .  .
99856 ( 316
9
-----
098
 61
-----
3756
3756
-----
   0
```

Otherwiſe,

Otherwiſe, with the diviſors ſet down, it will ſtand thus :

```
    . . .
    99856 (316
    9
6)  98
    61
62)  3756
     3756
        0
```

And ſo in others.

Again, if you were to extract the ſquare root out of 22178791 :

```
22178791 ( 4709, 43637, &c.
16
 617
 609
  88791
  84681
   411000
   376736
    3426400
    2825649
     60075100
     56513196
      356190400
      282566169
       73624231
```

Firſt having pointed it, ſeek a number, whoſe ſquare (if it cannot be exactly equalled) ſhall be the next leſs ſquare (or neareſt) to 22, the figures to the firſt point, and you will find it to be 4. For 5×5, or 25, is greater than 22 ; and 4×4, or 16, is leſs ; wherefore 4 will be the firſt figure of the root. This, therefore, being writ in the quotient, from 22 take the ſquare 4×4, or 16 ; and to the remainder 6, adjoin the next figures 17, and you will have 617 ; from whoſe diviſion, by the double of 4, you are to obtain the ſecond figure of the root, *viz.* neglecting the laſt figure 7, ſay, how many times is 8 contained in 61 ? Anſwer, 7 ; wherefore write 7 in the quotient, and from 617 take the product of 7 into 87, or 609, and there will remain 8, to which join the two next figures 87, and you will have 887 ; by the diviſion whereof by the double of 47, or 94, you are to obtain the third figure ; in order to which ſay, how many times is 94 contained in 88 ? Anſwer, 0 ; wherefore write 0 in the quotient, and adjoin the two laſt figures 91, and you will have 88791, by whoſe diviſion by the double of 470, or 940, you are to obtain the laſt figure ; *viz.* ſay, how many times 940 in 8879 ? Anſwer, 9 ; wherefore write 9 in the quotient, and you will have the root 4709. But ſince the product 9×9409, or 84681, ſubtracted from 88791, leaves 4110, the number 4709 is not the root of the number 22178791 preciſely, but a little leſs.

If then it be required to have the root approach nearer, carry on the operation in decimals, by adding to the remainder two cyphers in each operation. Thus, the remainder 4110, having two cyphers added to it, becomes 411000 ; the diviſion whereof, by the double of 4709, or 9418, will give the firſt decimal figure 4. Then having writ 4 in the quotient, ſubtract 4×94184, or 376736, from 411000, and there will remain 34264. And ſo having added two more cyphers, the work may be carried on at pleaſure, the root at length coming out 4709, 43637, &c.

But when the root is carried on half way or above, the reſt of the figures may be obtained by diviſion alone : as in this example, if you have a mind to extract the root to nine figures, after the five former 4709,4 are extracted, the four latter may be had, by dividing the remainder by the double of 4709,4.

Thus if the root of 32976 were to be extracted to five places, in numbers ; after the figures are pointed, write 1 in the quotient, as being the figure of whoſe ſquare 1×1, or 1, is the greateſt that is contained in 3, the figure to the firſt point ; and having taken the ſquare of 1 from 3, there will remain 2 ; then having ſet the two next figures, *viz.* 29, to it (*viz.* to 2,) ſeek how many times the double of 1, *viz.* 2, is contained in 22, and you will find indeed that it is contained more than ten times ; but you are never to take your diviſor 10 times, nor even 9 times in this caſe ; becauſe the product of 9×29, or 261, is greater than 229, from which it would be to be taken, or ſubtracted ; wherefore write only 8. And then having written 8 in the quotient, and ſubtracted 8×28, or 224, there will remain 5 ; and having ſet down to this the figures 76, ſeek how many times the double of 18, or 36, is contained in 57, and you will find one, and ſo write 1 in the quotient ; and having ſubtracted 1×361, or 361, from 576, there will remain 215. Laſtly, to obtain the remaining figures, divide this number 215, by the double of 181, *viz.* 362, and you will have the figures, 59 which, being writ in the quotient, give the root 181,59.

```
      . . .
      32976 (  181,59
      1
    2)229
      224
36)   576
      361
362)  215(59, &c.
```

After the ſame manner are roots extracted out of decimal numbers. Thus the root of 329,76 is 18,159 ; and the root of 3,2976 is 1,8159, and the root of 0,032976, is 0,18159, and ſo on. But the root of 3297,6 is 57,4247 ; and the root of 32,976 is 5,74247. And thus the root of 9,9856 is 3,16.

To extract the other, or higher root, out of a given number.—The extraction of the cubic root, and all other roots, may be comprehended under one general rule ; *viz.* every third figure, beginning from unity, is firſt to be pointed, if the root to be extracted be a cubic one ; or every fifth, if it be a quadrato-cubic (or of the fifth power ;) and then ſuch a figure is to be writ in the quotient, whoſe greateſt power (that is, whoſe cube, if it be a cubic power, or whoſe quadrato-cube, if it be the fifth power, &c.) ſhall either be equal to the figure, or figures, before the firſt point, or next leſs under them ; and then having ſubtracted that power, the next figure will be found by dividing the remainder augmented by the next figure of the reſolvend, by the next leaſt power of the quotient multiplied by the index of the power to be extracted, that is, by the triple ſquare, if the root be a cubic one ; or by the quintuple biquadrate, (that is, five times the biquadrate,) if the root be of the fifth power, &c. And having again ſubtracted the power of the whole quotient from the firſt reſolvend, the third figure will be found by dividing that remainder, augmented by the next figure of the reſolvend, by the next leſſer power of the whole quotient, multiplied by the index of the power to be extracted.

Thus, to extract the cube root of 13312053, the number is firſt to be pointed after this manner, *viz.* 13312053 then you are to write the figure 2, whoſe cube is 8, in the firſt place of the quotient, as that which is the next leſſer leffer cube to the figure 13, (which is not a perfect cube number) or as far as the firft point; and having fubtracted that cube, there will remain 5; which being augmented by the next figure of the refolvend 3, and divided by the triple fquare of the quotient 2, by feeking how many times 3×4, or 12, is contained in 53, gives 4, or the fecond figure of the quotient. But fince the

$$\begin{array}{rl} & 13312053\ (237 \\ \text{Sub. the cube} & 8 \\ \hline 12)\ \text{rem.} : & 53\ 4 \text{ or } 3 \\ \hline \text{Subtract cube} & 12167 \\ 1587)\ \text{rem.} : & 11450\ (\ 7 \\ \hline & 13312053 \\ \text{Remains} & 0 \\ \hline \end{array}$$

cube of the quotient 24, *viz.* 13824, would come out too great to be fubtracted from the figures 13312, that precede the fecond point, there muft only 3 be writ in the quotient; then the quotient 23 being in a feparate place multiplied by 23, gives the fquare 529, which again multiplied by 23, gives the cube 12167; and this taken from 13312, will leave 1145, which augmented by the next figure of the refolvend 0, and divided by the triple fquare of the quotient 23, *viz.* by feeking how many times 3×529, or 1587, is contained in 11450, gives 7, for the third figure of the quotient. Then the quotient 237, multiplied by 237, gives the fquare 56169, which again multiplied by 237, gives the cube 13312053; and this taken from the refolvend, leaves 0. Whence it is evident, that the root fought is 237.

So alfo, to extract the quadrato-cubical root of 36430820, it muft be pointed over every fifth figure; and the figure 3, whofe quadrato-cube, or fifth power 243, is the next leffer to 364, *viz.* to the firft point, muft be writ in the quotient. Then the quadrato-cube 243 being fubtracted from 364, there remains 121, which augmented by the next figure of the refolvend, *viz.* 3, and divided by five times the biquadrate of the quotient, *viz.* by feeking how many times 5×81, or 405, is contained in 1213, gives two for the fecond figure. That quotient 32 being thrice multiplied by itfelf, makes the bi-

$$\begin{array}{rl} & 36430820(32{,}5, \\ \hline & 243 \\ 405) & 1213(2 \\ \hline & 33554432 \\ 5242880) & 2876388{,}0(5 \end{array}$$

quadrate 1048576; and this again, multiplied by 32, makes the quadrato-cube 33554432, which, being fubtracted from the refolvend, leaves 2876388. Therefore 32 is the integral part of the root but not the true root; wherefore, if you have a mind to profecute the work in decimals, the remainder, augmented by a cypher, muft be divided by five times the aforefaid biquadrate of the quotient, by feeking how many times 5×1048576, or 5242880, is contained in 2876388,0, and there will come out the third figure, or the firft decimal 5. And fo by fubtracting the quadrato-cube of the quotient 32,5, from the refolvend, and dividing the remainder by five times its biquadrate, the fourth figure may be obtained. And fo on *in infinitum.*

In fome cafes it is convenient only to indicate the extraction of a root, efpecially where it cannot be had exactly. Now, the fign or character whereby roots are denoted, is $\surd$; to which is added, the exponent of the power, if it be above a fquare, and even fometimes if it be not. *E. gr.* $\sqrt[2]{}$ denotes the fquare root; $\sqrt[3]{}$ the cube root, &c. See ROOT.

When a biquadratic root is to be extracted, you may extract twice the fquare root, becaufe $\sqrt[4]{}$ is as much as $\surd \times \surd$. And when the cubo-cubic root is to be extracted, you may firft extract the cube root, and then the fquare root of that cube root, becaufe the $\sqrt[6]{}$ is the fame as $\sqrt[2]{} \times \sqrt[3]{}$; whence fome have called thefe roots, not cubo-cubic ones but quadrato-cubes. And the fame is to be obferved in other roots, whofe indices are not prime numbers.

To prove the extraction of roots.—1. For a *fquare root;* multiply the root found by itfelf, and to the product add the remainder, if there were any: if the fum be equal to the number given, the operation is juft.

2. For a *cube root.* Multiply the root found by itfelf, and the product, again, by the fame root. To the laft product, add the remainder, if there were any. If the fum come out the number firft given, the work is juft.

After the like manner may the extraction of the other roots be proved.

To extract the roots of equations, or algebraic quantities.—The extraction of roots out of fimple algebraic quantities, is evident, even from the nature, or marks of notation itfelf; as that $\sqrt{aa}$ is a, and that $\sqrt{aacc}$ is ac, and that $\sqrt{9aacc}$ is 3ac; and that $\sqrt{49a^4xx}$ is 7aax. And alfo that $\sqrt{\frac{a^4}{cc}}$, or $\frac{\sqrt{a^4}}{\sqrt{cc}}$ is $\frac{aa}{c}$, and that $\sqrt{\frac{a^4bb}{cc}}$ is $\frac{aab}{c}$, and that $\sqrt{\frac{9aazz}{25bb}}$ is $\frac{3az}{5b}$, and that $\sqrt{\frac{4}{9}}$ is $\frac{2}{3}$, and that $\sqrt[3]{\frac{8b^6}{27a^3}}$ is $\frac{2bb}{3a}$, and that $\sqrt[4]{aabb}$ is $\sqrt{ab}$; moreover, that $b\sqrt{aacc}$, or b into $\sqrt{aacc}$, is equivalent to b into ac, or abc: and that $3c\sqrt{\frac{9aazz}{25bb}}$ is equivalent to $3c \times \frac{3az}{5b}$, or $\frac{9acz}{5b}$. And that $\frac{a+3x}{c}\sqrt{\frac{4bbx^4}{81aa}}$. is equivalent to $\frac{a+3x}{c} \times \frac{2bxx}{9a}$, or to $\frac{2abxx+6bx^3}{9ac}$. I fay all thefe are evident, becaufe it will appear at firft fight, that the propofed quantities are produced, by multiplying the roots into themfelves (as aa from a into a; aacc from ac into ac; 9aacc from 3ac into 3ac, &c.) The rule is to extract the required root of the numeral coefficient, if there be any, and to divide the exponents of the literal or algebraic quantities by the number that denominates the root required. It is evident from the application of this rule, that any power which has a pofitive fign may have either a pofitive or negative root, if the root is denominated by an even number, becaufe + or −, multiplied into themfelves an even number of times will give +. Alfo, that if a power have a negative fign, no root of it denominated by an even number can be affigned. But if the root to be extracted is denominated by an odd number, the fign of the root will be the fame as the fign of the given quantity whofe root is required. However, it will often happen, that the number, denominating the required root, will not exactly divide the exponent of the given power, in which cafe the required root will have a fractional exponent, thus, $\sqrt[3]{8a}$ is $= 2a^{\frac{1}{3}}$. But when quantities confift of feveral terms, the bufinefs is performed as in numbers.

Thus, to extract the fquare root out of aa + 2ab + bb; in the firft place, write the root of the firft term aa, *viz.* a, in the quotient, and having fubtracted its fquare $a \times a$, there will remain 2ab + bb to find the remainder of the root by. Say, therefore, how many times is the double of the quotient, or 2a, contained in the firft term of the remainder 2ab? I anfwer, b [times]: therefore write b in the quotient, and having fubtracted the product of b into 2a + b, or 2ab + bb,

$$\begin{array}{l} aa + 2ab + bb\ (a + b \\ aa \\ \hline 0 + 2ab + bb \\ \quad + 2ab + bb \\ \hline \quad 0 \qquad 0 \end{array}$$

there

there will remain nothing; which ſhews that the work is finiſhed, the root coming out a + b.

And thus to extract the ſquare root out of $a^4 + 6a^3b + 5aabb - 12ab^3 + 4b^4$, firſt ſet in the quotient the root of the firſt term a^4, *viz.* aa, and having ſubtracted its ſquare aa × aa, or a^4, there will remain $6a^3b + 5aabb - 12ab^3 + 4b^4$ to find the remainder of the root. Say, therefore, how many times is 2aa contained in $6a^3b$? Anſwer, 3ab; wherefore write 3ab in the quotient; and having ſubtracted the product of 3ab, into 2aa + 3ab, or $6a^3b + 9aabb$, there will yet remain $-4aabb - 12ab^3 + 4b^4$, to carry on the work. Therefore, ſay again, how many times is the double of the quotient, *viz.* 2aa + 6ab, contained in $-4aabb - 12ab^3$? or, which is the ſame thing, ſay, how many times is the double of the firſt term of the quotient, or 2aa, contained in the firſt term of the remainder $-4aabb$? Anſwer, $-2bb$. Therefore having writ $-2bb$ in the quotient, and ſubtracted the product $-2bb$ into $2aa + 6ab - 2bb$, or $-4aabb - 12ab^3 + 4b^4$, there will remain nothing.

Whence it follows, that the root is $aa + 3ab - 2bb$.

$$\begin{array}{l}
a^4 + 6a^3b + 5aabb - 12ab^3 + 4b^4\ (aa + 3ab - 2bb \\
a^4 \\
\overline{\quad} 6a^3b + 5aabb - 12ab^3 + 4b^4 \\
o + 6a^3b + 9aabb \\
\hline
\quad o - 4aabb - 12ab^3 + 4b^4 \\
\quad\ \ - 4aabb - 12ab^3 + 4b^4 \\
\hline
\quad\ o \quad o \quad o
\end{array}$$

And thus the ſquare root of the quantity $xx - ax + \frac{1}{4}aa$ is $x - \frac{1}{2}a$, and the ſquare root of the quantity $16a^4 - 24aaxx + 9x^4 + 12bbxx - 16aabb + 4b^4$ is $3xx - 4aa + 2bb$, and the ſquare root of the quantity $y^4 + 4y^3 + 8y^2 + 8y + 4$ is $yy + 2y + 2$; as may appear underneath.

1.
$$\begin{array}{l}
xx - ax + \frac{1}{4}aa\ (x - \frac{1}{2}a \\
xx \\
\hline
o - ax + \frac{1}{4}aa \\
\hline
\quad o \quad o
\end{array}$$

2.
$$\begin{array}{l}
9x^4 \begin{array}{l} \quad\qquad\qquad + 16a^4 \\ - 24aa \\ + 12bb \end{array} x^2 \begin{array}{l} \\ - 16aabb \\ + 4b^4 \end{array} \left(3x^2 \begin{array}{l} - 4aa \\ + 2bb \end{array} \right. \\
9x^4 \\
\hline
o \qquad\quad + 16a^4 \\
\begin{array}{l} - 24aa \\ + 12bb \end{array} x^2 \begin{array}{l} - 16a^2b^2 \\ + 4b^4 \end{array} \\
\hline
\quad o \quad o
\end{array}$$

3
$$\begin{array}{l}
y^4 + 4y^3 + 8y^2 + 8y + 4\ (yy + 2y + 2 \\
y^4 \\
\hline
o \\
4y^3 + 8yy \\
\hline
\quad o + 4yy + 8y + 4 \\
\quad\ \ + 4yy + 8y + 4 \\
\hline
\quad o \quad o \quad o
\end{array}$$

If you would extract the cube root out of $a^3 + 3aab + 3bb + b^3$, the operation is performed thus:

$$\begin{array}{l}
a^3 + 3aab + 3abb + b^3\ (a + b \\
a^3 \\
\overline{\quad} \\
3aa)\ o + 3aab\ (b \\
\hline
\quad a^3 + 3aab + 3abb + b^3 \\
\hline
\qquad o \quad o \quad o
\end{array}$$

Extract firſt the cube root of the firſt term a^3, *viz.* a, and ſet it down in the quotient; then ſubtracting its cube a^3; ſay, how many times is its treble ſquare, or 3aa, contained in the next term of the remainder 3aab; and there comes out b; wherefore write b in the quotient, and ſubtracting the cube of the quotient a + b, there will remain o; therefore a + b is the root. After the ſame manner, if the cube root is to be extracted out of $z^6 + 6z^5 - 40z^3 + 96z - 64$, it will come out $zz + 2z - 4$. And ſo likewiſe in higher roots.

The general rule for extracting any root out of any given quantity, is as follows. Having ranged the quantity according to the dimenſions of its letters, extract the ſaid root out of the firſt term, and that ſhall be the firſt member of the root required; then raiſe this root to a dimenſion lower by unit than the number that denominates the root required; and multiply the power that ariſes by that number itſelf; divide the ſecond term of the given quantity by the product, and the quotient ſhall give the ſecond member of the root required. The other members of the root, if there be more than two, are found after the ſame manner. In ſome caſes the exact root cannot be found in finite terms: thus, the ſquare root of $a^2 + x^2$ is found to be $a + \frac{x^2}{2a} - \frac{x^4}{8a^3} + \frac{x^6}{16a^5} - \frac{5x^8}{128a^7}$, &c.

The operation is thus:

$$\begin{array}{l}
\qquad\qquad a^2 + x^2\ (a + \frac{x^2}{2a} - \frac{x^4}{8a^3} + \frac{x^6}{16a^5}, \&c. \\
\qquad\qquad a^2 \overline{\qquad\quad} \\
2a + \frac{x^2}{2a}) * + x^2 \\
\quad \times \frac{x^2}{2a}) \ = x^2 + \frac{x^4}{4a^2} \\
\hline
2a + \frac{x^2}{a} - \frac{x^4}{8a^3}) \ - \frac{x^4}{4a^2} \\
\quad \times - \frac{x^4}{8a^3}) = - \frac{x^4}{4a^2} - \frac{x^6}{8a^4} + \frac{x^8}{64a^6} \\
\hline
\qquad\qquad + \frac{x^6}{8a^4} - \frac{x^8}{64a^6}, \&c.
\end{array}$$

In the ſame manner the cube root of $a^3 + x^3$ will be found to be $a + \frac{x^3}{3a^2} - \frac{x^6}{9a^5} + \frac{5x^9}{81a^7} - \frac{10x^{12}}{243a^{11}}$, &c. Thus,

$$\begin{array}{l}
\quad a^3 + x^3 \left(a + \frac{x^3}{3a^2} \right. \\
\quad a^3 \\
3a^2)\ * x^3.
\end{array}$$

Then cube $a + \frac{x^3}{3a^2}$, and we ſhall have $a^3 + x^3 + \frac{x^6}{3a^3} + \frac{x^9}{27a^3}$, which ſubtracted from the given quantity $a^3 + x^3$, leaves $- \frac{x^6}{3a^3} - \frac{x^9}{27a}$ for the next reſolvend; and this

this divided by $3a^2$ will give $-\frac{x^6}{9a^5}$ for the next term of the quotient, &c. But the roots of quantities of this kind are much more expeditioufly obtained by means of the binomial theorem. For the fquare root of $a^2 + x^2 = \overline{a^2 + x^2}|^{\frac{1}{2}}$; and $\overline{a^2 + x^2}|^{\frac{1}{2}} = \overline{a^2}|^{\frac{1}{2}} + \frac{1}{2} \times \overline{a^2}|^{\frac{1}{2} - 1} \times x^2 + \frac{1}{2} \times \frac{\frac{1}{2} - 1}{2} \times \overline{a^2}|^{\frac{1}{2} - 2} \times \overline{x^2}|^2 + \frac{1}{2} \times \frac{\frac{1}{2} - 1}{2} \times \frac{\frac{1}{2} - 2}{3} \times \overline{a^2}|^{\frac{1}{2} - 3} \times \overline{x^2}|^3$, &c. $= \overline{a^2}|^{\frac{1}{2}} + \frac{1}{2} \times \overline{a^2}|^{-\frac{1}{2}} x^2 + \frac{1}{2} \times -\frac{1}{4} \times \overline{a^2}|^{-\frac{3}{2}} x^4 + \frac{1}{2} \times -\frac{1}{4} \times -\frac{1}{2} \times \overline{a^2}|^{-\frac{5}{2}} x^6$, &c. $= a + \frac{1}{2} \times a^{-1} x^2 - \frac{1}{8} \times a^{-3} x^4 + \frac{1}{16} \times a^{-5} x^6$, &c. = (bringing the powers of a from the numerators to the denominators, by changing the figns of their exponents) $a + \frac{x^2}{2a} - \frac{x^4}{8a^3} + \frac{x^6}{16a^5}$, &c.

Thus alfo the cube root of $a^3 + x^3 = \overline{a^3 + x^3}|^{\frac{1}{3}}$; and $\overline{a^3 + x^3}|^{\frac{1}{3}} = \overline{a^3}|^{\frac{1}{3}} + \frac{1}{3} \times \overline{a^3}|^{\frac{1}{3} - 1} \times x^3 + \frac{1}{3} \times \frac{\frac{1}{3} - 1}{2} \times \overline{a^3}|^{\frac{1}{3} - 2} \times \overline{x^3}|^2 + \frac{1}{3} \times \frac{\frac{1}{3} - 1}{2} \times \frac{\frac{1}{3} - 2}{3} \times \overline{a^3}|^{\frac{1}{3} - 3} \times \overline{x^3}|^3$, &c. $= \overline{a^3}|^{\frac{1}{3}} + \frac{1}{3} \times \overline{a^3}|^{-\frac{2}{3}} x^3 + \frac{1}{3} \times -\frac{1}{3} \times \overline{a^3}|^{-\frac{5}{3}} x^6 + \frac{1}{3} \times -\frac{1}{3} \times -\frac{5}{9} \times \overline{a^3}|^{-\frac{8}{3}} x^8$, &c. $= a + \frac{1}{3} \times a^{-2} x^3 - \frac{1}{9} \times a^5 \times x^6 + \frac{5}{81} a^{-8} x^9$, &c. $= a + \frac{x^3}{3a^2} - \frac{x^6}{9a^5} + \frac{5x^9}{81a^8}$, &c. See Maclaurin's Algebra, part i. ch. viii. p. 50, 51. See ROOT.

EXTRACTOR, in *Midwifery*, an inftrument contrived to extract children in cafes of difficult births. We have the defcription of a forceps for extracting children by the head when lodged low in the pelvis of the mother, in the Medic. Eff. Edinb. vol. iii. art. 20. See alfo the abridgment of this book, vol. ii. p. 438, where fome alteration is mentioned of this inftrument from Giffard's Midwifery, and an improvement of it by Mr. Freke. See FORCEPS.

EXTRACTUM CATHARTICUM, a form of medicine in the London Difpenfatory, intended as an equivalent for the *extractum Rudii*, commonly called Rudius's pill, and which is for many reafons a better compofition than that pill. It is now called "extractum colocynthidis compofitum." See COLOCYNTHIS.

EXTRADOS, the outfide of a vault.

EXTRANEOUS FOSSILS, in *Geology*. Adventitious, fecondary, or figured foffils, have among them (fee FOSSILS, *Extraneous*) thofe remains and exuvia of organized beings, which are found imbedded in the ftrata of the earth. Since the difcovery of Mr. William Smith, that each particular fhell, and other organic remain, has its proper and appropriate place in the lamina of fome particular ftratum, and of which it is often a perfect, and, perhaps, the moft unerring teft of identity, in moft inftances, the knowledge and exact difcrimination of thefe numerous animal and vegetable remains has appeared a matter of the firft importance to geologifts, efpecially fince it has been further afcertained, as it now is, that moft, if not every one, of the organic remains, differ effentially from any recent fpecies of the animals and plants, to which former, and too curfory, obfervations had referred them; while many of them differ altogether and entirely from any thing now living or growing: which two points afcertained, have tended irrefiftibly to fhew that thefe organic remains were not entombed by the Mofaic deluge, as moft writers had fuppofed, becaufe they differ entirely from the antediluvian race, of which the prefent living ones are the defcendants and exact reprefentatives, as the Mofaic account informs us, and are not of fubfequent creation. Another refult of the former of thefe facts has been to fhew, that the feveral animals and plants whofe foffil remains we meet with in the ftrata, lived and died on the ftratum in which we find them, prior to the depofition, and, perhaps, prior alfo to the creation of the matter of the lamina which covers them; and that the period of the exiftence of particular fpecies was in moft, if not every inftance, limited to that took up in the depofition of the particular ftratum in which they are found imbedded, feeming to fuggeft, that they were *created* at the period of the ftratification, which anfwers to the loweft lamina in which they are found, and ceafed to exift altogether at the period anfwering to the higheft lamina in which they are found; a fuppofition in no ways inconfiftent with the Mofaic account of creation, if the whole of the foffil race be different from the prefent race of organized beings, and of a period of time antecedent to the events defcribed by the facred hiftorian, except in his introductory words, "In the beginning God created the heavens and the earth." It may, poffibly, be urged, againft the idea of a temporary duration of the primitive animals and plants, and their becoming after that *extinct*, that the fame kind of organic remains are found again, after large fucceffions of depofitions with remains of different beings, in afcending the feries of ftrata, or in very diftant parts of the globe; to which it may be anfwered, that where fufficient difcrimination has been made in the fpecific differences of organic remains refembling each other, but found imbedded in a ftrata feparated by thofe of a different kind, and with different kinds of organic beings in them, it has generally, if not always, turned out, that the remains refembling each other, and hitherto fuppofed identic, are in reality not fo, but of perfectly diftinct fpecies; their *varieties*, as fome might be difpofed to call them, in conformity to the language of the naturalifts refpecting accidental deviations in fome recent fpecies, being *conftant*, and fuch as properly conftituted diftinct fpecies in the great families of the primitive creation. Refpecting organic fubftances found at very diftant places on the globe, which, on being brought together and thoroughly examined, appear to be identic; before any argument is drawn therefrom, againft the temporary exiftence and extinction of their originals in the primitive race which inhabited the waters of this globe, it fhould be diftinctly afcertained that the feries of ftrata and organic remains above and below the two places in the feries whence the fpecimens were brought are really different; or, in other words, that the identic fpecies really do belong to different parts of the feries of ftrata: for if, on the contrary, they belong to the *fame ftratum*, however its obvious mineralogical character may appear changed, it is to be expected that the organic remains will be identic, fince Mr. Smith has, on tracing the ending or actual out-crop of a ftratum for feveral hundred miles, always found the organic remains the fame; as the numerous fpecimens in his collection, marked and brought from the extreme and intermediate points of fuch examination, do teftify.

It is alfo to be taken into confideration, that the difcoveries of Mr. Farey, relative to denudated tracts on our globe, fhew the poffibility, and, perhaps, the frequent occurrence of fuch deep excavations being left in the ftrata of the earth, as to exhibit the edges, and indeed confiderable tracts of the planes of ftrata, at immenfe depths in the feries, below thofe proper to the general ftrata on the fur-

 faces

face, and having their regular baffet, or ending, on the furface, at great diftances from fuch denudated expofurcs of them. The immenfe denudation, for inftance, which has laid bare the fourth or loweft limeftone rock of Derbyfhire and Staffordfhire, and the excavation of Dove-dale and other vallies therein, appears to have expofed ftrata to view, which are from $1\frac{1}{2}$ to 2 miles in perpendicular depth beneath the red earth, or gypfeous tract, which furrounds them on all fides! (except, perhaps, a narrow ftrip on the north, along the grand ridge, or waterfhead of the ifland,) which lower expofed parts of the fourth lime rock do not, perhaps, anywhere baffet, or come regularly to the furface, within 90 or 100 miles of Dove-dale and other vallies, where the denudation has expofed them. The continents feem, from the relations of travellers, likely to furnifh numerous inftances of denudations in the mountain chains, which will be found to expofe ftrata that lie very low indeed in the general feries, and at very great diftances from the regular or continued line of ending or outcrop of thofe particular ftrata; and, without adverting to which circumftances, the exact identity of organic remains from diftant places fo circumftanced, might feem to contradict our ideas of their being peculiar to peculiar ftrata. But after all, fhould identically the fame fpecies of organic remains be found in diftant parts of the feries of terreftrial ftrata, what have we to limit the architect of "heaven and earth," from having re-created fimilar animals or plants during the countlefs periods of the primitive creation and exiftence? Analogy furely cannot be faid to do this, when the animals and plants created fince he faid "Let the waters be gathered together, and let the *dry land* appear," and which ftill continue to exift, have fo many points of refemblance to fome of the primitive and extinct ones, both in forms and habits, that they have for ages paffed as identic therewith. Mr. James Parkinfon and Mr. W. Martin, having engaged in works intended to collect information on, and more accurately to difcriminate, extraneous or organic foffil remains, which works are ftill in progrefs, and the refults of Mr. W. Smith's labours and thofe of his pupils being yet in a great meafure unpublifhed, we fhall defer what we have further to add on thefe highly interefting and curious relics to the article Reliquia, which feems, indeed, their more appropriate title. In the mean time, as the ufual names of the feveral foffil animals and plants, &c. occur, we fhall not fail to lay before our readers fuch facts and particulars as we can collect, and with propriety communicate, concerning the objects of the unpublifhed refearches of the meritorious individuals alluded to; to whofe credit it ought to be known, that extended and undifguifed communications have all along been made among the circle of their friends, and in confequence of which a fpirit of enquiry on the fubject has been excited, in various diftricts of the kingdom, from which the happieft confequences to fcience may be expected fhortly to arife.

Extraneons, *Extraneus*, Lat. belonging to nothing, forcing. This word, during the laft century, was admitted into the mufical technica, in fpeaking of an unufual and irregular change of key, which is called extraneous modulation, or modulating into an unrelative key, as in the key of C natural, D with a fharp 3d, D ♭, B ♮, and B ♭, which are unrelative keys, having no found in common with the chord of C natural. With refpect to extraneous modulation, Rouffeau fays that no compofers have frequent recourfe to fudden and unufual modulation, but thofe who are fteril in fancy and invention: and we fhould believe the affertion well founded, if Eman. Bach, Haydn, and Mozart, were excepted, who cannot be accufed of want of invention. It is to the clumfy imitators of thefe great mafters, who, in total want of melody, have recourfe to unexpected harmony, that Rouffeau's accufation feems to attach.

EXTRAORDINARII, in *Roman Antiquity*, a body of forces, confifting of a third part of the horfe, and a fifth part of the foot, which was feparated from the reft, to prevent any defign that might be formed againft the natural forces. See Ablecti.

EXTRAORDINARY, fomething out of the common courfe.

Extraordinary *couriers*, are thofe fent exprefs on fome urgent occafion.

Extraordinary *embaffador*, or *envoy*, is fuch a one as is fent to treat or negociate fome fpecial and important affair, as a marriage, a treaty, confederacy, &c. or even on occafion of fome ceremony, as condolence, congratulation, &c. See Embassador.

A gazette, journal, or other news-paper extraordinary, is that publifhed after fome great and notable event, containing the detail or particulars thereof, which are not found in the ordinary papers. Our news-writers generally ufe poftfcripts, or fupplements, inftead of extraordinaries.

Extraordinary *culverin*. See Culverin.

EXTRAVAGANTES, a part of the canon law, containing divers conftitutions of the popes, not included in the body of the canon-law; whence the denomination extravagantes: "quafi extra corpus juris vagantes."

The extravagantes are divided into two parts: the firft contains twenty conftitutions of John XXII. and the fecond other later conftitutions of the faid John, and his fucceffors. See Canon-*Law*, and Decretals.

EXTRAVASATION, a term in *Surgery*, derived from *extra*, *out of*, and *vafa*, *the veffels*; it fignifies an effufion of any fluid from the veffels, vifcus, or receptacle, in which fuch fluid is naturally contained, and the paffage of the fame into another fituation, which is very frequently the interftices of the cellular membrane. In the head, blood is often extravafated, under the cranium, upon the furface of the dura mater, in confequence of the rupture of one of the arteries of this membrane from external violence. The fame fluid is alfo frequently extravafated on the pia mater, and in the convolutions of the cerebrum, or, more deeply in the ventricles, and very fubftance of the brain.

In cafes of wounds of the abdomen, large quantities of blood are occafionally extravafated in the cavity of the peritonæum, or the contents of the ftomach, bowels, gall-bladder, or fome other injured vifcus, may become effufed. When the urinary bladder is wounded, or when a flough takes place in a certain part of it, from the diftenfion occafioned by a long protracted, and unrelieved retention of urine, the latter fluid may become extravafated in the abdomen. In the example of ftrictures, the urethra occafionally ulcerates between the obftruction, and the neck of the bladder, and the urine is confequently extravafated in the cellular membrane of the perinæum and fcrotum. Sometimes, when a portion of the bowels mortifies, after being returned into the belly, in cafes of hernia, the inteftinal matter efcapes from the alimentary canal, through the breach occafioned by the floughing.

In the thorax, furgeons fometimes have opportunities of feeing cafes, in which confiderable extravafations of blood arife, in confequence of ftabs and gun-fhot wounds.

In the limbs, and indeed, we might fay, in every fituation, practitioners frequently meet with extravafations of blood, in cafes of wounded arteries, aneurifms, and violent contufions

contufions and blows, which rupture veffels of important fize. Bloody fwellings, produced in the laft-mentioned manner, are technically named ecchymofes, and have already been treated of elfewhere. See Ecchymosis.

Our defign, in the prefent place, is to confider extravafations in a furgical point of view, as they occur in the head, the cheft, and the belly; taking occafion, however, to refer the reader for certain parts of the fubject to other places in this work.

Extravafation of blood in the head, from external violence.—After explaining with equal perfpicuity and elegance, how the dura mater ferves as a periofteum to the internal furface of the bones of the cranium, in the fame manner as the pericranium does to the external table, Mr. Pott notices, that by blows, falls, and other fhocks, fome of the larger of the veffels, which carry on the communication between the dura mater and the fkull, may be broken, and a quantity of blood fhed upon the furface of that membrane. This, he obferves, is one fpecies of bloody extravafation, and, indeed, the only one which can be formed between the fkull and dura mater. If the broken veffels be few, and the quantity of blood which is fhed, be fmall, the fymptoms are generally flight, and, by proper treatment, difappear: when they are large, or numerous, or the quantity of extravafated fluid confiderable, the fymptoms are generally urgent in proportion; but, continues Mr. Pott, whether they be flight, or confiderable, whether immediately alarming, or not, they are always, and uniformly, fuch as indicate preffure made on the brain and nerves, *viz.* ftupidity, drowfinefs, diminution, or lofs of fenfe, fpeech, and voluntary motion.

The fhock which the head fometimes receives by falls from on high, or by ftrokes from ponderous bodies, may likewife occafion a breach in fome of the veffels, either of the pia mater, or brain, and thus produce an extravafation of the fluid which fhould circulate through them.

Mr. Pott remarks, that an extravafation may be the only complaint caufed by the accident; or it may be joined with, or added to, a fracture of the fkull. But, this is not all; for it may be produced not only when the cranium is unhurt by the blow, but, even when no violence of any kind has been offered to, or received by the head.

Vertigo, vomiting, ftupidity, hemorrhage, lofs of fenfe and motion, either partial or total, are fet down by this celebrated furgical author as the fymptoms of an extravafation within the cranium; fometimes one or more occur in the fame fubject; fometimes all of them. Thefe fymptoms, which are all eafily accountable for from extravafation of fluid, and unnatural preffure made on the brain and nerves, are, fays Pott, frequently miftaken as indications of a difeafe, which, confidered abftractedly, can never caufe them; he means a fimple undepreffed fracture of the cranium, which may be accompanied by them, but cannot caufe them.

The fame writer repeats, that when a fluid is extravafated in any confiderable quantity within the cavity of the cranium, if any bad fymptoms are produced by it at all, they are, and muft be, fuch as indicate preffure made on the brain, and origin of the nerves, occafioning thereby either difturbance, or abolition of the offices of fenfe and motion; and this in a different degree, according to the quantity, kind, and fituation of the preffing fluid.

Mr. Pott feems to have entertained the common notion of hemorrhage from the ears and nofe being alfo fymptoms of an extravafation. However, the leaft reflection muft foon make any body perceive, that a bleeding from thofe parts is only indicative of their having fuftained a violent fhock in common with the reft of the head. Even the degree of violence is not at all denoted with any certainty by thefe circumftances; for, with refpect to the nofe, we know, that, in many perfons, the flighteft caufe will make it bleed.

When the above-mentioned fymptoms exift, Mr. Pott was of opinion, that we might pronounce, in a pofitive manner, our judgment, that the brain fuffers compreffion; but, fays he, to our very frequent mortification, we find thefe are the only circumftances which, in fuch cafe, we can depend upon; every thing elfe which relates, or belongs to them, being involved in a moft perplexing obfcurity. We not only have no certain infallible rule whereby to diftinguifh what the preffing fluid is, or where it is fituated; but we are, in many inftances, abfolutely incapable of knowing whether the fymptoms be occafioned by any fluid at all; for, a fragment of bone broken off from the internal table of the cranium, and making an equal degree of preffure, will produce exactly the fame complaints.

When a cafe, attended with the preceding fymptoms, occurred, the old furgeons ufed in general to conclude, that the brain had fuffered a concuffion, to which all the confequences were imputed.

Mr. Pott obferves, that a concuffion and an extravafation are very diftinct caufes of mifchief, though not always very diftinguifhable. M. Le Dran, and others of the modern French writers, have made a very fenfible and juft diftinction between that kind and degree of lofs of fenfe, which arifes from a mere commotion of the brain, and that which is caufed by a mere extravafation, in thofe inftances, in which the time of the attack or appearance of fuch fymptoms, is different, or diftinct. The lofs of fenfe, which immediately follows the violence, fay they, is moft probably owing to a commotion; but, that which comes on after an interval of time is paft, is moft probably caufed by extravafation.

Mr. Pott remarks, that this diftinction is certainly juft and good, as far as it will go. That degree of abolition, or diminution of fenfe, which immediately attends, or follows the blow or fall, and goes off again, without the affiftance of art, is in all probability occafioned by the fudden fhake or temporary derangement of the contents of the head; and the fame kind of fymptoms recurring again fome time after they had ceafed, or not coming on until fome time has paffed from the receipt of the violence, do moft probably proceed from the breach of a veffel within, or upon the brain. But, unluckily, we have it not very often in our power to make this exact diftinction. An extravafation is often made fo immediately, and fo largely, at the inftant of the accident, that all fenfe and motion are inftantaneoufly loft, and never again return. And it alfo fometimes happens (continues Mr. Pott), that, although an extravafation may poffibly not have been made at the moment of the accident, and the firft complaints may have been owing to commotion merely, yet a quantity of fluid having been fhed from its proper veffels very foon after the accident, and producing its proper fymptoms, before thofe caufed by the commotion have had time to go off, the fimilarity of the effects of each of thefe different caufes is fuch, as to deprive us of all power of diftinguifhing between the one and the other, or of determining, with any tolerable precifion, to which of them fuch fymptoms as remain are really owing.

Mr. Pott next obferves, that the nature and degree of the fymptoms, produced by the preffure of an extravafation, are various and different in different perfons, according to the kind, quantity, and fituation of the preffing fluid. Sometimes it is mere fluid blood; fometimes blood in a ſtate of coagulation; ſometimes it is a clear lymph; and, at others, blood and water are found mixed together; each of theſe is found either ſimple or mixed in different ſituations; that is, between the ſkull and dura mater, between the dura and pia mater, or in the natural cavities of the brain, called its ventricles, and ſometimes, in caſes of great violence, they are found at the ſame time in all theſe different parts. Sometimes, a conſiderable quantity is ſhed inſtantly at the time of the accident; and ſometimes the breach, by which the effuſion is made, is ſo circumſtanced, both as to nature and ſituation, that it is at firſt very ſmall, and increaſes by faſter or ſlower degrees. In the former (ſays Pott), the ſymptoms are generally immediate and urgent, and the extravaſation is of the bloody kind. In the latter, they are frequently ſlight at firſt, appear after ſome little interval of time, increaſe gradually, till they become urgent, or fatal, and are, in ſuch caſe, generally occaſioned by extravaſated lymph. So that although the immediate appearance of bad ſymptoms does moſt certainly imply miſchief of ſome kind or other, yet, on the other hand, no man ought to ſuppoſe his patient free from hazard, either becauſe ſuch ſymptoms do not ſhew themſelves at firſt, or becauſe they appear to be but ſlight; thoſe which come on late, or, appearing ſlight at firſt, increaſe gradually, being full as much to be dreaded as to conſequence as the more immediately alarming ones; with this material difference between them, that the one *may* be the conſequence of a mere concuſſion of the brain, and may by means of quietude and evacuation go quite off; whereas, the other being moſt frequently owing to an extravaſation of lymph, (though ſometimes of blood alſo,) within the ſubſtance of the brain, are very ſeldom removed by art. (Pott's Works, vol. i.) It appears from ſome excellent obſervations publiſhed by Mr. Abernethy on the ſubject of injuries of the head, that a fracture of the ſkull is not likely to be followed by an equal degree of extravaſation in every part, as the veſſels, connecting the dura mater to the cranium, are in moſt parts of that membrane of a ſmall ſize. If theſe are accidentally ruptured, a ſlight hemorrhage enſues, which ſoon ſtops, and only a thin ſtratum of coagulated blood is found, if the bone be removed. But, ſays Mr. Abernethy, if the fracture happens in the track of the principal artery of the dura mater; if the trunk, or even a conſiderable branch of that veſſel be torn, the hemorrhage will be profuſe, and the operation of the trephine becomes immediately neceſſary to preſerve the life of the patient.

When an interval of ſenſe occurs between the blow and the ſtupor occaſioned by the effuſed blood, the diſcrimination of the nature of the caſe is greatly facilitated by that circumſtance, as we have already related, becauſe it becomes manifeſt, that the bad ſymptoms, which now come on, are not owing to the firſt mere ſhock of the external violence on the brain. The patient was moſt probably ſtunned by the blow, at the very inſtant of its occurrence; but he gradually regained his ſenſes, in proportion as the firſt effects of the ſhock on the brain ſubſided. However, as ſome veſſel was wounded by the ſame blow, an hemorrhage continues under the cranium, on, or within, the brain, and as ſoon as a certain quantity of blood is extravaſated, its preſſure produces a recurrence of ſtupefaction.

Unfortunately, great obſcurity attends numerous caſes, in conſequence of patients having no interval of ſenſe, and remaining in a ſtate of complete ſtupefaction ever after the accident. We know not, whether the brain is labouring under concuſſion, or compreſſion, or both; and even when we do know that the bad ſymptoms ariſe from an extravaſation, we are frequently unable to ſay where the effuſed blood is ſituated. Now, ſince the operation of trepanning is not likely to afford aſſiſtance, unleſs the blood be upon the dura mater, ſo as to allow of being taken away, and ſince the operation itſelf is by no means free from danger, we ſhould be very reluctant to put it in practice, without having good foundation for believing that there will be found immediately under the perforation, which we are about to make in the bone, the extravaſated blood, which gives riſe to the urgent complaints. Practitioners are highly indebted to Mr. Abernethy for a ſuggeſtion, which promiſes to be of exceedingly great aſſiſtance in directing whether the trephine ought to be uſed, or not, on a particular part of the head. "Unleſs one of the large arteries of the dura mater be wounded, (ſays this gentleman,) the quantity of blood poured out will be inconſiderable; and the ſlight compreſſion of the brain, which this occaſions, may not be attended with any peculiar ſymptoms; or, perhaps, it may occaſion ſome ſtupor, or excite an irritation diſpoſing the ſubjacent parts to become inflamed; but both theſe effects will gradually abate, nor will any inflammation enſue, if proper means are taken to prevent it. It is indeed highly probable that in many caſes, which have done well without an operation, ſuch an extravaſation has exiſted. But, if there be ſo much blood on the dura mater as materially to derange the functions of the brain, the bone, to a certain extent, will no longer receive blood from within; and by the operation performed for its expoſure, the pericranium muſt have been ſeparated from its outſide. I believe, that a bone ſo circumſtanced will not be found to bleed; and I am certain it cannot with the ſame freedom and celerity, as it does when the dura mater remains connected with it internally."

In ſome caſes, related by Mr. Abernethy, there was not the leaſt hemorrhage, and this gentleman mentions his having twice been able, by attending to the want of hemorrhage from the outſide of the cranium, to aſcertain the extent to which the dura mater was detached within. Alſo, when ſymptoms ſeemed to require the perforation of the ſkull, Mr. Abernethy has frequently ſeen the operation contra-indicated by the hemorrhage from the bone, and rightly, as the event proved.

When the bone has been for ſome time bare, this criterion may not be ſo clear; but Mr. Abernethy ſcraped the ſurface of a portion of the ſkull, which had remained ſome time in a denuded ſtate, and he found that it bled freely enough to denote that the dura mater was adherent to the inner-table, and, conſequently, that making a perforation there could be of no ſervice. See Eſſay on Injuries of the Head, p. 32—34.

We ſhall next enumerate the ſymptoms of preſſure on the brain, and contraſt them with thoſe of concuſſion. It is to be underſtood, that the complaints produced are nearly the ſame, whether the preſſure is made by an extravaſation, or a fracture of the cranium with depreſſion.

Symptoms of Preſſure.

1. Patient at firſt ſtunned, with cold extremities.
2. Revives, and has an interval of ſenſe, in caſes of extravaſation, but not in thoſe of a depreſſed fracture.
3. The quantity of effuſed blood increaſing, he becomes drowſy and ſtupid.
4. Pulſe regular and ſlow.
5. Patient quite inſenſible.
6. Pupil dilated.
7. Stertorous reſpiration.

N.B. When the bleeding is very copious in the firſt inſtance,

ſtance, or when a violent concuſſion of the brain has alſo happened, the patient has no interval of ſenſe.

Symptoms of Concuſſion.

First ſtage.

1. Patient at firſt ſtunned.
2. Extremities cold; pulſe hardly perceptible.
3. When the violence has not exceeded a certain degree, the ſenſes return gradually.
4. The ſtomach rejects its contents; ſickneſs betrays irritability in the œſophagus and ſtomach, and cannot be expected, when the brain is labouring under much compreſſion, the great effect of which is to produce an univerſal inſenſibility, or palſy, throughout the body.
5. The pulſe is now ſlow, and intermits.

Second ſtage.

6. In proportion as the immediate effects of the ſhock of the brain ſubſide, ſymptoms of irritation and inflammation of that organ come on.
7. Symptomatic inflammatory fever begins.
8. Pupil of the eye contracted.
9. The veſſels of the eye become red and turgid.
10. Delirium.
11. Pulſe very frequent and ſmall.

We ſhall not expatiate on this ſubject; but refer to Compression, Concussion, Injuries *of the* Head, and Trepanning, for further information.

Extravaſation of blood in the thorax.—In caſes of wounds which penetrate the cavity of the cheſt, the intercoſtal arteries are liable to be injured, and if the blood cannot readily flow outward through the wound, it is apt to inſinuate itſelf between the pleura and lungs. An extravaſation of blood may alſo occur in the thorax, when ſome of the veſſels of the lungs, one of the coronary arteries of the heart, or the internal mammary artery, have been wounded. An effuſion of blood in the cheſt may likely obviouſly originate from a wound of the auricles, or ventricles of the heart, or of the thoracic aorta, and vena cava; but we need hardly obſerve, that in theſe and other inſtances, in which the bleeding would be in a moment exceſſively profuſe, the extravaſation proves inſtantly fatal. Smaller veſſels are frequently injured, and pour out a conſiderable quantity of blood in the cheſt; yet the records of ſurgery evince, that theſe accidents do not always have a fatal termination.

The ſymptoms commonly enumerated by ſurgical writers, as indicative of an extravaſation of blood in the thorax, are the following: the patient is greatly oppreſſed, and experiences a kind of uneaſineſs which will not let him remain for any length of time in the ſame poſture. He feels conſiderable difficulty in ſitting up in bed, except his body be bent a good way forward, in which poſition the diaphragm is relaxed, and not ſo much dragged by the weight of the extravaſated fluid. When the thighs are bent, the patient can lie with tolerable eaſe on his back, he is alſo not averſe to lying on the ſide on which the wound is ſituated; but he cannot place himſelf on the oppoſite one, without feeling very acute pain in the ſituation of the mediaſtinum.

His reſpiration is ſhort, frequent, and interrupted by ſighs; his veins become empty, a mortal paleneſs ſpreads over his countenance; his extremities become cold; a viſcid perſpiration covers his neck and temples; his teeth chatter, his pulſe grows weak, and if (as moſt frequently happens) the lungs are wounded, he coughs up frothy blood, and air iſſues from the wound.

The preceding claſs of ſymptoms, however, are not always attendant on every conſiderable effuſion of blood in the thorax. Wounded perſons have been known to die of ſuch an extravaſation, whoſe reſpiration was tolerably free, and who did not complain of ſuffering more inconvenience in one poſture than another. Sabatier ſtates, that ſeveral facts of this kind have fallen under his own obſervation. Other wounded perſons alſo, who have had moſt of the complaints, uſually imputed to extravaſations of blood in the thorax, have been cured by ordinary means.

The ſymptoms of an extravaſation of blood in the thorax are upon the whole very equivocal. Hence, ſeveral attentive practitioners have taken extraordinary pains to diſcover additional circumſtances, by which the nature of the caſe might be more infallibly aſcertained. Theſe endeavours, however, ſeem to have been attended with little ſucceſs. A ſurgeon of the name of Valentine aſſerted, that a ſort of ecchymoſis of the integuments, over the angles of the ribs, was an invariable ſymptom; but ſucceeding obſervers have not found the remark correct.

When there is no doubt in the practitioner's mind that blood is extravaſated in the cavity of the thorax, and that it is the occaſion of a dangerous oppreſſion of the lungs and diaphragm, the obvious indication is to endeavour to promote the eſcape of the effuſed fluid. However, before undertaking any operation, the revived ſtate of the pulſe, the return of warmth in the extremities, and the ceſſation of convulſions ought to denote, that the hemorrhage no longer continues from the wounded veſſels. If vent were given to the extravaſation before the bleeding had ceaſed, a freſh quantity of blood would ſoon be poured out in the cheſt, and the patient die exhauſted.

For another reaſon, alſo, prudence requires that the practitioner ſhould not precipitately have recourſe to an operation: *viz.* allowing a little while gives nature an opportunity of employing her own reſources, and any one who will be at the trouble of referring to books of ſurgical caſes, will ſoon meet with examples in which there is every reaſon to believe that there was more or leſs blood extravaſated in the cheſt, though the patients completely recovered without any operation.

There are five principal methods of diſcharging blood from the cavity of the cheſt. 1. By placing the patient in a poſture which favours the eſcape of the blood. 2. By introducing a ſyringe for the purpoſe of ſucking it out, or a mere cannula, through which it is to flow. 3. By enlarging the wound. 4. By employing injections, with which the clots of blood are to be waſhed away. 5. By making an opening into the thorax in a depending ſituation.

Having thus curſorily treated of extravaſations in the cheſt, we ſhall quit the ſubject for the preſent, intending to reſume the conſideration of it in ſpeaking of wounds of the thorax. See Wounds.

For an explanation of the method of making a depending opening into the cheſt, ſee Paracentesis.

Extravaſations in the Abdomen.—Various kinds of fluids may be extravaſated in the abdomen in caſes of wounds, ſloughing of the inteſtines, &c. Bile, chyle, urine, blood, feces, &c. are all apt to be effuſed under particular circumſtances. Surgeons uſed formerly to ſuppoſe, that whenever any fluid eſcaped from a veſſel, or bowel, into the general cavity of the peritonæum, it always became extenſively diffuſed among the convolutions of the inteſtines. The erroneous ſuppoſition ſeemed to be confirmed by facts, the most open to obfervation, and completely exempt from the poffibility of miftake. Practitioners faw that the water of dropfies, the pus of abfceffes, which had burft into the abdomen, as well as the chyle and feces, which had efcaped through a wound, or other fort of breach of an inteftine, were invariably and univerfally diffufed among the folds of the mefentery and bowels after death.

M. Petit (the fon) firft queftioned the accuracy of the foregoing opinion, in relation to the patient while alive. He fuggefted that as in the living body the inteftines were diftended with feces, alimentary matter and air, while they were alfo mutually acting againft each other, and in a continual ftate of compreffion from the alternate contraction of the diaphragm and abdominal mufcles, there might be a fuperior refiftance made to the weight of the extravafated fluid tending to feparate the vifcera to which we allude. On the contrary, fays Petit, is it not poffible that, as foon as the patient is dead, and the above kind of refiftance is taken away, the extravafated fluid may infinuate itfelf any where without difficulty? M. Petit remarks, that the truth of the preceding fuggeftion cannot be doubted, when we confider, that certain cafes of hernia get well, notwithftanding the burfting of the gangrenous part of the inteftine, after its reduction into the abdomen. In fuch inftances, in fact, the contents of the bowels appear to efcape outward through the wound entirely in confequence of the refiftance made to their diffufion among the convolutions of the inteftines. However it might be objected, that, in cafes of hernia, fince the bowel is almoft always adherent to the edge of the abdominal ring, the iffue of the inteftinal matter through the wound is rather to be afcribed to the eafe with which this event may happen, than to any refiftance made internally by the furrounding vifcera. But M. Petit cites feveral cafes, which fully confirm, that there is a vaft refiftance made to the lodgment of extravafated fluids among the convolutions of the bowels, and folds of the mefentery.

After death, any fluid, extravafated in the abdomen, may by its mere gravity infinuate itfelf any where, and become difperfed among the various parts, becaufe thefe parts being without action make no oppofition. But in the living ftate, all the abdominal vifcera reciprocally act upon each other, and forming, as it were, only one body, by reafon of fuch mutual fupport, the refiftance which is made to any extravafated matter will always keep it from becoming widely diffufed, in the manner which many have imagined.

Let us next, with M. Petit, reflect upon the inferences to be drawn from fuch reciprocal action of the abdominal vifcera.

The firft confequence is, that an extravafated fluid can only infinuate itfelf into the cavity of the abdomen, in the fame way that a fluid becomes effufed in an external part; that is to fay, the extravafation can only fpread by degrees, and fucceffively, into fuch places as offer the leaft refiftance. Blood, when it infinuates itfelf into the interftices of the mufcles, can only get from one membranous cell into another, by the firft one being fo diftended, that the fluid can more readily get into a fecond cell, and from this into a third, than increafe the diftended ftate of its firft fituation. Juft fo in the abdomen, the blood which efcapes from a wounded veffel, is firft effufed into a fituation near the opening in the veffel, either between the peritonæum and furface formed by the inteftines, or more deeply among the convolutions of the bowels, or fome of the folds of the mefentery. In the proportion as the bleeding continues, the blood forces its original boundary, and dilates the place which it occupies, in every direction, until it meets with lefs refiftance in making its way, either upward or downward, or to the right or left. The extravafation continues to dilate the new fpace, which it fills in the fame way, until either the firft limits are forced, or the effufed fluid fpreads in fome other direction. The extravafation will expand in this manner, till the refiftance, made by the vifcera, becomes equal to the impetus, with which the blood iffues from the veffel. M. Petit was of opinion, that it was this kind of refiftance which put a ftop to the hemorrhage, even before any coagulum had been formed in the opening of the veffel. That the blood, while flowing from the veffel and in a fluid ftate, fhould only make one mafs and be contained in one cavity, till coagulation takes place, is a circumftance which cannot rationally be imputed to any thing elfe, than the refiftance depending upon the mutual action of the vifcera in the living ftate. It is alfo equally certain, that it is in confequence of the fudden ceffation of fuch refiftance, that extravafated blood, which is fluid after death, becomes difperfed among the different convolutions of the bowels, and forms numerous fcattered collections.

The fecond inference which M. Petit mentions, as deducible from the refiftance arifing from the reciprocal preffure of the abdominal vifcera, is that an extravafation in the cavity of the abdomen cannot fo eafily happen, as fome have fancied. It was once not an uncommon idea, that a breach in a very moderate veffel could occafion a confiderable extravafation, becaufe the orifice could not be compreffed, like that of a veffel in a more external fituation. It is indeed true, that no compreffion can be directly applied to the opening in an internal veffel; but the refiftance which the furrounding vifcera make to the extravafation, operates as a fubftitute. It is even probable, according to Petit, that when blood is effufed in the abdomen, it has a greater refiftance to overcome, than when extravafated in an external part. This author ftates, that the refiftance of the cellular membrane, the common bond of connection between the mufcles, is undoubtedly lefs than that which depends on the reciprocal action of the inteftines, and reft of the vifcera. The inceffant alternate motion of the abdomen and thorax is in favour of the preceding opinion. The facility alfo, with which abfceffes fituated in the abdomen are difcharged, through a fmall, and very frequently not a depending opening, is an additional fact, proving that the abdominal vifcera, by the manner in which they mutually prefs upon each other, make a greater refiftance to an extravafation, than can be made by the cellular fubftance in other parts of the body.

Swords have often been thruft completely through the body, without giving rife to any dangerous fymptoms, or only to fuch as frequently attend wounds, which do reach into the cavity of the belly. We cannot imagine, contrary to all probability, that, in this cafe, the weapon has flipped over the inteftines, through their interftices, and by good luck has wounded none of the blood-veffels. We muft rather conclude, that an extravafation does not always enfue from a wound of the vifcera or blood-veffels, or at leaft, that the extravafation is not invariably attended with fuch confequences as former practitioners ufed to fuppofe.

For the purpofe of rendering the foregoing remarks more intelligible, let us follow M. Petit in his obfervations, and take notice of the principle which he has laid down in his excellent memoir, *viz.* that without a particular action in the mufcular fibres of the inteftine or artery, no extravafation would occur in the abdomen, even were there a breach in fuch bowel or veffel. Suppofing the blood veffels deftitute of action, and the place of the opening preffed upon by a force equal to that, which operates upon the reft of their extent, the fluid, which they contain, would never be be effufed in the abdomen, fo as to form an extravafation. Befides its being evident, that this muft be the fact, M. Petit mentions his having actually obferved it in the body of a man, who died of gangrene in the abdomen, in confequence of a hernia, which was attended for upwards of a fortnight with the moft violent fymptoms of ftrangulation. Nearly the whole of the inteftinal canal was equally affected with gangrenous mifchief, fo that it was fcarcely poffible to handle any of the bowels without occafioning a breach in them. However, although the inteftines were filled with very fluid excrement, none of it was extravafated in the abdomen. In feveral places, indeed, Petit difcovered numerous little breaches of continuity, which had allowed a little of the excrement to efcape, but only juft enough to tinge the adjacent parts. Petit acknowledges, at the fame time, that round where thefe holes were fituated, fome flight adhefions had taken place between the bowels, and thefe and other parts ; but they were fo weak, and eafily broken, as to be quite incapable of hindering an extravafation. Petit concludes, that in this inftance no extravafation happened, becaufe the inteftinal canal was every where affected with gangrene in nearly the fame degree, and the difeafe had deftroyed the tone and action of the mufcular fibres of the inteftines.

It is contended by Petit, that the foregoing cafe affords fufficient proof, that, without a contractile power in the blood veffels and inteftines, no extravafation of their contents could be produced in the abdomen, and that fuch an event would certainly be oppofed by the action of the abdominal mufcles and diaphragm, which make uniform and equal preffure upon all the vifcera. If this ftatement be correct, it is obvious, firft, that the greater the action of the wounded veffels is, in relation to the quantity of fluid which they have to propel, the greater will be an extravafation from them : fecondly, that no extravafation can arife unlefs the action of the veffels themfelves be capable of overcoming the refiftance depending upon the mutual action of the parts. Hence, only wounds of veffels above a certain fize can give rife to extravafations, at leaft, to any of importance. The veins cannot occafion fo much extravafation as the arteries : nor are wounds of the inteftines fo apt to be followed by an effufion of the chyle and feces, as the fame injuries of the blood veffels are liable to be attended with an extravafation of blood. Petit was alfo of opinion, that wounds of the ftomach were not fo often as thofe of the bowels the caufe of this kind of accident.

The feces cannot be fo eafily extravafated as blood, not only becaufe the action of the inteftines, particularly that of the fmall ones, upon their contents, is weaker than that of the blood veffels upon the blood, but, principally, becaufe, when there is a breach in one of the bowels, the contents will continue their courfe through the inteftinal canal, without any need of there being a confiderable obftacle to the occurrence of an effufion. However, Petit admonifhes us not to conclude, from what has been faid, that the chyle and feces can never be extravafated in the abdomen. There is no doubt whatever, he obferves, that an extravafation may take place, when the wound in the bowel is of ample fize, the gut filled with chyle or excrement, and care is not taken to empty the large inteftines very often with glyfters. The event may alfo happen, when pain and irritation render the mufcular action of the inteftines violent, irregular, and convulfive, and when unequal preffure is made upon the abdomen. Under fuch circumftances, the refiftance made to an extravafation, by the reciprocal action of the vifcera, is overcome, and the contents of the bowels will continue to be effufed, until the impulfe arifing from the contractile power of thefe organs returns to a ftate of equilibrium with the refiftance depending on the mutual action of all the vifcera.

The extravafation of chyle and feces does not take place differently from that of blood ; but in wounds of the bowels there is this advantage, that the fame opening which has given paffage to the extravafated fluid, may alfo allow it to return and pafs off. Petit remarks that we need no further proof of what has been ftated, than the great evacuations of blood, which fome wounded perfons have had with their ftools, without being afflicted with any of the fymptoms of extravafation. It is highly improbable, that fuch bleeding could depend upon the injury of any of the veffels ramifying upon the inteftinal canal, fince their fize is too inconfiderable. We rather believe that, in thefe cafes, fome veffels, either of the mefentery, or fome other part, have been wounded at the fame time as the inteftine, and that the blood has infinuated itfelf into, and taken its courfe through the bowels, in confequence of the refiftance made to its extravafation among the vifcera.

The foregoing remarks, made by Petit (the fon), clearly prove not only that an extravafation of feces cannot fo eafily happen in the abdomen as has been imagined ; but, alfo, that it is lefs dangerous than an effufion of blood ufually is, and that it is accompanied by lefs violent fymptoms. When the contents of the bowels are extravafated, adhefions are likewife obferved to form more readily, and to limit the effufed matter fooner, than when the extravafation confifts of blood. After fuch adhefions have once formed, it is probable that the extravafated matter may be got rid of in the fame favourable way, as certain abfceffes, which have difcharged themfelves into the inteftinal canal. Blood, however, cannot infinuate itfelf again into the canal of the veffel, out of which it has efcaped, becaufe a clot blocks up the opening. But a wound in an inteftine remains continually open, till it is clofed by the adhefions which the bowel contracts to the adjacent parts : adhefion, indeed, is the only means by which a wound of this defcription can be healed.

M. Petit remarks, that among the numerous facts which might be adduced in proof of the difficulty with which a wound of the ftomach permits the aliment to be extravafated, the operation of an emetic in this cafe is a ftriking one. Petit expreffes his belief, that vomiting does not depend upon the action of the mufcular fibres of the ftomach, but entirely upon the fudden and violent contraction of the abdominal mufcles. This author conceives, that, if the particular action of the ftomach itfelf had much concern in the production of vomiting, an extravafation of the alimentary matter would neceffarily happen in the abdomen when that vifcus is wounded. However, in the inftances referred to by Petit, the occurrence did not take place, becaufe, notwithftanding the violence with which the abdominal mufcles and diaphragm contracted, they made equal and uniform preffure on all fides of the ftomach. The danger of an extravafation is alfo lefs, inafmuch as a wound of the ftomach is always much fmaller in relation to its cavity, than that of a bowel, in regard to the inteftinal canal.

Circumftances are very different, in refpect to wounds of the gall and urinary bladders, efpecially when thefe receptacles are full. An extravafation is then an inevitable confequence, both on account of the great fluidity of the bile and urine, and of the contractile power with which the parts are endued, and againft which the action of the abdominal mufcles makes no fort of refiftance. An extravafation of thefe fluids is extremely dangerous, by reafon of their irritating quality with refpect to the vifcera. The co-

lics,

lies and irregular contractions which fuch ftimulating fluids excite, caufe the extravafation to become more widely diffufed. The eafe alfo, with which the bile and urine mix with the ferum, that naturally moiftens the furfaces of all the vifcera, leads us to fufpect, that whenever thofe fluids are extravafated, they very foon become univerfally difperfed among all the convolutions of the inteftines.

Againft thefe latter extravafations little can be done, and unlefs they are in fmall quantity, and their increafe can be prevented, the patient's life hardly admits of being faved. Leaving a catheter in the bladder, indeed, is a fure means of hindering the extravafation of urine from augmenting; but not much confidence can be placed in the kind of outlet afforded by the duct of the gall-bladder.

When the extravafated matter is completely encyfted and circumfcribed, it happens, that as fuch matter had to overcome the refiftance of the parts before it could be effufed, no fooner is a paffage afforded for its efcape, than the reaction of the feparated parts neceffarily forces out whatever fluid has infinuated itfelf between them. This is a third confequence, which is pointed out by Petit as refulting from the refiftance, made by the reciprocal action of the abdominal vifcera, to extravafations.

The foregoing obfervations tend to fhew, that an extravafation in the abdomen, and efpecially one of blood, may be as completely difcharged as a collection of fluid in the thorax. The evacuation, at leaft, may always be eafily effected, when the extravafation is bounded at any part by the parietes of the abdomen: a circumftance, which muft invariably occur, whenever the extravafation is confiderable. Indeed Petit informs us, that it was always the cafe, as far as his experience went even when the effufion was not very copious.

It is not enough to make furgeons underftand, that fluids, extravafated in the abdomen, admit of being difcharged by an operation; we deem it alfo neceffary to explain the fymptoms denoting the cafes in which fuch a proceeding is proper.

In order to underftand this interefting part of the fubject, Petit, and moft furgical writers after him, have advifed us to draw a diftinction between the confecutive fymptoms and the primary ones, or thofe which attend the wound from the firft, and are, ftrictly fpeaking, proper to it, becaufe they depend effentially upon the divifion of the injured parts. Such breach of continuity occafions, from the firft, pain, irritation, tenfion, convulfions, and fwelling and inflammation of the abdomen, affections naturally leading to other confecutive fymptoms, which vary according to the injured parts, and the degree of inflammation. Of the latter clafs are, hiccough, vomiting, conftipation, fuppreffion, or retention of the bile and urine, a great deal of fever generally at firft, and, after the inflammation has attained a certain pitch, a concentration and finking of the pulfe, confiderable proftration of ftrength, and cold fweats.

If when the firft train of fymptoms has been relieved, and after an interval of from four to eight days or more, the fymptoms recur, or become exafperated, without any apparent caufe, we may infer that fuch confecutive complaints depend upon an extravafation.

It may at firft feem extraordinary, that the fymptoms of an extravafation of blood fhould be confecutive; for, as the effufion takes place at the moment, when the wound firft happens, why do not the fymptoms commence at the fame time?

Petit has referred the reafon to the following circumftances: blood, extravafated in the abdomen, does not give rife to any complaints, either by the preffure which it makes, or by its quality; and whenever any fymptoms are occafioned on the firft occurrence of the effufion, they are thofe of weaknefs, depending on the lofs of blood to the circulation. The extravafation afterwards becomes entirely circumfcribed by the adhefions, which are produced by the inflammation around. An additional quantity of fluid continues to be fecreted from the veffels into the encyfted cavity of the effufed blood, and confequently pain, inflammation, &c. are occafioned by the increafing diftention, now produced.

We fhall not ftop to enquire into the accuracy of the latter part of the foregoing ftatement, as the fact, that the fymptoms of an extravafation are confecutive, is a piece of information highly important to the practitioner, while the theory of the fubject is a fubordinate confideration.

The remainder of the remarks, refpecting extravafations in the abdomen, and their treatment, will be found in the article WOUNDS. Some obfervations will alfo be offered, when we fpeak of HERNIA.

EXTRAVASATION is a term fometimes likewife ufed by the gardeners in fpeaking of gums, juices, &c. which oufe out of their trees either fpontaneoufly, or at incifions.

EXTREAM, or EXTREME, is applied to the laft and outermoft part of any thing; or that which finifhes and terminates it on that fide.

The extreams of a line are points. There is no paffing out of one extream into the other, without going through the middle. Extream remedies muft only be had recourfe to in extream neceffity.

Some anatomifts apply the denomination extremes, or extremities, to the arms and legs. See EXTREMITIES.

EXTREAMS, in *Logic*, denote the two extream terms of the conclufion of a fyllogifm, *viz.* the predicate and fubject.

They are called extreams, from their relation to another term, which is a medium or mean between them.

The predicate, as being likewife had in the firft propofition, is called the *majus extremum*, greater extream; and the fubject, as being put in the fecond, or minor propofition, is called the *minus extremum*, leffer extream.

Thus, in the fyllogifm, man is an animal: Peter is a man, therefore Peter is an animal; the word animal is the greater extream, Peter the lefs extream, and the man the medium. See SYLLOGISM.

EXTREAM *and Mean Proportion*, in *Geometry*, is when a line is fo divided, that the whole line is to the greater fegment, as that fegment is to the other.

Or, as Euclid expreffeth it, when the line is fo divided, that the rectangle under the whole line, and the leffer fegment, is equal to the fquare of the greater fegment.

The invention of this divifion is thus: let the given line be $AB = a$ (*Plate* VII. *Geometry. fig.* 87.) and for the greater fegment put x, the leffer will be $a - x$. Then, by the hypothefis, $a : x :: x : a - x$. Therefore, $aa - ax = xx$, confequently $aa = ax + xx$. And, by adding $\frac{1}{4}aa$ on each fide, to make $xx + ax + \frac{1}{4}aa$, a complete fquare, the equation will ftand thus, $\frac{5}{4}aa = xx + xa + \frac{1}{4}aa$.

Now, fince the latter is exactly a fquare, its root $x + \frac{1}{2}a = \sqrt{\frac{5}{4}aa}$, and by tranfpofition it will be $\sqrt{\frac{5}{4}aa} - \frac{1}{2}a = x$; which laft equation is a canon for finding x.

For at the foot of $AB = a$, fet at right angles $CB = \frac{1}{2}a$; then draw CA, the fquare of which is equal $ABq + CBq = \frac{5}{4}aa$. And therefore $AC = \sqrt{\frac{5}{4}aa}$; make $CD = CA$. From whence $CB = \frac{1}{2}a$ being taken as the

cafe

case requires, there remains B D = x; which transferred into A B, shall give the point E, where A B is cut according to extream and mean proportion.

This cannot be exactly done in numbers; but if you would have it tolerably near, add together the square of any number, and the square of its half, and extract, as near as you can, the square root of the sum; from whence taking half, the remainder is the greater part.

Extreams, in right-angled spherical trigonometry. When one of the five circular parts of a right-angled spherical triangle, *viz.* the three sides and two oblique angles, (for the right-angle is neglected) is pitched upon for the middle term, then the two circular parts lying immediately next to it are called extreams conjunct; and the two parts remote from the assumed middle part, or not immediately next it, extreams disjunct. See Circular *Parts*, Triangle, and Trigonometry.

Extream *Unction*, one of the sacraments of the Romish church, the fifth in order, administered to people dangerously sick, by anointing them with holy oils, and pronouncing several prayers over them.

It is called extream unction, as being only given to persons in extremity. In the thirteenth century, it was called the "unction of the sick," and not extream unction: for, in the earlier ages, it was given before the viaticum; which practice, according to F. Mabillon, was not changed till the thirteenth century.

The reasons he assigns for the change are, that in that age there arose divers mistaken opinions, several of which we find mentioned and condemned in the English councils; among the rest, it was held, that such as had received this sacrament, in case they recovered, might not make use of their wives, nor eat meat, nor go barefooted; whence they chose to forbear it till the last extremity, which practice prevailed. See the Councils of Worcester and Exeter, in the year 1287; that of Winchester, in 1308; and F. Mabillon, Acta Sanct. Benedict. Sæc. iii. p. 1.

The form of extream unction is now deprecative, as the divines call it; formerly it was absolute and indicative. This sacrament is not only in use in the Latin, but also in the Greek church, and throughout the East, though under another name, and with some difference in the circumstances; in that the orientals do not wait till their sick are come to extremity, in order to anoint them; but the sick generally go to church themselves; and it is administered to them as often as they are indisposed: the Greeks taking that direction of St. James, chap. v. ver. 14. which is the foundation of the practice, in a general sense: "Is any sick among you? let him call for the elders of the church, and let them pray over him, anointing him with oil." F. Dandini distinguishes two kinds of unction among the Maronites: the one called unction with the oil of the lamp; but this, he suggests, is not the sacramental unction ordinarily administered to such as are in extreme sickness; because the oil is only consecrated by a priest, and it is given to all who are present; not to the sick only, but also to the healthy; even the priest who officiates partakes of it. The other kind of unction, according to that father, is only for the sick; this is performed with oil consecrated by the bishop alone, on Holy Thursday; and this, it seems, is the sacramental unction.

The unction with lamp-oil is in use, not only among the Maronites, but throughout all the Eastern church, who use it very religiously. The truth is, they do not seem to have any other sacrament of extream unction beside this. Yet F. Goar observes, though it be only a ceremony, with regard to those in health, it is a real sacrament to those that are sick.

In their great churches they have a lamp, wherein this oil for the sick is preserved; this lamp they call κανδηλα του ευχελαιου, that is, *the lamp of oil joined with prayer;* for what the Latins call extream unction, the Greeks call ευχελαιον, or αγιον ελαιον, that is, *oil with prayer*, or *holy oil.*

Extreme, in *Music*, is applied to such intervals as deviate as much as possible from the true chord of the same name, without changing their names; generally when the term extreme is added to the prefix diminished or superfluous (which denote a minor semitone), its effect is to double that diminishing or superfluous effect, or to make it $\frac{576}{625} = 72\,\Sigma + 2f + 6m$; but sometimes we find Mr. Orwend applying a major comma and a minor semitone as the effect of his term extreme, or $\frac{128}{135} = 47\,\Sigma + f + 4m$, = the medius semitone: at other times we find extreme, when added to other prefixes, to have different effects, as extreme sharp intervals, for instance, are sometimes found a minor semitone above the intervals respectively, or $\frac{24}{25} = 36\,\Sigma + f + 3m$: but in other instances the same prefix signifies a major comma more, or $\frac{128}{135} = 47\,\Sigma + f + 4m =$ the medius semitone. It were much to be wished that these various applications of terms, so perplexing to a reader, could be got rid of, and a consistent nomenclature in harmonies adopted.

EXTREMITIES, in *Anatomy*, is a term applied to the limbs, as distinguishing them from the other divisions of the animal body, the head, and trunk. They are immediately connected with the latter by one end, and totally free in all other parts. The numerous varieties of their form depend partly on the bones, which enter into their composition; but, in a material degree also, on the soft parts which surround these, and which give to the limbs that roundness and elegance of figure, in which beauty is united with activity and strength. The extremities, being essentially concerned in all the functions of animal life, and constituting the great agents of locomotion, are composed of organs especially destined for these purposes. Their volume is formed by bones and muscles, supplied by numerous vessels, and communicating with the common centre of sensation, the brain, by nerves distributed most extensively; producing, in one part, the most important sense of touch, and giving the spring in all to rapid and varied motions.

The extremities are four in number, divided in man into upper and lower; in other animals into anterior and posterior. Each extremity is divided into four parts; the upper into the shoulder, the arm, the fore-arm, and the hand; the lower into the hip, the thigh, the leg, and the foot. In treating of these, both separately and generally, we shall consider only the bones, and the connections between them. On these depend all the motions of the limbs, the direction and extent of action of the muscles being wholly dependent on the bony points to which they are attached, and on the form and mode of junction of the bones on which they exert their power. The influence of any muscle will be considered in the detailed description of each, and may be easily applied to the subject immediately before us.

Our present plan is to offer, first, some general observations on the external figure of the bones of the extremities, as far as it relates to their uses; on their modes of articulation and their motions. We shall next examine separately and in detail each division of the bones of the upper extremity, the ligaments connecting them, the mechanism of their articulations, and their individual motions; afterwards the combined movements of the several parts, and the powers of the member, as resulting from this construction, both in the passive paffive and active ftate. A fimilar mode will be purfued in confidering the lower extremity. We fhall conclude with a comparifon between the upper and lower limbs as to fize, figure, direction, motions, and growth.

The bones determine effentially the fize, figure, and direction of the extremities, forming, by their affemblage, folid and flexible columns, capable of motion in very varied directions. Some of thefe in each column differ very widely in form; while others partake of the figure of both oppofite varieties. We defcribe them under the different names of long, of broad or flat, and of fhort bones.

In the limbs the bones diminifh fucceffively in length and fize, and increafe in number, as we defcend from the trunk to the oppofite extremity, from the arm, or thigh, to the fingers or toes. In confequence of this arrangement the upper part of the limb enjoys extenfive motions, whilft the lower is characterized by multiplied, but confined movements. Thefe bones have every where an analogous ftructure, being broad and voluminous at their *extremities*, contracted, and frequently rounded in their middle part, or *body*. The increafed volume of the extremities poffeffes the double advantage of enlarging the articular furface, and thereby diminifhing the chances of difplacement, and of preferving the fymmetry of the limb. We perceive, for inftance, that the bellies of the mufcles correfpond to the middle or fmalleft part of the bone, while the flat and contracted tendons are fixed near the protuberant extremities. The augmentation of fize, in the ends of the long bones, is by no means fudden; it commences infenfibly from the body. We remark, on thefe extremities, various eminences, fubfervient to the purpofes of articulation, or giving an advantageous attachment to tendons. The middle part, or body, is generally fmooth, offering prominent lines for mufcular or tendinous attachments. Thefe, where ftrongly marked, deftroy the cylindrical form of the bone: they are ufually three in number, longitudinal, feparated by plane furfaces, and give the bone a prifmatic figure, as may be obferved in the arm, fore-arm, and leg. In thefe inftances a fection of the bone is manifeftly triangular; yet its internal canal preferves a circular form. We may obferve alfo, that the body, in nearly all the long bones, appears as if twifted on itfelf; fo that the direction of the upper end differs more or lefs from that of the lower. This is rendered evident, by tracing the oblique courfe of the prominent lines between the two extremities; for example, in the bone of the arm.

The long bones are formed from three points of offification. The firft of thefe is obferved in the centre of the body, extending on each fide to the extremities, at which the bony cylinder is arrived at the period of birth. Soon after this time, a point of bone is perceived in the centre of each cartilaginous extremity, which increafes gradually, advancing towards the body, with which it at laft unites. From this confideration of the figure and formation of the long bones, we may naturally derive the arbitrary divifion into a *body* and two *extremities*; which divifion we fhall adopt throughout. The body of the bone is the *diaphyfis* of fome Latin writers; and the two ends being at firft united to the body only by cartilage, are called *epiphyfes*.

The broad bones are not found fo generally in the extremities as thofe of the long form; we obferve them only at the part immediately united with the trunk, where they offer an ample fpace for the attachment of the powerful mufcles concerned in moving the limb. In our defcription we obferve two *furfaces* and a *circumference*. The former, if they give attachment to mufcles, are ufually unequal and rough; the latter is thicker than the middle of the bone, offering more points of origin to mufcular fibres, as we may obferve in the margin of the hip bone.

The fhort bones of the extremities are found in fituations where it was requifite to unite a certain degree of mobility with firmnefs, as, for inftance, in the foot. They are collected in confiderable number in the regions which they occupy; and have numerous eminences and depreffions on their external furfaces, neceffary for their reciprocal articulations and for the infertion of the connecting ligaments. Nothing can be more irregular than their figure, which, in addition to their comparative fmallnefs and number, has given rife to much ambiguity of defcription. By confidering them under the fame afpects as the other bones, and by carefully noticing their relations to thefe, all confufion may be avoided. The fhort bones, in general, continue longer in a cartilaginous ftate than the others, refembling, in the phenomena of their offification, the epiphyfes, or extremities of the long bones.

There ftill remain fome fmall bones, found only in the extremities, which can hardly be included in either of the above claffes, and are diftinguifhed by the epithet of fefamoid. They poffefs this peculiarity, that they are formed, not in common cartilage, but in the middle of a tendon, or ligament, and that no trace of them can be obferved in early life. Of their ufe we fhall fpeak hereafter.

There are fome general characters belonging to all the above-mentioned claffes of bones. We obferve in all eminences and hollows, either giving attachment to mufcles, or ligaments, or forming furfaces for articulation. The eminences defigned for the former purpofe are very numerous in the bones of the extremities, and vary greatly in figure. They fometimes appear only as afperities impreffed in the midft of a fmooth furface, giving origin to a number of diftinct aponeurotic fibres; fometimes as prominences or tubercles more or lefs elevated and rough, giving infertion to one or more tendons; or, laftly, as a continued raifed line. In general thefe eminences are proportioned to the mufcles which are fixed to them; fo that under which-ever form they appear, there is an equality of fpace allowed for the tendinous infertions of mufcles of equal bulk. They are in general lefs ftrongly marked in the female than in the male; in the infant than in the adult; in feeble animals than in the carnivorous tribes, which live by preying on others. Their prominence is indicative of vigour and activity of motion; being more developed as the mufcles are more powerful. This is ftrikingly exemplified by a comparifon of the bones of a well made and mufcular man, where the outline of each mufcle might be traced with energy and precifion through the fkin, with thofe of a weak and ill proportioned male, whofe rounded and faintly marked limbs, refembling thofe of the female, betray a total want of vigour or addrefs. The ufes of thefe eminences may be clearly traced to their removing the infertions of mufcles farther from the centre, or axis of the bone, and confequently increafing their power of moving it. The eminences, which give attachment to ligaments, poffefs the advantage of removing the ligament farther from the joint, and thereby facilitating, and giving greater extent to its motions. Thefe eminences have received different names, according to their fituation, their direction, or figure, as we fhall fee more particularly hereafter.

The hollows obferved on the external furfaces of the bones, (with the exception of articular cavities, of which we fhall fpeak below,) are defigned either for the attachments of mufcles, or for giving paffage to their tendons. The firft of thefe have the evident advantage of increafing the furface, without augmenting the bulk of the bone; the

the latter appear as gutters, or grooves more or lefs deep, lined by cartilage, and completed by very ftrong ligamentous bands, through which the tendons glide in their way to their final attachments.

The connections between the bones of the extremities, whatever be their mode, are known by the general term of articulations. Their varieties have given rife to numerous technical, and in fome meafure obfolete, names, for which we refer to the articles JOINT and DIARTHROSIS. Some joints allow of motion in every direction; and we may trace a gradual decreafe of mobility, through many intermediate fteps, till we arrive at articulations which admit only of a gliding of the bones on each other. We have examples of the firft in the joints of the fhoulder and hip; where the extent of motion requires rounded articular furfaces, concave and convex in the oppofite contiguous bones; conftituting what is commonly termed the ball and focket joint. In man the moveable bone has the rounded head, the fupporting bone the correfponding hollow. In fome animals we have inftances of a contrary difpofition, in which a concavity in the moveable bone moves in all directions on an oppofite convex furface. This mode of connection is found only in the fhoulder and hip; and one advantage refulting from this ftructure being found at the upper part of the limbs, is, that the whole member neceffarily partakes of the fame extenfive motions; while it allows of a greater firmnefs and folidity in the inferior articulations. The joints we have juft mentioned are, in this fenfe, the joints, not only of the bones of the arm and thigh, but of all the limb, the motions of which, confidered as a whole, they effentially and principally influence. Hence, if their mobility is deftroyed, either by accident or difeafe, the limb becomes ufelefs: whilft a fimilar occurrence in the inferior joints produces a partial inconvenience only. By this arrangement alfo, the joint, which, from its want of firmnefs, is moft liable to injury, is the furtheft removed from the immediate action of external bodies.

The extent of motion decreafes as we proceed towards the extremities of the limbs. We find no rounded head, whofe axis makes an angle with that of the cylinder of the bone, but an articular furface placed directly at the top or bottom. Of this we have examples in the connection of the collar bone with the breaft, of the fore-arm with the wrift, &c. In thefe, all power of rolling the bone, which is enjoyed in a high degree by the thigh, and by the arm, is deficient. In the next ftep, the motions are confined to flexion and extenfion, as in the elbow, the knee, and the middle of the fingers. In this divifion the articular furfaces confift of eminences and hollows adapted reciprocally to each other, allowing of motion in one direction only. They are remarkable alfo for their large extent, which imparts to them folidity; and for admitting a greater degree of motion in the direction of flexion, than in the oppofite one of extenfion, as may be obferved in the knee, elbow, and fingers. The degree of extenfion is always effectually limited, either by a projection of bone, as in the elbow; or by ftrong ligaments, as in the knee, &c. In other inftances, the articulation allows of rotation only; a convex furface turning in a concave, or a hollow furface rolling over a convex one; both of which may be feen in the motions of the bones of the fore-arm. In the laft kind we obferve only a gliding of plane articular furfaces on each other, more or lefs obfcure, limited on all fides by ligaments binding the bones clofely together. To make up for this very confined motion, we ufually find many fuch joints united, producing in this ftate a more fenfible degree of motion than could poffibly occur in any of them fingly. This may be feen in the wrift.

In all thefe articulations we find a fmooth and polifhed cruft, of an elaftic fubftance, called cartilage, on the furface of the correfponding bones, the immediate means of their motions on each other. It is fuppofed to obviate by its elafticity the dangers refulting from fudden and violent fhocks. The two correfponding cartilages of oppofite bones are fo difpofed as to touch at all points in fome pofitions of the limb, whilft in others they quit each other more or lefs, and are found oppofite the foft parts furrounding the articulation. They are moulded into the form of the bone to which they adhere, preferving its general figure. But in fome cafes the cartilage is thicker in its middle than at the edges, thereby increafing the convexity; in others the converfe may be obferved, and the hollow of the articular furface is proportionably increafed. Both occur in the hip and fhoulder: the firft in the heads of the thigh and arm bones, the laft in the cavities which receive them, and in this manner the uniformity of contact is preferved. In the other articulations the cartilaginous crufts are nearly of equal thicknefs throughout.

The contact of the articular furfaces is fecured by ligaments deftined immediately for this purpofe, and by the mufcles which pafs from one bone to another, fupporting the joint either by the mufcular fibres, or their tendons. The ligaments are formed by very ftrong fibres, a little elaftic, difpofed in parallel lines, or interlaced in various directions. Their great refiftance infures, at all times, more particularly when the limb is at reft, the relations between the oppofite bones; their fituation limits in a great degree their inordinate motions. We obferve them under many forms, and named either from thefe, or from their fituation. Among the firft are capfular ligaments, which are found furrounding fome of the joints like cylindrical bags, embracing the oppofite bones by the circumference of the two ends. Of this we have examples in the hip and fhoulder, and nowhere elfe perhaps in the extremities. The ligamentous fibres are here interwoven and ftrengthened by the adherence of the furrounding tendons, loft at either extremity in the periofteum, to which they are firmly united. The reafon why capfular ligaments are found only in thefe articulations will be readily underftood. They enjoy motion in every way nearly alike, and require on all fides an equal degree of refiftance. Where, from the form of the articular furfaces, the motions are confined to narrower bounds, ligaments are neceffary only in particular fituations in order to regulate them. We find them in the other joints generally on the fides, from which the name of lateral ligaments. Thefe are fometimes rounded, fometimes flat, interwoven with the periofteum at each extremity, formed of fibres lying in parallel lines, or diverging at either end. There are other ligaments, not directly concerned in the joint, which ftill ftrengthen and regulate its motions, as may be remarked particularly in the fhoulder. Befides thefe we obferve many irregular flips, or bands of ligaments, difperfed here and there over the joint feparated by fat and cellular tiffue from the neighbouring parts. The ligaments, of whatever defcription, unite the oppofite furfaces of bones, prevent their difplacement, and yet allow of eafy and rapid motions; a double advantage arifing from their firmnefs on one part, from their flexibility on the other. They fometimes give attachment to mufcles.

The mufcles furrounding the joints of the extremities are very powerful agents in fecuring their contact, and the more fo as their power increafes in proportion as the chance of difplacement is greater. The moft vigorous efforts at difplacement are made during violent and extended motions; at fuch times the mufcles paffing from bone to bone, and croffing the articulation, are ftrongly contracted, are firm in their contractions, and powerfully oppofe the tendency which the extremities of the bones may have to abandon each other. In repofe, when the mufcles are relaxed, and offer but little refiftance, the chances of luxation are few, but if they occur, the probability of its taking place is exceedingly increafed.

In fome joints of the extremities we find a fubftance of a fomewhat cartilaginous ftructure, occupying the interval between the cartilaginous furfaces, and called for this reafon inter-articular cartilage. Such bodies are fometimes moveable, as in the knee, correfponding to the varying want of uniformity in the articular extremities, or fixed more firmly to the end of the bone, or the neighbouring ligaments. They are elaftic and highly flexible, refembling cartilage in the firft quality, the fibrous ligaments in the fecond. This peculiarity of ftructure has given rife to the name of articular fibro-cartilages, a term beftowed on them in recent times by the French anatomift Bichat.

Thefe furfaces are all moiftened by a fluid, called fynovia, on the compofition of which we fhall not dwell here. It is fecreted by a delicate membrane which completes the ftructure of the joint, by lining every part of its furface : whatever be the figure of the cartilages, or the ligaments, from both of which it is diftinct, it adheres clofely to them. It forms a bag without an opening fpread over the whole organ, reflected from the cartilages to the ligaments or tendons ; fo that whatever it embraces is, in reality, without the articular cavity as it is termed, though projecting into it. To the whole it gives that fmooth, polifhed furface fo neceffary for the eafy and rapid movements the articulations enjoy, at the fame time fecreting the fluid which facilitates them ; it gives to the joint alfo its peculiar fhining character.

The moft fimple motion of articular furfaces, common to them all, is gliding on each other in oppofite directions ; it is often fo obfcure as to be fcarcely perceptible. As we afcend we find it multiplied in a variety of ways. The limb can be confiderably bent, or extended ; it can be removed from, or brought nearer to the axis of the trunk : the firft of thefe motions is called abduction, the latter adduction ; in fome cafes, as in the fhoulder, they are termed elevation, or depreffion. The motions of fome joints are confined to any two of thefe, as in the knee ; others enjoy the whole, and all the intermediate degrees, as in the thigh. The union of thefe different movements, as exhibited in the arm or thigh, has been called circumduction. In this cafe the bone, inftead of being moved in one direction, and back again to the oppofite, is carried fucceffively through all, defcribing by its extremity a circle, or the bafe of a cone, the apex of which is in the articulation above. Rotation, or rolling, is very different from this. In circumduction the bone is moved from its prior fituation to a more diftant one ; in rotation it remains in the fame place, it turns only on its axis, as may be obferved in fimply rolling the arm.

From this curfory review of the external characters of the bones of the extremities, of their modes of connection and motions, we proceed to the detailed defcription of each. It will be neceffary to premife, that in our terms of pofition and afpect, we fhall always fuppofe the body erect, the arms depending, and the hands fupine, fo that the little finger is in contact, or at leaft next to the external fide of the thigh. In this fituation we fhall fuppofe a vertical plane dividing the body into two halves, from before backward. With a clear impreffion of this idea we fhall find no difficulty or confufion in the terms anterior and pofterior, fuperior and inferior, external and internal, as applied to the different afpects or furfaces of bones ; by the latter, internal, we always mean the furface next the imaginary middle plane above-mentioned. Thefe arbitrary terms, though applicable only to one determined pofition of the body, are yet neceffary to give tolerable precifion to anatomical defcription : when by their affiftance we have made ourfelves familiar with the objects they are defigned to illuftrate, they may be difmiffed as eafily as they have been adopted ; our ideas of the relative fituation of parts will be diftinct, and may be applied readily to every poffible variety of pofture. In order to obviate all ambiguity, we fhall introduce alfo the nomenclature of Chauffier, as conveying exact and precife notions of the relations of oppofite bones to each other. The terms are generally fimple, and always perfpicuous as applied to the prefent fubject.

The upper extremity—is divided into four parts ; the fhoulder, the arm, the fore-arm, and the hand, each of which will be feparately confidered.

The fhoulder is the divifion of the upper extremity attached immediately to the fuperior and lateral parts of the trunk ; it is formed by two bones, one broad, placed vertically behind, called the *fcapula*, or fhoulder blade, the other long, fituated horizontally before, called the *clavicle*, or collar bone. The difpofition of thefe bones gives the broad form and character to the upper part of the cheft, which is in itfelf very confiderably contracted at this part, its apparent breadth and magnitude being derived from the lateral appofition of the fhoulders. Generally, alfo, there is a proportion between thefe and the dimenfions of the cheft : they are large, and ftrongly developed, when the latter is well formed ; contracted and narrow when it is fmall or badly fhaped. The height of the fhoulder depends on the fituation of the fcapula ; it is lower proportionably in the female, and in males of a feeble body, than in individuals of the oppofite character. In the latter cafe, though the bones form the outline, it is the brawny mufcles which fill it up, conftituting, by their well-defined and maffy forms, the diftinguifhing character of the fex in man, and other animals.

The *fcapula*, fhoulder blade, or omo-plate, is a bone of an irregularly triangular figure, feated on the upper and back part of the trunk. It is connected by mufcles to the head, the vertebræ, and the ribs, by articulation to the clavicle and humerus. The fcapula has fuch a latitude of motion as to make it difficult to affign precifely its fituation on the trunk. But when the arm is at reft, it covers the fpace between the firft and eighth ribs, with its bafe or pofterior margin at a fmall diftance from the vertebral column, to which it approaches nearer above than it does below. At this line the fcapula lies pretty clofe on the ribs ; forwards, we find it receding confiderably from the oppofite furface of the trunk, in which fituation it is conftantly preferved by its connection with the clavicle.

For convenience of defcription, we divide the fcapula into two furfaces, the dorfal or exterior, and the coftal or interior ; into three margins or coftæ, the fuperior, the pofterior, or bafe, and the inferior, or external cofta. The rounded points at which thefe edges meet are ufually called angles, and are named, from their feveral fituations, the fuperior, the inferior, and the anterior angles of the fcapula.

The dorfal furface, the dorfum, or back of the fcapula, is divided into two very unequal portions by a ftrong and folid procefs of bone projecting from it tranfverfely, called, the fpine of the fcapula. It commences at the pofterior margin, about one-fourth part of the whole length below the fuperior angle, increafes gradually in depth as it advances

vances obliquely forward towards the anterior angle, beyond which it projects in the form of a broad, flat procefs, called the acromion. The fpine is connected with the whole breadth of the dorfum, with the exception of that portion of it called the neck; its anterior edge is fmooth, rounded, and concave, and is gradually loft in the under furface of the arch of the acromion. The pofterior, or projecting ridge of the fpine, is broad and flattened, varying however in breadth in different parts. At its commencement is a fmooth, triangular fpace, over which paffes a part of the tendon of the trapezius. Further on it is rough, the upper margin of the crifta giving attachment to this mufcle, the lower to the pofterior half of the deltoid. The acromion is flattened in a direction contrary to that of the fpine of which it is a continuation, is of confiderable breadth, rough and fomewhat convex above, concave and fmooth below. On the internal edge, which is continuous with the fuperior crifta of the fpine, is a fmooth oval furface for articulation with the clavicle. The external edge is rough and irregular, giving attachment to the middle part of the deltoid. The fummit of the acromion is rounded, and marked by the attachment of a ligament which connects it with the coracoid procefs. Towards the anterior part of the bafis of the fpine, near the neck, we obferve holes for the admiffion of the nutrient veffels. The upper furface of the fpine is hollow, forming a portion of the fupra-fpinal foffa, the name given to that portion of the dorfum fituated above the fpine, and which gives lodgment to the fupra-fpinatus mufcle. The lower furface is alfo concave, though irregularly fo, and contributes to the formation of the infra-fpinal foffa, the part of the dorfum lying below the fpine, which is occupied by the infra-fpinatus mufcle; the latter portion fcarcely deferves the name of foffa, being convex in its centre. Towards the inferior part of the dorfal furface is a ridge running in the direction of the inferior cofta, for nearly its whole length; it gives attachment to an aponeurofis, which feparates the infra-fpinatus from the teres major, and teres minor. Towards the inferior angle this ridge is met at a very acute angle by another, originating in the inferior cofta. The latter forms the line of divifion between the two laft mentioned mufcles, the upper and fmaller part giving attachment to the teres minor, the lower and broader to the teres major.

The under or coftal furface of the fcapula is concave, marked by feveral converging ridges running from the bafe towards the anterior angle. They give attachment to the aponeurotic divifions of the fub-fcapularis, its flefhy bundles lying in the intervening fhallow depreffions. Towards the fuperior and inferior angles we mark fome projecting points, which give attachment to the ferratus major anticus, as alfo more or lefs evidently a rifing line between, defigned for the fame purpofe.

The fuperior margin, or cofta of the fcapula, is the fhorteft of the three borders. It is thin towards the fuperior angle, becomes broader as we trace it forwards to its termination in a ftrong curved procefs, called, from its fimilarity to a crow's beak, the coracoid procefs. At the root of this procefs we obferve a deep notch, croffed by a ligament, fo as to form a circular hole; in many inftances the circle is completed by bone. It gives paffage to the fupra-fcapulary nerve, and ufually to a branch of the fupra-fcapulary artery and veins. Juft behind this notch the omohyoideus mufcle has its origin. The coracoid procefs is rather flattened, convex and rough above, where it gives attachment to ligaments connecting it with the under furface of the clavicle, concave and fmooth below. Its internal edge gives attachment to the pectoralis minor, its external to a ftrong ligament, croffing from it to the acromion, its fummit to the united heads of the biceps, and the coraco-brachialis.

The bafe of the fcapula is the longeft of the three margins, offering a waving line with an obtufe projection in it, oppofite the commencement of the fpine; to this, and to the margin below it, the rhomboidei are attached. From its junction with the fuperior cofta refults the fuperior angle, to which the levator fcapulæ is partly attached.

The inferior cofta is much broader than the other, dividing at its anterior part into two projecting lines, with a hollow between them. Towards the inferior angle, where it joins the bafe, the edge is thinner, and convex, giving attachment to the teres major, and occafionally to fome fibres of the latiffimus dorfi. The outer of the prominent lines gives origin above to the long head of the triceps; below to the teres minor. The inner line, and intervening hollow, is occupied by the fub-fcapularis. The inferior cofta terminates above, at the anterior angle, towards the coracoid procefs, in an ovate, flightly hollowed furface, called the glenoid cavity. This furface is at right angles with the plane of the bone, its long diameter perpendicular, and its broader part below. It is covered by cartilage, the edges raifed a little by a fibrous ring, which adds fomewhat to its depth. At the upper end of the brim is attached the long head of the biceps. The glenoid cavity is articulated with the head of the humerus; it ftands off a little from the body of the bone, fupported by a fhort procefs, more contracted than the brim of the cavity, called the neck of the fcapula. This narrowing is more particularly obfervable on the back, under the fpine.

The fcapula is, in its ftructure, compact; thin and diaphanous every where but at its edges and proceffes, where the bone is thick and cellular. Its offification commences at an early period in the fœtus, and advances confiderably before birth. At the latter period, however, the acromion, the coracoid procefs, and the bafe, ftill exift in the ftate of cartilaginous epiphyfes.

The clavicle, or collar bone, is placed nearly tranfverfely at the fuperior and anterior part of the cheft, between it and the top of the fhoulder. In figure it fomewhat refembles the italic *f*; the two thirds next the fternum being of an irregularly cylindrical, or nearly prifmatic form, and gently convex anteriorly; the third next the fcapula flattened horizontally, broad, and with a more confiderable convexity directed backwards. It is more flender, and lefs curved in the female than in the male.

The extremities of the bone are diftinguifhed from their fituation by the names of the external or pectoral, and the fcapular, or humeral ends of the clavicle. The firft of thefe is triangular, prefents an irregular articular furface of confiderable extent for connection with the fternum; its plane is nearly at right angles to the body of the bone. The fcapular extremity prefents alfo a flat, articular furface, oblong horizontally, accommodated to the oppofite one in the acromion. The upper furface is rounded towards the fternum, where the fterno-cleidomaftoideus is attached, fmooth in its middle portion, flat and broader next the fcapula. The under fide, to which thefe characters are equally applicable, is marked near the fternal end, by a roughened furface, for the attachment of a ligament connecting the clavicle to the firft rib. Towards the middle is a confiderable longitudinal hollow for the lodgment of the fub-clavius mufcle. Near the fcapular end the face of the bone is unequal, with a rough eminence in it for the infertion of ligaments which bind it to the coracoid procefs of the fcapula. Towards the fternum the anterior edge is broad, and

and bends gently forwards, for about one-half of its length, where it gives origin to a portion of the pectoralis major; it then becomes thinner, flopes backwards, and terminates by fuddenly turning forwards again towards its junction with the acromion. It gives attachment to the anterior half of the deltoid. The curvatures of the pofterior edge are the inverfe of the preceding. The bone is rounded, fmooth and concave for the two-thirds next the fternum; unequal and convex towards the fcapula, where the trapezius is attached.

The clavicle is in ftructure like the other long bones; the medullary cavity is very confined. At the time of birth its form is already ftrongly marked, and its offification nearly complete.

The articulations of the fhoulder.—The fcapula is connected with the trunk by a great number of mufcles, which partly fupport it, and allow of all thofe varied motions of which it is capable. It is clofely bound alfo to the clavicle, which latter bone is immediately articulated with the fternum. We have here only to examine the two laft connections, beginning with that between the clavicle and fternum, as forming the union between the fhoulder and the trunk.

The fternal end of the clavicle is covered by a cartilaginous cruft of confiderable thicknefs, prefenting an irregular convex furface. At the upper part of the fternum is an articular cavity, flightly hollowed, of lefs extent than the oppofite articular furface of the clavicle, fo that the latter rifes confiderably above it; a circumftance particularly ftriking in lean perfons.

The ligaments which connect thefe furfaces are four, an anterior and a pofterior, an inter-clavicular, and a cofto-clavicular ligament. To complete the joint, we find alfo an inter-articular cartilage, dividing it into two feparate cavities, and a diftinct capfular membrane lining each of thefe.

The anterior ligament covers the front of the joint, lying between the fkin and the fterno-maftoideus without, and the capfules immediately within. It is compofed of fibres, which defcend obliquely from the upper and anterior edge of the clavicle, diverging as they proceed to be fixed into the upper edge of the articular cavity in the fternum. Thefe ligamentous fibres leave feveral intervals between them, which are occupied by cellular tiffue and veffels.

The pofterior ligament is fmaller and not fo ftrong as the anterior. It feparates the fterno-hyoideus and fterno-thyroideus from the capfules to which it firmly adheres. It extends from the pofterior edge of the clavicle to the oppofite part of the fternum. The fibres defcend a little in their paffage, diverging as they approach the latter bone.

The inter-clavicular ligament is placed between the two clavicles, immediately above the hollow at the upper edge of the fternum, with the integuments only in front, and the fterno-hyoidei and fterno-thyroidei behind. It is attached to the upper edge of the fternal extremity of each clavicle, the fibres croffing in a flattened form from one to the other, and longer above than below; they are often feparated by intervals filled up with cellular tiffue.

The cofto-clavicular, or rhomboid ligament, paffes obliquely upward from the cartilage of the firft rib to the internal edge of the under furface of the clavicle, clofe to its fternal end. It is flat and fhort, the fibres becoming longer as they recede from the fternum. In front of it lies the fubclavian mufcle, and immediately behind it the fubclavian vein. It has no immediate connection with the articulation, but ferves to ftrengthen it and regulate its motions.

Between the clavicle and fternum we find an intermediate round, flattened piece of fibro-cartilage, its furfaces accommodated to the ends of thefe two bones. Its circumference lying immediately under the ligaments of the joint, is united to the furface of the anterior and pofterior. It is united alfo above and below, by means of a ftrong and thick fibrous fubftance, to the circumference of the articular furface of both the clavicle and fternum. The fibro-cartilage is thicker above, and much thinner next the cartilage of the rib. The fibres which compofe it are lefs apparent in its middle than nearer its edges. From its clofe connection with the furrounding parts, it cannot be moved in any of the actions of this joint.

The capfular membranes adhere to the ligaments which furround the articulation, between the fibres of which they are often apparent. They both adhere alfo to the fibro-cartilage, one of them lining the cavity between it and the fternum, the other the correfponding cavity between it and the end of the clavicle. The membrane is every where delicate, its inner furface moiftened by fynovia, which is fecreted but in a very fmall quantity.

From the difpofition of the ligaments belonging to this articulation, there remain but few intervals not covered and fupported by them; fo that it nearly approaches in ftructure thofe joints which we find furrounded by a fibrous capfule, as in the cafes of the fhoulder and the hip, which it fomewhat refembles, alfo in the extent of its motions.

Articulation of the clavicle with the fcapula.—At the fcapular extremity of the clavicle we find a fmall oval facet, covered by cartilage, correfponding to a fimilar one in the internal edge of the acromion. We often meet alfo with a delicate inter-articular cartilage, its fuperficies fometimes equalling the articular furfaces of the bones, at others lefs; it is thickeft above, and adheres by its circumference to the ligaments. To fecure this joint, we find ligaments above and below it; and the clavicle is further bound to the coracoid procefs of the fcapula by ftrong ligaments, without being any where in contact with it.

The upper ligament forms a broad and flat band, which covers the whole length of the articulation, croffing from the upper edge of one articular furface to the other, the fibres being longer as they are feated more fuperficially. It lies immediately under the tendinous aponeurofes of the trapezius and deltoid, which form a ftrong, diftinct layer of fibres, not eafily feparable from the ligament.

Underneath the joint lies another ligament, the fibres following the direction of the preceding, which it approaches in front, being feparated behind by an interval filled with cellular tiffue. Above, it is in contact with the capfular membrane; below, with the fupra-fpinatus. The fynovial membrane is found lining the articular furfaces, reflected from one to the other, and containing but little fynovia. It is fometimes double, where the inter-articular cartilage is perfect.

The ligaments which further connect the clavicle with the fcapula are attached to the coracoid procefs, from which they purfue different directions to be inferted into the clavicle. The moft delicate of thefe has been called the ligamentum bicorne. It arifes from the inner edge of the coracoid procefs, near its point, and, as it advances upwards and inwards, fplits into two layers, which envelope the fubclavian mufcle. The upper band is attached to the clavicle, near the end of the rhomboid ligament; the under layer paffes to the rib immediately below it. It is not ftrong enough to add much to the fecurity of the connection between the bones. The other ligamentous bands, placed between the coracoid procefs and the clavicle, have been divided by many authors into two diftinct ligaments: one, the pofterior bundle, has been called, from its figure, conoides; the other,

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for a fimilar reafon, trapezoides. Though fcarcely diftinct in their origin, they differ fo much in figure, and in the direction of their fibres, that we fhall confider them as feparate ligaments. The pofterior ligamentum fcapulæ commune conoides is attached below, by the fummit of the cone, to the root of the coracoid procefs; above, to the rough tubercle fituated on the under fide of the humeral end of the clavicle. It is compofed of fhort thick fibres, radiating as they afcend, parallel to, and continuous with thofe of the anterior ligament, as they approach nearer the acromion. Below, its fibres are often united with thofe forming the ligament croffing the notch of the fcapula. The anterior ligament, ligamentum commune trapezoides, croffes obliquely from the coracoid procefs to the clavicle, as a broad flattened band, exceeding the preceding in length. It is fixed below to the pofterior part of the upper furface of the coracoid procefs, above, to an oblique line proceeding from the tubercle towards the end of the clavicle. The anterior fibres are longer than the pofterior; the latter, at the union with the fibres of the pofterior ligament, form an angle pointing towards the acromion, and leaving in front an angular cavity which is filled by fat. Thefe ligaments are covered by the fubclavius in front, by the trapezius behind, leaving an interval of an inch or more towards the fcapulo-clavicular articulation.

The fcapula has two other ligaments proper to itfelf, which we fhall defcribe here, although they have no immediate relation with the articulation of the clavicle and fcapula. One clofes the notch in the laft-named bone, the other is extended between the coracoid procefs and the fcapula. The firft, confifting of a flat, compact band of filvery fhining fibres, croffes from the pofterior angle of the notch to the bafe of the coracoid procefs, converting it into an hole, through which the fupra fcapulary nerve, and frequently alfo the fupra fcapulary veffels pafs.

The ligament placed between the coracoid procefs and the acromion is of a triangular form, of confiderable furface, thin, and flattened. Its bafe is attached along the external edge of the coracoid procefs, from which it proceeds in two diftinct bands, feparated by cellular tiffue, and converging, as they approach the acromion, into one common fheet. The pofterior fibres pafs obliquely outwards, the anterior are directly tranfverfe; the interval between them is croffed by fome fcattered flips of ligament. Its upper furface is covered by the deltoid and clavicle, its lower fide is in contact with the fupra-fpinatus. Its anterior edge is not defined, but continuous with a thick and denfe layer of cellular membrane, lying between the deltoid and the tendons of the infra and fupra-fpinatus. This ligament completes the arch formed by the coracoid procefs and acromion over the fhoulder-joint.

The mechanifm and motions of the fhoulder.—The fcapula, by its mufcular connection with the trunk, is capable of powerful and varied motion; the clavicle, on the contrary, can only follow the impulfe communicated by the fcapula, whofe motions it regulates and limits under certain circumftances. The fcapula forms the effential part of the fhoulder, the clavicle can be confidered only as acceffory in man, and fome animals who ufe their anterior extremities for other purpofes befides progreffion. The fcapula may in fome meafure be confidered as defending that part of the thorax over which it moves; but its more evident ufe is to ferve as the bafe of all the motions of the arm, which at the fame time it increafes moft extenfively. In this refpect it differs from the hip, which is in itfelf motionlefs, although affording a point from which the thigh directs all its movements. We fhall recur to this difference hereafter: in this place it will be fufficient to notice, that notwithftanding the apparent want of firmnefs in the fhoulder, it is enabled, by means of its numerous and powerful mufcles, to offer a folid refiftance to the impulfe communicated from the arm in any of the violent actions of the upper extremity. The fcapula plainly accompanies the motions of the arm, forwards and backwards, but in the fimple elevation outwards, and in depreffion of that bone, its movement is fcarcely obfervable. In the former cafes it rotates on an imaginary axis, perpendicular to its plane, placed fomewhat about the middle of the bone.

In the inftance where the arm paffes forward from the ftate of adduction, the fuperior angle of the fcapula is lowered a little, and approaches the vertebral column, whilft the inferior recedes from it, and is at the fame time fomewhat elevated. Where the arm is carried backwards the converfe of this occurs. In thefe rolling motions the clavicle is concerned but little if at all; the fcapula turning on it at the joint which unites them, the articular furfaces gliding on each other, and the ligaments above and below becoming alternately ftretched or relaxed, as the motions are fucceffively continued. They, however, are not capable of refifting alone any violent effort tending to difplace the bones in this rotatory motion; it is the ftrong ligaments croffing from the coracoid procefs, to the tubercle of the clavicle which, by their alternate tenfion, fecure their relations under thefe circumftances. This articulation is further defended from injury by the mobility of both bones, which would recede before any violent fhock.

The clavicle acts as a prop, preventing the fhoulder and arm from falling forwards and approaching the breaft, either by their weight or by the action of the mufcles which move them. It is partly preferved in its fituation by mufcles which are fixed to it above. Its exiftence is neceffary for many of the motions of the upper extremity, particularly thofe in which it is carried forward; it favours alfo the circumduction of the arm, by keeping it at a diftance from the trunk, and allows the whole limb to defcribe arcs of a fphere, the centre of which is found at its fternal end. We find confequently that animals without clavicles enjoy thefe motions but imperfectly, in many inftances in no degree. Their abolition in the cafe of fractured clavicle is another proof of the utility of the latter in directing the actions of the fhoulder.

The combined motions of the fcapula and clavicle are thofe of depreffion, elevation, thofe in which the fhoulder is carried forward, or backward, and the combination of thefe or circumduction.

When we raife the fhoulder, the fcapula paffes during its elevation a little obliquely forward. The inferior angle advances, whilft the upper edge or cofta recedes from the trunk. The fcapular end of the clavicle is neceffarily alfo raifed, fo as to increafe the fpace between it and the firft rib, and to diminifh fomewhat the angle it forms with the acromion, its fternal end preffing more and more on the articular cavity in the fternum; the rhomboid ligament is ftretched, limiting the elevation, and the inter-clavicular ligament relaxed.

In depreffing the fhoulder the exact inverfe of thefe effects is produced, and requires not therefore a minute detail. We fhall obferve only that the lower furface of the clavicle may be brought fo near to the firft rib, as to comprefs the intervening veffels very confiderably, and produce a painful fwelling of the arm. The depreffion is much limited by this contiguity of the rib, which lies pretty clofe to the clavicle in the moft common and eafy pofition of the fhoulder.

When the fcapula advances forwards its, anterior angle recedes from the trunk, being kept off by the clavicle, the bafe at the fame time approaching nearer the breaft. The clavicle becomes more diftant from the firft rib in the horizontal

horizontal direction, the inter-clavicular, and the pofterior ligaments are rendered tenfe, the fternal end preffing inwards and backwards. In this fituation luxations have occurred, but the accident is rare, as the fhoulder is feldom expofed to any violence under thefe circumftances, that by its direction would probably effect it.

In carrying the fhoulder backward, the anterior angle of the fcapula is brought nearer to the cheft, and the bafe approaches the fpine. As the fcapula has a confiderable extent of motion in this direction, and is accompanied by the fcapular end of the clavicle, it will readily be conceived, that if the movement is fudden and violent, the fternal end will diftend its anterior ligament, may rupture it and become luxated forwards on the fternum. In fact this is the moft common mode of difplacement.

The fhoulder may be moved in any of the intermediate directions to thofe we have defcribed; and in all we are to confider it as a lever compofed of two parts, one horizontal, the other vertical, the fternal end of the clavicle being the refting point, or the centre of the movements of the lever. The continued fucceffion of all thefe motions produces the circumduction of the fhoulder, a motion in which the clavicle defcribes a cone, the fummit of which will be at its fternal, and the bafe traced by its fcapular extremity. We are not to confound this motion of the fhoulder with that of rotation, defcribed above.

The direction of the fhoulder is fubject to variations from the flighteft motion; in general it is fo inclined that the glenoid cavity points outwards, proving moft evidently, if any argument were wanting, that the upper extremities are not defigned to fupport the body in the attitude of a quadruped. In fact, in that pofition, the head of the arm bone would prefs, not againft the glenoid cavity, but on the capfular ligament which furrounds it, and which is utterly incapable of long refifting the effort.

The Arm.—The humerus, the only bone in the arm, the largeft and ftrongeft of thofe of the upper extremity, is placed between the fhoulder and the fore-arm. It is nearly ftraight, bending gently forwards below, "tanquam ad meliorem amplexem," fays Albinus. Of an irregular prifmatic form, fomewhat rounded at its upper and middle portions, flattened and gradually widening below, fo as to be broadeft at its lower end where it fupports the fore-arm. It has the appearance of having been twifted in the middle, as if at an early period the upper end had been carried round forcibly outwards, and the lower end in the oppofite direction. We divide it into two extremities, a fuperior or fcapular, and an inferior, or cubital; and into a middle portion or body.

At the upper end, the moft bulky part of the bone, are three eminences; the head, and the great and fmall tubercle of the humerus. The head of the humerus is rounded, forming nearly the half of a fphere, fmooth, covered by cartilage, articulated with the glenoid cavity of the fcapula. It ftands on a very fhort procefs, fomewhat more contracted than the articular circumference, called improperly, perhaps, the neck of the humerus. The head and neck are directed obliquely upwards, fo that a line drawn in their axes would form an obtufe angle with the body of the bone; they are alfo inclined backwards with refpect to the plane of the condyles at the lower extremity. From this oblique pofition of the head with regard to the body of the humerus, the neck is longer, and the contraction more ftrongly marked below than it is above, where we remark only a fhallow groove dividing the head from the tubercles.

The great tubercle is placed externally, oppofite to the head. It is rough, broad, and flattened; marked by three diftinct furfaces for the attachment of tendons. One, anterior, for the tendon of the fupra-fpinatus mufcle; a middle fpot, for that of the infra-fpinatus, and one below for the teres minor. The leffer tubercle, placed in front of the bone, is rough, much fmaller but more elevated than the laft. It gives attachment to the fub-fcapularis. Dividing the tubercles is a deep longitudinal groove, of which we fhall fpeak below.

The body of the humerus, though of a very irregular form, is fufficiently marked for us to divide it into three differently inclined furfaces, and as many projecting lines between them. Owing to the twifted figure of the bone thefe angular lines purfue rather a fpiral than a ftraight courfe.

The anterior ridge or fpine commences at the inner edge of the great tubercle, and is continued through the middle of the bone to the lower end. It is rough in its upper half, giving attachment above to the pectoralis major, and lower down to a portion of the deltoid: below it is rounded and fmooth, giving attachment to and covered by the brachialis internus. The internal line defcending from the fmall tubercle, gives attachment above to the latiffimus dorfi, and lower down to the coraco-brachialis and triceps. Towards the anti-brachial extremity it becomes much more prominent, affording attachment to a ftrong inter-mufcular aponeurofis. The external edge begins at the under fide of the neck, running obliquely forwards as it defcends. It is but faintly marked above where it gives attachment to a portion of the triceps; is interrupted towards the middle, leaving a fmooth flat furface, over which the radial nerve and accompanying veffels turn; below it rifes again into a more acute, and elevated ridge, which gives attachment to an inter-mufcular ligament, and fome mufcles belonging to the fore-arm. In the internal furface, bounded by the anterior and inner lines, we obferve above the bicipital groove, continued between the tubercles and the fpines, proceeding from them for fome way down the bone, increafing in breadth, and gradually becoming obliterated. It is lined by cartilage, and provided with a fynovial membrane, where it lodges the tendon of the long head of the biceps. Towards the lower end of the groove, at its outer fide, is a rough line for the infertion of the tendon of the teres major. About the middle of the internal furface the coraco-brachialis has an attachment, and below this the brachialis internus. The external face is larger than the preceding: covered above by the deltoid, ftrongly marked by a rough prominence interfecting it obliquely for the infertion of this mufcle. Immediately below this ridge is a broad fhallow oblique depreffion, along which the radial nerve and fome veffels pafs. Towards the lower extremity the bone is flightly concave, and gives attachment to the brachialis internus. The pofterior furface is fmooth and rounded, altering its direction in a confiderable degree as we trace it downwards: it gives origin to and is covered by the triceps.

The lower, or anti-brachial extremity of the humerus, is broad and flattened tranfverfely, and advances a little forwards from the axis of the body of bone. In the middle is an articular furface for connection with the fore-arm, and on either fide a projecting point, called tuberofity, or condyle. Of thefe the internal (pofterior of Albinus) is the moft projecting. It is fomewhat flattened, continuous above with the internal fpine, marked irregularly below by the attachments of mufcles, and the internal lateral ligament of the elbow joint. The external condyle (prior Albini) is much lefs prominent, and gives attachment to the external lateral ligament, as well as to feveral mufcles which lie on the radial and dorfal fides of the fore-arm.

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The articular furface, placed between thefe two points, defcends a little way beyond them. It is marked by feveral eminences and hollows. Next to the external condyle is a rounded eminence (capitulum of Albinus) adapted to the hollow in the head of the radius, and at its inner fide is a groove for the internal projecting edge of that hollow. The remaining divifion forms the pulley or trochlea (rotula of Albinus) for articulation with the ulna. We obferve two prominent edges and a depreffion between them. The edge next the radius is not fo prominent in front as behind, neither does it rife fo high as the edge next the internal condyle, which defcends a confiderable way below the reft of the articular furface, floping gradually into the hollow of the pulley on one fide, and terminating abruptly by an acute margin on the other. The hollowed part, forming nearly three-fourths of a circle in extent from before backwards, is much broader behind, directed from thence obliquely inwards as we follow it to the front of the bone. Above the middle of the pulley, at its back part, is a deep cavity, oblong tranfverfely, which receives the olecranon, or extremity of the ulna, during the extenfion of the fore-arm. Oppofite to this, at the termination of the pulley in front, is a fmaller hollow for the reception of the coronoid procefs of the ulna, when the fore-arm is bent. Between thefe correfponding hollows there remains but a thin plate of bone, in many inftances diaphanous.

The humerus refembles in ftructure the other long bones. Its offification commences at three points; at the middle and at each end. At the time of birth the fcapular extremity of the humerus is entirely cartilaginous, and of greater proportionate bulk. At the lower extremity the capitulum is much larger in comparifon with the trochlea than in the adult bone.

The articulation of the humerus with the fcapula, forming the fhoulder joint.—The head of the humerus is covered by a layer of cartilage, much thicker in the middle than at the circumference. The glenoid cavity of the fcapula is lined by cartilage, thinner in the middle than round its edges. The margin of the cavity is further provided with a fibrous elevated border, proceeding above from the tendon of biceps which gives off a bundle on either fide; below, from the circumference of the articular cavity. Over the joint is the bridge formed by the acromion, the coracoid procefs, and the ligament ftretched acrofs between them. The head of the humerus moves on the glenoid cavity; but from the fmall relative fize of the latter, the furface of the head of the humerus in contact with it forms but a fmall part of its articular fuperficies, the remainder of which is thus out of the cavity, and correfponds to the capfular ligament.

The capfular or orbicular ligament enclofes the whole of the joint in the form of an oblong fac, contracting a little at each extremity. The upper edge is fixed round the glenoid cavity of the fcapula, beyond the fibrous ring we have juft mentioned. In fome inftances there is an interval left on the inner fide, which is then fupplied by the tendon of the fub-fcapularis. The lower edge is attached round the neck of the humerus; clofe to the margin of the articular cartilage above, at a greater diftance from it below. The attachment is interrupted between the two tubercles, the ligament croffing from one to the other over the bicipital groove. The deficiency occafionally obferved on the inner fide is fupplied as above by the tendon of the fub-fcapularis, which may be feen from within the joint covered only by the reflected fynovial membrane. The capfular ligament is remarkable for its length, which allows the articular furfaces of the two bones to be feparated from each other, by the diftance of an inch, on the admiffion of air into the cavity. It is covered above by a denfe ligamentous band paffing from the outer edge of the coracoid procefs, to the anterior part of the larger tubercle, where it unites with the tendon of the fupra-fpinatus; and fo clofely joined by its under furface to the capfular ligament, that, but for its attachment to the coracoid procefs, it would be difficult to make any diftinction between them. It is this acceffary band which makes the capfular ligament thicker above than in any other part. The fhoulder joint is further ftrengthened by the tendons of the fupra-fpinatus, infra-fpinatus, teres minor, and fub-fcapularis, which furround it, and which are firmly united to different parts of the capfular ligament. The latter is in contact alfo with the deltoid above, and the origin of the long head of the triceps below. It is formed by fibres running in various directions, and croffing each other, is thinneft where covered by the infra-fpinatus, and teres minor, ftronger on the inner and under fides; apparently infufficient to fecure the firmnefs of the articulation, if not fupported by the mufcles proceeding from the fcapula. The fynovial membrane is fpread over its internal furface, and reflected over the articular cartilages. At the edge of the bicipital groove a procefs goes from it, which defcends along the groove, lining it for the fpace of about an inch. It is then reflected on all fides over the tendon of the long head of the biceps, and continues to give it a covering in its paffage through the joint to its attachment above the glenoid cavity. By the reflection of the fheath below, the efcape of fynovia is prevented, and the tendon may ftill be faid to be exterior to the cavity of the joint.

The mechanifm of the fhoulder joint as to mobility and refiftance.—Although motion be the principal office of the upper extremity, there are many accidental circumftances in which firmnefs of oppofition is as neceffary as in the lower, and the means nearly as complete.

The motions of the arm are very extenfive, generally combined in different degrees with thofe of the fhoulder. Indeed fo great is its mobility, that it efcapes on that account many injuries it would otherwife be liable to, from the loofenefs of its articulation with the fhoulder. Add to this that the point of fupport, the glenoid cavity of the fcapula, is in itfelf fo moveable, as further to modify and leffen the effects of external impulfes. We have before obferved that the fcapula more particularly accompanies the arm in its motions backwards and forwards, lefs fo in its elevation outward and depreffion; the clavicle neceffarily partakes of the movement, and from this difpofition two advantages are derived that the circuit of motion is enlarged, whilft tendency to difplacement is diminifhed by the diftribution of the effort over three points inftead of one.

The arm, and confequently the whole limb, may be elevated, depreffed, carried forward, backward, and in all the intermediate directions; it may be rolled alfo on its axis in any of thefe conditions.

When the arm is raifed, the head of the humerus glides from above downwards in the glenoid cavity, in fome meafure abandons it, and refts againft the lower fide of the capfular ligament, which it diftends more or lefs according as the fcapula has accompanied it in its movement. If the arm be elevated outwards or abducted, it cannot be much affifted by the fcapula; the great tubercle is buried under the arch formed by the acromion, the coracoid procefs, and the ligament between them, and in this fituation the capfule is particularly ftretched, is liable to be torn, and the arm luxated downwards. When the arm is thus raifed above the horizontal line, at a diftance from the trunk, the weight of the body brought to bear with force on the head of the bone, as in the cafe of falling, tends to deprefs it; and at the fame time the actions of the pectoralis major, latiffimus dorfi, and teres major, concur in producing the fame effect; fince they have their fixed points in the trunk, and their moveable point in the humerus. Luxation, under thefe circumftances, is by no means rare. The action of mufcles alone is fcarcely adequate to the effect, which is generally the confequence of fome violent impulfe.

In depreffion or adduction, the arm returns to its natural pofition, in which difplacement is almoft impoffible. Where the limb is perpendicular, any external impulfe acting on its lower end, would only prefs the head of the bone firmly againft the arch of the acromion. The only mode in which it could be made to pafs beyond the arch, would be by carrying the lower end inwards; but this is oppofed by the trunk, fo that in this pofition of the arm luxation upwards is effectually prevented.

When the arm is carried forward to a confiderable height, it is accompanied in its motion by the rotation of the fcapula, and the head of the bone fcarcely quits the glenoid cavity. It is on thefe accounts that when in falling forward the arm is projected confiderably beyond the head, luxation is rarely the confequence, though the fhock be fevere. In the motion backwards the head of the humerus quits in fome degree the articular cavity, and bears againft the capfular ligament and the tendon of the fub-fcapularis. The extent of this motion is alfo increafed by the coincident movement of the fcapula, and at the fame time the probability of luxation diminifhed; it is not, however, fo free as the motion forwards.

Circumduction, or the fucceffion of thefe motions, is enjoyed extenfively in the joint of the fhoulder; the execution of it in the anterior half of the circle is more eafy, becaufe more unconfined than in the pofterior. And we may obferve as a general axiom, applicable to all the motions of the arm, that the movements forwards are far more extenfive than thofe in the contrary directions, whatever be the point from which they commence, in whatever direction the limb may be; examples of thefe are too familiar for us to particularize them, the caufe will be readily underftood from our account of the mechanifm of this part of the upper extremity.

The rotation of the arm takes place exclufively in the fhoulder joint, not accompanied as the others by any correfponding motion of the fcapula and clavicle. In this motion the head of the humerus merely glides backwards or forwards in the glenoid cavity, according as it is rolled inwards or outwards; it is not extenfive, and cannot give occafion to difplacement of the bones. In cafes where the functions of the elbow joint have been fo far deftroyed, as to prevent the rolling of the bones of the fore-arm one over the other, the rotation of the humerus has been obferved to be more marked, to compenfate the deficiency.

The fore arm, placed between the arm and the hand, is compofed of two bones, the ulna and radius.

The ulna, the largeft of the two, is on the inner fide. Irregular in fhape, ftrong, and larger above, leffening gradually in fize to its lower end. We divide it into two extremities, an upper or humeral, a lower or carpal; and into a middle portion or body.

The humeral extremity comprifes two ftrongly marked eminences, the olecranon and coronoid proceffes, and two lunated cavities, the largeft articulated with the pulley in the lower end of the humerus, the leffer with the head of the radius. The olecranon projects beyond the coronoid procefs in a line with the body of the bone; it is ftrong, fomewhat curved, rough above, where it affords attachment to the triceps; fmooth behind, where it lies immediately under the fkin; concave before, where it forms the upper part of the great figmoid cavity. The coronoid procefs ftands oppofite to the olecranon in front of the bone. Its upper furface forms the lower part of the laft named cavity, the under is marked by the attachment of the brachiæus internus. The edge next the radius is hollowed by the leffer figmoid cavity, the oppofite margin is acute, and gives attachment to the pronator teres, the flexor fublimis, and the internal lateral ligament of the elbow joint. The great figmoid cavity (finus lunatus of Albinus) lies between thefe proceffes. It is deeply concave longitudinally, adapted to the figure of the trochlea of the humerus; divided tranfverfely in the middle by a contraction of the articular furface, and a faintly marked line between the narrowed points. The upper divifion made by the olecranon is the largeft. The cavity is divided alfo into two unequal portions, by a convex line traverfing its whole length, the internal divifion is the largeft, and moft hollowed, for the reception of the inner border of the trochlea. The leffer figmoid cavity is oval tranfverfely, flightly hollow, continuous above with the larger cavity.

The body of the ulna is of an irregular prifmatic form, largeft above, curved gently forward, and turning towards the radius below. We diftinguifh in it three furfaces, and a like number of angular ridges between them. The anterior edge or fpine paffes from the leffer figmoid cavity in a curved line to the carpal extremity; it is acute above, and gradually foftened below, till it becomes fcarcely vifible. It gives attachment to the interoffeous ligament. The internal edge (pofterior, Alb.) is rounded, giving attachment to the flexor profundus above, to the pronator quadratus below. It follows a curved line from the infide of the coronoid procefs, and is fomewhat more prominent below, for the attachment of the latter mufcle. The pofterior edge (exterior, Alb.) beginning from behind the olecranon, is ftrongly marked in its upper two thirds, and infenfibly loft below. It gives attachment to an aponeurofis. The anterior furface (latus interius, Alb.) is broader above than below, gibbous in the middle, and concave at each end: the hollow part below is occupied by the pronator quadratus, the remainder gives attachment to flexor profundus. Towards the upper end is a fmall hole directed upwards for the admiffion of the nutrient veffels. The pofterior furface (prius, Alb.) is divided through its whole length by a prominent line; at the upper end of the internal divifion is a triangular fpace for the attachment of the anconæus; below it is covered by the extenfor carpi ulnaris. The external divifion, that neareft the radius, gives attachment above to the fupinator brevis, below to the extenfors of the thumb and fore-finger. The internal furface is broad, and a little concave above, giving attachment to the flexor profundus, convex and much narrower below, lying immediately under the fkin.

The carpal extremity is fmall, marked by two eminences; one placed externally, called the head or capitulum, the other, from its fhape, the ftyloid procefs. The head prefents a rounded articular furface, correfponding below to a triangular inter-articular cartilage placed between it and the carpus; externally to an articular cavity in the inner fide of the carpal extremity of the radius. The ftyloid procefs projects beyond the head; it is fmall, of a conical fhape, the point giving attachment to the internal lateral ligament of the wrift. Between thefe proceffes is a tranfverfe groove, which gives attachment to the fibro-cartilage juft mentioned. Behind they are feparated by another longitudinal groove, which lodges the tendon of the extenfor carpi ulnaris.

The ulna is formed from three points of offification, as the

 other

other long bones. At the time of birth the form of the olecranon is fully determined, whilſt the coronoid proceſs projects but little. The conſequence is, that the great ſigmoid cavity is leſs concave in compariſon than in the adult, and the leſſer ſigmoid cavity is proportionably ſmall and ſhallow.

The radius is ſituated on the outer ſide of the fore-arm. It is ſhorter than the ulna; ſmaller above than below, and gently curved in the middle. The upper or humeral extremity, called alſo the head of the radius, preſents a circular articular ſurface; ſlightly hollowed in the middle, correſponding to the rounded eminence on the cubital end of the humerus. The ſmooth articular ſurface is continued a ſhort way down the bone, and is broadeſt on the inſide, where it lies in the leſſer ſigmoid cavity. This diviſion is ſupported by a narrower portion of bone, cylindrical, and of an inch in length, called the neck of the radius. Immediately below, on the inner ſide, is an oval protuberance, ſmooth on its anterior half, over which the tendon of the biceps paſſes, ſeparated from it by a burſa mucoſa; rough poſteriorly where this tendon is inſerted.

The body of the radius is of an irregular priſmatic form, which makes a natural diviſion of it into three faces, and as many angular lines. The anterior edge is more prominent above than below. The upper part gives attachment to the long flexor of the thumb, to the flexor ſublimis, and to the ſupinator brevis; its lower to the pronator quadratus. The internal edge or ſpine, acute in the middle, rounded at each end, gives attachment to the interoſſeous ligament. The poſterior, prominent alſo in the middle, and diſappearing inſenſibly above and below, gives no muſcular attachments. The anterior ſurface is concave above, where it gives origin to the flexor longus pollicis; a little convex below, where the pronator quadratus is fixed. About its middle is the hole for the nutrient veſſels of the bone. The poſterior ſurface, like the former, increaſes gradually in breadth from above downwards, is irregular, gives attachment above to the ſupinator brevis, and lower down to the extenſors of the thumb; its inferior part, covered by the extenſor communis, the extenſor tertii internodii pollicis, and the indicator. The external ſurface is convex throughout. Its upper third gives attachment to the ſupinator brevis: about its middle is a rough eminence, into which the pronator teres is implanted; below it is covered by the radial extenſors of the carpus.

The carpal extremity is larger than the ſuperior, irregularly quadrilateral, the longeſt ſide anterior. We obſerve in it an articular cavity, oblique, ſlightly hollowed, croſſed by a riſing line from before backwards, adapted to two of the bones of the carpus; the outer diviſion to the os ſcaphoides, the internal to the ſemi-lunare. The anterior edge of the cavity is rough for the inſertion of ligaments. The poſterior offers two grooves; the internal, broad and ſuperficial, gives paſſage to the extenſor communis and indicator, the outer, narrow and deeper, follows an oblique courſe from within outwards and downwards: through it paſſes the extenſor tertii internodii pollicis. On the inner margin is a lunated articular ſurface, correſponding to the capitulum of the ulna. The outer ſide, divided from the poſterior by a riſing ſpine, is marked in a ſimilar manner by two hollows. The anterior offers two grooves for the extenſores primi and ſecundi internodii pollicis; the poſterior is marked by the tendons of the radial extenſors. At the ſharp ridge, between this ſide and the anterior, the ſupinator longus is implanted. The prominence between the hollows is continued downwards into a blunt proceſs, paſſing beyond the articular ſurface, called the ſtyloid proceſs of the radius. It gives attachment to the external lateral ligament of the wriſt. The radius reſembles, both in its formation and ſtructure, the other long bones. At the time of birth its extremities are yet cartilaginous; the lower end is ſooneſt completely oſſified.

The elbow joint; the articulation of the ulna and radius with the humerus.—The lower end of the humerus preſents an articular ſurface compoſed of alternate eminences and depreſſions, covered by a continued cruſt of ſmooth cartilage. The great ſigmoid cavity of the ulna is lined by cartilage, interrupted in the middle by a tranſverſe contraction and groove; continued into the leſſer ſigmoid cavity. The head of the radius is alſo covered by cartilage, continued over its circular margin for a ſhort way down its cylinder. The humeral end of the ulna correſponds to the pulley, that of the radius to the capitulum at the lower extremity of the humerus. Theſe ſurfaces are bound together by ligaments, and covered by a ſynovial membrane reflected from one to another.

The ligaments which more particularly ſecure the joint are called lateral, one being placed on its outer, the other on its inner ſide. The internal lateral ligament is fixed above to the internal condyle of the humerus. It radiates as it deſcends, dividing into two portions; the anterior is fixed to the inner ſide of the coronoid proceſs of the ulna, the poſterior, the ſmalleſt of the two, to the olecranon. The anterior diviſion is covered by the tendon common to the muſcles proceeding from the internal condyle, and is partially united to it. Immediately under the ligament is the capſular membrane. The external lateral ligament can with difficulty be diſtinguiſhed from the common tendon of the muſcles attached to the external condyle. It is fixed above to this condyle, below it is united to a large portion of the circle of the annular ligament of the radius. It is not ſo ſtrong, ſo large, nor ſo clearly defined as the internal lateral ligament, its fibres diverge conſiderably, and are in contact with the ſynovial membrane. In addition to theſe ligaments we find ſcattered bands of fibres traverſing in different directions, both before and behind the articulation; their irregularity ſcarcely admits of deſcription. Between them and the ſynovial membrane lie ſome cellular tiſſue and fat. This ſynovial membrane is reflected from the humerus cloſe at the margin of the articular cartilage, and is continued under the ligaments to the oppoſite ſurfaces of the ulna and radius, lining the ſigmoid cavities of the firſt, and ſpread over the head of the latter. It is common therefore to the articulations of the fore-arm with the arm, and of the bones of the fore-arm between themſelves. This joint is ſtrengthened alſo in a remarkable degree by the numerous muſcles which are attached round it, and which cover it on every ſide.

The motions of the fore-arm on the arm—are confined to flexion and extenſion, the ulna executing the principal part, the radius neceſſarily following the ſame direction. In a ſtate of complete flexion the coronoid proceſs of the ulna and the prominent margin of the head of the radius are found correſponding to the oppoſite hollows in front of the humerus, the olecranon below the condyles, having moved a conſiderable diſtance from the internal one. At this time the lateral ligaments are relaxed; the poſterior half of the trochlea of the humerus in contact with the capſular membrane, reflected from it to the olecranon, and protected by the triceps. Under theſe relations the joint is ſecure; diſplacement in any direction would be almoſt impoſſible, without ſome fracture of bone. In the intermediate ſtates between flexion and extenſion the articulation has not the ſame appearance of ſecurity; but from the great mobility of the lower end of the humerus; from its receding eaſily

before

before every ſhock when the fore-arm is in ſuch ſituation, we ſeldom meet with a diſlocation of the latter under theſe circumſtances. In the extenſion of the fore-arm on the arm, the radius and ulna glide backwards over the articular ſurface of the humerus, until ſtopped by the olecranon becoming locked in the cavity adapted for its reception in the latter bone. At this time the lateral ligaments are tightened as well as the capſule in front of the joint. It is in the ſtate of complete extenſion that luxations moſt uſually occur, the humerus paſſing down in front of the bones of the fore-arm. This frequently happens in a violent fall on the hands. The whole weight of the body is carried forwards with conſiderable impetus on the arms which are ſtretched out to ſave the head from coming to the ground. In this caſe the fore-arm is fixed, and the humerus, following the impulſe of the body, ruptures the ligaments, and is thruſt forwards, the olecranon oppoſing itſelf to all diſplacement backwards. It would appear alſo, that a diſlocation might occur from lifting a heavy weight with the arm fully extended; but here the effort is voluntary, and the pain felt in the bend of the elbow is a ſufficient warning to deſiſt. When the fore-arm is extended it forms an obtuſe angle with the arm, and when bent it is not found in the ſame line with the humerus, but ſlants a little inwards towards the breaſt. Both theſe circumſtances depend on the obliquity of the pulley at the lower end of the humerus. This direction of the fore-arm, and conſequently of the hand in the ſtate of flexion, is particularly obſervable in man, and neceſſarily requires the exiſtence of a clavicle, without which the fore-arm, when bent, would be carried to the oppoſite ſhoulder. Thus in the different ranks of animals the exiſtence of a clavicle, and the motion of pronation, are found generally connected with this obliquity in the flexion of the fore-arm. In the ſtate of demi-flexion we may obſerve a ſlight lateral motion of the fore-arm on the arm, which cannot take place in the ſtates either of complete flexion, or extenſion.

The articulations of the radius with the ulna.—Theſe bones are in immediate contact at their humeral and carpal extremities; between theſe points there is a vacancy occupied by a flat interoſſeous ligament. Above, the head of the radius is received into the leſſer ſigmoid cavity of the ulna; below, it offers a ſhallow articular ſurface, which revolves on the capitulum at the carpal end of that bone. Firſt we ſhall examine the articulation at the humeral ends. It is lined by the ſynovial membrane common to it, and to the articulation of the fore-arm with the arm, and ſecured by a ſtrong flat circular band of fibres, called the annular or orbicular ligament of the radius. This ligament forms three-fourths of a circle, which is completed by the leſſer ſigmoid cavity, and in which the head of the radius turns. It is about three lines in breadth, fixed before and behind to the ends of the leſſer ſigmoid cavity, loſt inſenſibly above over the ſurface of the ſynovial capſule, to which it is firmly united, terminating by a more defined edge below. It is compoſed of parallel circular fibres, into which the external lateral ligament is fixed from above, as alſo ſome oblique fibres proceeding from the olecranon, the ligamentum adceſſorium poſticum of Weitbrecht. The annular ligament is of a denſe compact texture, frequently cartilaginous in advanced age. It lies immediately over the ſynovial membrane, but is no where connected in any degree with the radius. It is covered by muſcles.

The ſpace between the upper and lower articulations is filled by the intervention of ligamentous fibres, which further ſecure the relations between the radius and ulna. A portion of theſe has obtained the name of the oblique ligament, or chorda tranſverſalis; the remainder is included under the general term of interoſſeous ligament. The oblique ligament, a ſmall and flat band of fibres, paſſes obliquely from the inner edge of the coronoid proceſs below the leſſer ſigmoid cavity to be inſerted into the radius at a point which lies juſt below its tubercle. In this courſe it accompanies the inner edge of the tendon of the biceps, its direction being oppoſite to the fibres of the interoſſeous ligament, and in a plane anterior to them. Between this ligament and the head of the radius there is left a triangular ſpace filled by cellular tiſſue, in which the tubercle of that bone revolves. The interoſſeous ligament commences below the tubercle attached to the inner ridge or ſpine of the radius, from which the fibres paſs obliquely downwards and inwards to be attached to the oppoſite ſpine of the ulna. It is compoſed of flat parallel fibres, leaving various intervals for the paſſage of veſſels. It is covered on both its ſurfaces by the deep ſeated muſcles of the fore-arm, to which it affords attachments. It is more delicate above, inſenſibly loſing its ſhining appearance, and interrupted by a large vacancy, which gives paſſage to the poſterior interoſſeous veſſels; ſtronger below, where we find another opening for the paſſage of the anterior interoſſeous veſſels. On the poſterior ſurface of this ligament, and more eſpecially at the upper end, we often find flat bands of fibres decuſſating it: they have been deſcribed under the name of the poſterior tranſverſal chord.

The inferior articulation between the radius and ulna, or that at the carpal ends of theſe bones, is provided with a ſynovial capſule, and a triangular fibro-cartilage interpoſed between the ulna and the bones of the carpus, and filling the vacancy obſerved between them in the ſkeleton.

This triangular cartilage is fixed by its baſe to the prominent edge which divides the articular cavity at the bottom of the radius, from that which receives the capitulum of the ulna. It is attached by its ſummit to the groove between the capitulum and the ſtyloid proceſs. Its edges are united to the ſynovial membranes of both articulations, the radio-carpal and the radio-cubital. Its upper and lower ſurfaces are concave and ſmooth, the ſuperior correſponding to the lower ſurface of the ulna. It is occaſionally incomplete at the baſe, allowing of the contact of the two capſular membranes juſt mentioned.

The capſular membrane is looſe, ſo as not to impede the extended rotation of the radius. It is continued from the upper ſurface of the inter-articular cartilage over the articular ſurfaces of the radius and ulna. It is ſometimes covered here and there by a few ſcattered ligamentous fibres, which are in many inſtances ſcarcely obſervable.

The motions of the bones of the fore-arm, between themſelves and their powers of reſiſtance.—We have hitherto conſidered the fore-arm only in its relation to the arm, in which the ulna was more eſſentially concerned; the movements in the preſent caſe depend chiefly, and almoſt excluſively, on the radius, and are neceſſarily communicated to the hand with which it is articulated below, the ulna concurring but little in the conſtruction of the joint of the wriſt. Theſe bones are thus diſpoſed inverſely as to importance in the joints of the elbow and wriſt: above, the ulna plays the principal part, the radius being acceſſary only; whereas below, the ulna is of comparatively little importance, the radius of the greateſt. Their form is accommodated to the different uſe of each: the ulna large above and ſmall below; the radius of little volume at its upper extremity, broad and ſolid at its lower, where it ſupports the hand. This double oppoſition in the form of the bones is not only accommodated to their functions, but renders the ſolidity of the fore-arm nearly equal throughout.

out. The radius, however, from its more direct connection with the hand, more immediately fuftains any effort impreffed on the latter, as in pufhing violently, or falling, and is often fractured under fuch circumftances. Still the refult of the general mechanifm will be, that the fame bone, not having to fupport the motions of the two joints, the elbow and wrift, motions which are often fimultaneous, fractures and diflocations are the lefs likely to occur.

The radius may be rolled on the ulna inwards and outwards. In the former cafe, fuppofing the radius to be horizontal, the palm of the hand is turned downwards, and the motion called on that account pronation; in the latter it is turned upwards, and the motion called fupination. In pronation, which is the moft common pofition, the humeral end of the radius turns on its axis in the hoop formed for it by the leffer figmoid cavity dna the annular ligament, while the carpal extremity rolls over the lower end of the ulna, tracing an arc of a circle. In this ftate the relative fituations of the bones are changed, the radius croffing the ulna, and diminifhing the fpace between them. If pronation be carried forcibly too far, a diflocation may take place in either articulation; more readily in the lower, on account of the greater extent of motion, and lefs ftrength of reftraining ligaments; in the upper, the radius does not quit its fituation, and is fecured by a very ftrong ligament, befides the powerful fupport of the mufcles attached round it. In fupination the radius moves in the contrary direction, until it becomes parallel to the ulna, beyond which it cannot go. If it is forced beyond thefe limits a diflocation of one of the articulations muft enfue, moft probably of the lower. A great obftacle to luxations of this joint, either in pronation or fupination, is found in the triangular fibro-cartilage at the lower end of the bones, which is very ftrong, and which muft neceffarily be torn.

Although at firft fight one might be difpofed to imagine the ulna an immoveable fulcrum, round which the radius rolls, it is certain that in pronation the carpal end of the ulna paffes outwards, in fupination in the contrary direction, fo that it traces arcs of a circle in a contrary way to the carpal end of the radius. Of this any one will be effectually convinced by obfervation or experiment. But as the ulna cannot roll on the lower end of the humerus, it neceffarily involves the latter bone in the execution of thefe motions, which it thus affifts by its powers of rotation. Pronation and fupination then depend not only on the rotation of the radius, but on the oppofite motion of the ulna, and the rotation of the arm. The latter of thefe is very much more fenfible if the motions take place when the fore-arm is extended on the arm, than when it is bent: in the former cafe, from the difpofition of the bones and ligaments, any rotatory motion of the ulna is impoffible, in the latter it may exift in a flight degree.

We have obferved that the difpofition of the bones of the fore-arm is fuch as to offer the beft poffible refiftance to external efforts: nor is their pofition as to thefe motions lefs favourable, the head of the radius lying a little before the ulna, and the breadth of its carpal extremity removing its axis from the lower end of the ulna, fo as to increafe and facilitate the pronation and fupination of the hand, offering at the fame time a broad bafis for its fupport.

The hand—forms the fourth and laft divifion of the fuperior extremity; it is articulated with the lower end of the fore-arm. It varies confiderably in fize and form in different individuals: moft commonly is comparatively fmaller in females. We diftinguifh in it two furfaces, a dorfal and a palmar; two edges, a radial and ulnar; and alfo an upper or anti-brachial, and a lower or digital end. It is compofed of twenty-feven bones, which have been arranged under the different titles of carpus, metacarpus, and fingers.

The Carpus.—The carpus, or wrift, is oval tranfverfely, convex on its dorfal, hollowed on its palmar furface, where it gives paffage to the flexor tendons. This hollow is bounded laterally by four eminences refulting from different bones of the carpus, which give attachment to a ftrong ligament confining the tendons in their fituation. It is convex at the edge next the fore-arm, offering a number of irregular articular furfaces at the border next the metacarpus. It is formed by two rows of fmall irregularly fhaped bones, the upper range called anti-brachial, the lower metacarpal. Each of thefe ranges is compofed of four bones: thofe in the anti-brachial row, commencing from the radial edge, are the fcaphoides, lunare, cuneiforme and pififorme; in the metacarpal row the trapezium, trapezoides, magnum and unciforme. Although varying much in figure, they have fome characters in common, which allow of our defcribing them with tolerable precifion, without rendering confufed or obfcure our ideas of their mutual relations. We diftinguifh in each bone fix furfaces, or fides; an upper or anti-brachial, a lower or metacarpal, an anterior or palmar, a pofterior or dorfal, an outer or radial, and an inner or ulnar.

The fcaphoides, fo called from a fuppofed refemblance to a boat, is the largeft bone of the firft row. It is fomewhat oval in figure, the long axis being directed obliquely from above outwards and downwards. The upper furface is convex, triangular, articulated with the radius; the lower is alfo convex, correfponding to the oppofite furfaces of the trapezium and trapezoides. The pofterior narrow, and grooved by the infertion of ligaments; the anterior long and contracted, concave towards the fore-arm, convex and projecting below, forming one of the eminences before mentioned. The outer, or radial fide, is rough for the attachment of the external lateral ligament of the wrift; the internal prefenting a double articular furface, the upper narrow and convex, connected with the os lunare; the lower broad and concave, forming part of the articular cavity for the reception of the os magnum of the fecond row.

The lunare, or femi-lunare, has obtained its name from the figure of one of its articular furfaces, which refembles a crefcent. It is not fo elongated in form as the laft bone; convex and triangular above when articulated with the radius; concave below, narroweft in its tranfverfe diameter, articulated with the os magnum, and in a fmall degree with the unciforme; rough and unequal on the anterior and pofterior furfaces for the attachment of ligaments, the anterior fide the fmalleft; the outer face narrow, fmooth, in the form of a crefcent, with the convexity upwards in contact with the fcaphoides; the inner alfo fmooth, plane, articulated with the cuneiforme.

The os cuneiforme (triquetrum of Albinus) lefs in volume than the preceding, oblong and fomewhat pyramidal in fhape, its bafe next the os lunare, its apex directed obliquely inwards and downwards. The upper furface is convex, articulated with the bottom of the ulna by the intervention of the triangular fibro-cartilage before mentioned; the lower oblique, concave, articulated with the unciforme; the anterior prefents on its inner fide a flat circular articular facet articulated with the pififorme, on its outer it is rough for the attachment of ligaments; the pofterior and internal are alfo unequal and rough for fimilar purpofes; the external or radial furface is plane and fmooth, articulated with the lunare.

The os pififorme (fubrotundum of Albinus) has obtained its

its name from its rounded figure. It is the ſmalleſt of the bones of the carpus. On its poſterior ſurface we obſerve a ſlightly hollowed articular ſurface, where it reſts on the laſt deſcribed bone, "aſſidens patellæ in modum, aut ſeſamoidei," (Alb.) With this exception the bone is convex on all ſides, projecting beyond the plane of the other carpal bones, rough, and unequal, giving attachment above to the flexor carpi ulnaris, below to the abductor of the little finger, and before to the annular ligament of the wriſt. It conſtitutes one of the four prominent points of the palmar ſide of the carpus.

The trapezium (multangulum majus, Alb.) is the firſt bone on the radial ſide of the ſecond range of carpal bones, and lies ſomewhat anterior to them. Above it offers a concave articular ſurface, ſemi-circular, oppoſed to the ſcaphoides; below another, convex antero-poſteriorly, concave tranſverſely, articulated with the metacarpal bone of the thumb; on the front rough, with a deep groove at the upper end for the paſſage of the flexor carpi radialis; the outer edge of the groove giving attachment to the annular or tranſverſe ligament, and forming one of the eminences already mentioned; on the back and outer ſides rough and unequal for attachment of ligaments; on the inner ſide are two articular ſurfaces; the upper, large and concave, connected with the trapezoides; the lower, narrow and plane, for the metacarpal bone of the fore-finger.

The trapezoides (multangulum minus, Alb.) is very irregular in figure, placed like a wedge between the laſt and the following bones, the baſe of it being poſterior, the point towards the palm. The upper ſurface is concave, quadrilateral, and articulated with the ſcaphoides; the lower divided by a convex line croſſing from before backwards, adapted to the hollow of the metacarpal bone of the fore-finger; the dorſal or poſterior, convex, rough and broad; the anterior poſſeſſing the former characters, but much ſmaller; the external, convex articulated with the trapezium; the internal or ulnar, ſmaller and concave, ſmooth anteriorly where articulated with the following bone, rough behind for ligamentous attachments.

The os magnum (capitatum, Alb.) is the largeſt of the eight; longeſt in its vertical axis, rounded into an articular head above, (from whence it derives its name,) of a quadrilateral form below. The upper articular ſurface is convex, divided by a prominent line into two portions, one for the ſcaphoides, the other for the lunare; the lower is divided into three facets, the external articulated with the ſecond bone of the metacarpus, the middle the largeſt of the three, concave, ſupporting the third, the internal or poſterior very ſmall, plane, oppoſed to the inner edge of the fourth; the palmar and dorſal ſurfaces, rough and unequal for ligaments, the latter the largeſt of the two, the external narrow, articulated with the trapezoides; the internal of greater extent than any of the preceding, ſmooth above where contiguous to the unciforme, rough below, giving attachments to ligaments.

The unciforme (os hamatum; cuneiforme Alb.) completes the ſecond row of carpal bones, being the laſt on the ulnar ſide. Above is a rounded angle oppoſed to the lunare; below a ſmooth ſurface, convex tranſverſely, the outer ſurface ſupporting the fourth, the inner the fifth metacarpal bone; on the anterior ſide we obſerve, below, a curved proceſs projecting forward, to which the annular ligament is attached, as alſo ſome muſcles of the little finger; it forms the laſt of the four eminences referred to before; the ſuperior part of this ſurface is narrow, unequal, but ſmooth, giving attachment to ligaments; the poſterior ſurface is broad, triangular, and rough; the external offers an articular ſurface above, in contact with the os magnum, is rough below for ligamentary connections; the internal is directed obliquely, preſenting a curved, oblong, articular facet, and a rough line below it; the former oppoſed to the cuneiforme, the latter ſerving for attachments to ligaments.

The bones of the carpus reſemble each other in ſtructure; compoſed of a cellular or ſpongy ſubſtance, externally covered by a thin layer of compact bone. They are developed from ſingle points of oſſification, which do not commence till after birth. At that period they are entirely cartilaginous, diſtinct, well marked, and not at all proportionably larger than when fully oſſified, and on this account differing from the cartilaginous extremities of the long bones.

The articulation of the fore-arm with the carpus, or joint of the wriſt.—The ſuperior ſurfaces of the ſcaphoides, lunare, and cuneiforme, form by their union a common convex ſurface, oblong tranſverſely; each bone is covered by its proper cartilage, firmly united to the next by an intervening band of a fibro-cartilaginous ſtructure, which ſeparates this joint from the articulations of the carpal bones between themſelves. The lower extremity of the radius, and the triangular cartilage at the bottom of the ulna, form an elliptical concave ſurface, which receives the oppoſite convexity of the carpus, ſo that the ſcaphoides and lunare are oppoſed to the radius, and the cuneiforme to the inter-articular cartilage which ſeparates it from the ulna. The joint is ſtrengthened by ligaments on each ſide, and alſo before and behind, and lined by a ſynovial membrane.

The external lateral ligament is attached above to the ſtyloid proceſs of the radius; it advances forward a little as it deſcends, and is fixed on the outer ſide of the ſcaphoides. The fibres of which it is compoſed diverge below, and become continuous with the anterior ligament: we can often trace them on to the trapezium. Its form is irregular, and by no means defined, the edges being variouſly connected with the parts around it. The internal lateral ligament proceeds from the ſtyloid proceſs of the ulna, and is attached below to the inner ſide of the os cuneiforme. it is implanted alſo by ſome of its anterior fibres into the annular ligament, and piſiforme bone.

The anterior ligament is broad, and flat; fixed above to the anterior part of the ſtyloid proceſs of the radius, and the whole anterior edge of the articular cavity; from hence the fibres deſcend obliquely inwards, and are fixed below in an irregular line to the ſcaphoides, lunare, and cuneiforme; ſome fibres go to the piſiforme, the greateſt number are attached to the lunare. The flexor tendons lie in front, the ſynovial membrane immediately behind it. The poſterior ligament is not ſo broad as the preceding, and more evidently fibrous; its direction is nearly the ſame, being fixed above to the poſterior border of the articular hollow of the radius, below the lunare, and cuneiforme; it is covered by the extenſor tendons. Theſe ligaments are in nowiſe connected with the ulna, ſo that they cannot in any ſituation impede the rotation of the radius on that bone. The ſynovial membrane is ſpread over the articular ſurfaces of the radius, and triangular cartilage above, and the three bones of the carpus below; it is reflected between them under the ligaments, appearing in the intervals between their fibres in ſeveral ſpots. The joint of the wriſt is ſtrengthened on every ſide by ſtrong and numerous tendons, ſome of which are inſerted in its vicinity, others cloſely bound to its ſurface by ſtrong tranſverſe ligaments as they paſs from the fore-arm to the hand and fingers. The ſecurity derived from this conſtruction muſt be very great, without it the joint would preſently yield to the many violent impulſes it has to

ſuſtain

fuftain, to which the ligaments alone would offer a very inadequate refiftance.

The motions of the carpus on the fore-arm—are thofe of flexion, extenfion, lateral inclinations or abduction, and adduction, and circumduction. From the clofe connection of the carpal bones between themfelves, and with the reft of the hand, thefe motions of the carpus may be confidered at the fame time as general motions of the hand. Thofe of pronation and fupination depend on the motions of the bones of the fore-arm, and are in nowife dependant on this joint.

In flexion the articular convexity of the carpus glides from before backwards in the correfponding cavity of the fore-arm, and the pofterior ligament and extenfor tendons are ftretched; it may be carried to nearly a right angle without violence; an effort preffing beyond this point would ftrain, and might certainly diflocate the bones.

In extenfion an oppofite fucceffion of phenomena occurs, it is the anterior part of the joint which has the effort to fuftain. This motion is not confined to the bringing the carpus and hand into the fame ftraight line with the fore-arm, but may be continued in the oppofite direction to fome extent, fo as to make them form a confiderable angle with it on the dorfal afpect. The freedom of motion enjoyed by the carpus in this fenfe is fubfervient to many of the important ufes of the hand, and is not to be found in other analogous joints, where the power of flexion is greater, and that of extenfion limited to bringing the oppofite bones into the fame axis, as in the elbow, knee, &c. The lateral motions, thofe of abduction and adduction, are more confined, efpecially the laft. The lateral ligaments are alternately ftretched and relaxed, preventing their too great extent. Circumduction is alfo confined to narrow bounds, more particularly fo when pronation and fupination are not concerned in producing it.

The articulations between the carpal bones—all communicate together, being lined by a continuous fynovial membrane. The bones lie in clofe appofition, and are bound firmly by ligaments on the palmar and dorfal furfaces, fome by ligaments paffing deeply between them. The three firft bones of the upper row are in contact by nearly plane furfaces covered by cartilage, the fcaphoides connected with the lunare, the latter with the cuneiforme. The palmar ligaments uniting them lie deep under the anterior ligament of the wrift, the fibres of each paffing tranfverfely from bone to bone. The dorfal ligaments are more diftinct, the fibres longer as they are more fuperficial, they have the fame direction as the former. The fuperior, or interoffeous ligaments, have been already mentioned in fpeaking of the joint of the wrift, as feparating it from the articulations of the carpus. They are of clofe condenfed texture, paffing between the bones from before backwards, one joining the fcaphoides to the lunare, the other this laft bone to the cuneiforme. They are very narrow, the upper fide fmooth, covered by fynovial membrane forming a polifhed furface with the convexity of thefe bones, with the edges of whofe cartilages they are continuous. The os pififorme is placed without the ranks of the carpal bones, and has no communication with the common joint between them. It refts by a flightly concave articular furface on a correfponding convexity of the cuneiforme; the joint is lined by a fynovial membrane reflected from one to the other, ftrengthened by fcattered ligamentous fibres. Two bands of thefe, of confiderable fize and ftrength, pafs from the lower fide of the bone, one to the root of the metacarpal bone of the little finger; the other to the os unciforme. The pifiform bone is retained in its fituation by thefe, and, in fome meafure, alfo by the abductor mufcle of the little finger, to which it gives attachment. Above we obferve fome ligamentous fibres paffing from it to the ulna, and the infertion of the flexor carpi ulnaris. It performs the office of a patella, or fefamoid bone, for this latter mufcle "pofitum porrectumque inter ejus tendinem, ligamentumque ad os metacarpi digiti auricularis pertinens." Its motions are very limited; it forms, together with its connections above and below, a large portion of the channel through which the flexor tendons glide.

To form the articulation between the firft and fecond row we find the fcaphoides touching the trapezium and trapezoides, forming, in conjunction with the lunare, a cavity for the reception of the head of the os magnum, and the cuneiform bone fupporting the unciforme. The refpective articular furfaces are covered by a thin cruft of cartilage, and preferved in their fituations by palmar, dorfal, and lateral ligaments. The palmar ligaments are fhort and ftrong, formed by fibrous bands, paffing from one row to the other in different directions; the moft fuperficial are confounded with the anterior ligament of the wrift. The dorfal ligaments refemble them in their paffing from the upper row to the lower, but are too irregular in fize and direction to allow of fpecific defcriptions. Indeed they are both fo mixed with the furrounding ligamentous fibres as fcarcely to admit of diftinction. Of the lateral ligaments, the external is the fhorteft and ftrongeft, paffing from the fcaphoides to the trapezium; the internal ftretched between the cuneiforme and unciforme.

The bones of the fecond row are in contact by cartilaginous furfaces, and connected by ligaments, as thofe of the firft. The dorfal tranfverfe ligaments, are very diftinct, one between every two correfponding bones; the palmar are not fo well defined, the fibres of each being fhorter and more numerous, as they are more deeply feated. We can obferve one band, paffing from the trapezium to the os magnum in front of the trapezoides, independent of thofe between the contiguous bones. Between the unciforme and os magnum is a ftrong collection of fibres paffing from fide to fide through the depth of the carpus, adhering firmly to fuch parts of the correfponding bones as are not covered by cartilage. A fimilar connection exifts alfo between the os magnum and unciforme.

The fynovial membrane is continued from one articular facet to another, lining the ligaments we have defcribed, appearing in many places between their fibres. Nor does it form a continued furface only between the carpal bones, it is extended below into the joints, between the carpus and metacarpus; not always, however, into thofe formed above by the os magnum and unciforme. Owing to this general communication, difeafe of one articular furface is prefently propagated to the whole; in this refpect it muft be confidered only as a fingle joint.

The pifiform bone is in nowife concerned in the mechanifm of the carpus; its ufes have been mentioned above. So clofely are the bones of each row bound one to another, that they allow of fcarcely any perceptible gliding motion. The articulations between the two rows allow of a more fenfible movement; though this is confined to narrow limits. It refembles fomewhat that obferved in the joint of the wrift; they can be bent, and extended a little on each other, as well as inclined laterally; the firft of thefe is the moft evident. The little motion they poffefs is produced principally by the articulation of the head of the os magnum, which has the greateft effort to fuftain, and has been fometimes luxated backwards. Notwithftanding the obfcurity of movement in the carpal bones, it co-operates in increafing the mobility of the hand, whilft at the fame time, by the number

ber of articulating furfaces, impulfes may be to a certain degree weakened.

Before we enter on the latter point, it will be proper to take fome notice of another ligament, materially affecting the folidity of the carpus, though deftined but in a fecondary way for this purpofe, its firft office being to confine the flexor tendons in their paffage to the fingers. The annular ligament in front of the wrift, (ligamentum armillare, ligamentum carpi proprium,) paffes from the eminences formed by the pifiform and unciform bones to the oppofite ones of the fcaphoides and trapezium, completing the canal for the flexor tendons. It is compofed of very ftrong and thick fibres, becoming gradually thinner above and below; rough fuperficially, lined behind by a fynovial burfa. It gives attachment to feveral mufcles of the thumb and little finger. The fibres are all tranfverfe, numerous and compact, fecuring, in addition to its other ufes, the arch formed by the carpal bones. The carpus then derives its firmnefs from the large furface of the articulating facets in comparifon with the fmallnefs of the bones, from their number, from the numerous ligaments, and from the arched form refulting from the connection of the whole. It is further ftrengthened by numerous tendons, the flexors in front, the extenfors on its dorfal furface. Another caufe of the folidity of the carpus is, that the articulations between the two ranks are not in the fame tranfverfe line, the unciforme, and more efpecially the head of the os magnum, mounting far beyond the level of the trapezium and trapezoides, fo that any impulfe would not act on all at once, and caufe a general difplacement, the effort and the injury muft be partial, confined to the articulations between one or two of the bones.

The metacarpus (die mittelhand, Germ.) - is compofed of five bones, refting on the carpus above, giving fupport to the thumb and four fingers below. They are ftrong, thofe fupporting the fingers parallel to each other, the other a little anterior, and capable of altering its pofition. The intervals between them are filled by mufcles fo as to form a broad and folid body. The anterior face of the metacarpus is concave, conftituting the palm of the hand, the pofterior convex, and forms the back. The bones are diftinguifhed, from the connections below, into the metacarpal bones of the thumb, the fore, the middle, the ring, and the little fingers, or we clafs them numerically, beginning on the radial fide with the metacarpal bone fupporting the thumb. Of thefe divifions we fhall adopt the latter. The firft metacarpal is the largeft, and fhorteft of the whole; the fecond and third are nearly of the fame length; the fourth and fifth are fucceffively fhorter and fmaller. They are all fomewhat concave before, and flat behind, prefenting feveral more or lefs acute angles; larger at each extremity, the upper angular and unequal, the lower forming a convex head, compreffed laterally, with an articular furface terminating on the palmar fide in two prominent points; fmalleft in the middle of the body of the bone, increafing gradually in fize above and below. In confidering the diftinguifhing characters of each metacarpal bone, we fhall obferve them as feen on the carpal extremities, the bodies, and the digital extremities of each fucceffively, and not tire the reader by a feparate defcription of the feveral bones, in which it would be impoffible to avoid repetition, and which muft neceffarily be of greater length.

At the upper or carpal end of the firft metacarpal bone we obferve an articular furface convex tranfverfely, flightly concave in the oppofite direction, oppofed to the trapezium. It is furrounded by ligaments, and gives attachment on the outer fide to the extenfor offis metacarpi pollicis.

In the fecond are three articular furfaces, the middle concave, correfponding to the prominence of the trapezoides; the external fmall and flat, articulated with the trapezium; the internal divided into two portions, the upper articulated with the os magnum, the lower with the following bone. The circumference of this extremity is rough, and gives attachment to ligaments. On the palmar fide is a rough fpot, which gives attachment to the flexor carpi radialis; on the dorfal a tubercle, into which the extenfor carpi radialis longior is inferted.

In the third a quadrilateral articular furface oppofite to the os magnum, bounded before and behind by inequalities, giving attachments to ligaments; on the outfide by a fmooth facet articulated with the preceding bone; on the infide by two fmall round articular furfaces, feparated by a hollow contiguous to the following bone. At the external dorfal angle is a pyramidal eminence (proceffus ftyliformis), and clofe on the inner fide the infertion of the extenfor carpi radialis brevior.

In the fourth, at the top, a double articular furface, accommodated to thofe of the os magnum and unciforme, furrounded before and behind by rough points for ligamentous attachments, on the outfide by two prominent articular facets, correfponding to thofe of the laft bone; on the infide by a flightly concave furface articulated with the following.

In the fifth, a broad articular furface, convex from before backwards, concave tranverfely; flanting outwards and upwards, oppofed to the unciforme, bounded before and behind by rough furfaces for ligaments, on the outfide by a fmall articular facet connected with the laft bone on the infide by a tubercle which gives attachment to the tendon of the extenfor carpi ulnaris.

The bodies of the metacarpal bones are all concave anteriorly, and flightly convex on their dorfal furface. Although rather irregular in figure we can diftinguifh in them four fides, an anterior, a pofterior, an internal, and external. In the firft the pofterior furface is broad; in the three next we obferve above a prominent line running lengthwife, which foon bifurcates, forming the lateral boundaries of a flat triangular furface, the breadth of which increafes as it approaches the digital extremity; in the laft an angular line, running diagonally from the inner fide of its carpal end to the outfide of its lower extremity. In all of them the pofterior furface is covered by the extenfor tendons.

The anterior or palmar furface prefents alfo a longitudinal rifing line, generally more prominent towards the lower end. It feparates the attachments of the interoffei mufcles, and has fomewhat different directions in the feveral bones. In the firft rounded, covered by the opponens, and flexor brevis pollicis; in the third giving attachment above to the latter mufcle, below to the adductor pollicis. The lateral furfaces of thefe bones are broad, inclined obliquely in various directions, giving attachment to mufcles. In the firft they are compreffed and rounded, the outer fide giving attachment to the opponens, the inner to the firft external interoffeus (the abductor indicis of Albinus). In the laft the inner or ulnar fide gives attachment to the adductor offis metacarpi minimi digiti; the outer fide, as well both fides of the other metacarpal bones, give attachment to and are covered by the external and internal interoffeous mufcles.

The digital extremities are in all convex, and nearly alike in figure. On the palmar fide of the firft we obferve two flight depreffions correfponding to the fefamoid bones in front of the joint; on the fides of the articular furfaces of each deep hollows for ligaments, which fecure the articulations between thefe bones and the fingers.

The metacarpal bones refemble in ftructure and formation the other long bones. At the period of birth the extremities are cartilaginous, offification commencing in the body of the bone in the embryo of three months.

In the preceding defcription we have reckoned five metacarpal bones, according to the plan followed by the moft eminent anatomifts. By many the firft metacarpal bone has been omitted, and defcribed as the firft bone of the thumb, which they confider as compofed of three bones, like the fingers. By Albinus the metacarpus is divided into two portions, one, comprifing the four laft bones, he calls the metacarpus manus; the other, the metacarpus pollicis.

The articulations between the bones of the carpus and metacarpus are nearly fimilar in all but the firft. The articular furface at the upper end of the metacarpal bone of the thumb is convex and concave in oppofite directions, adapted to the correfponding furface of the trapezium. The joint is furrounded by ligamentous fibres paffing from one bone to another, amongft which the external and dorfal are the moft ftrongly marked, and the moft in number, the internal and anterior are continued on to the annular ligament. It is lined by a diftinct fynovial membrane. The difpofition of the ligamentous fibres is fuch as to form a capfule round the articulation, like that obferved in the fhoulder joint, but not fo loofe. The whole is fupported by the mufcles and tendons of the thumb. The fecond metacarpal bone is articulated with the trapezium, the trapezoides, and the os magnum; the third with the latter only; the fourth with it and the unciforme; the fifth with the laft alone. The furfaces are covered by cartilages continuous with thofe forming the joints between the metacarpal bones themfelves, and lined by a common fynovial membrane with occafional exceptions, as mentioned when fpeaking of the carpus. The ligaments on the dorfal furface pafs in different directions from the lower row of carpal bones, to the upper end of thofe of the metacarpus. There are two for the fecond of thefe, one from the trapezium, the other from the trapezoides; the third has but one from the os magnum; the fourth two, paffing from this bone and the unciforme; the fifth a fingle band from the latter. They are all fhort, flat, and compact. The palmar ligaments are lefs diftinct, being confounded with thofe around them. The moft evident are, a band paffing from the trapezium to the third and fourth metacarpals, confining in its paffage the tendon of the flexor carpi radialis; and a band between the trapezium and firft metacarpal.

The articulations of the metacarpal bones between themfelves.—The metacarpal bones, with the exception of the firft, touch at both ends by lateral articular facets, which have been already defcribed. The fynovial membrane lining thofe at the carpal extremity is open above, forming a free communication with the carpus. They are fecured in their relations by tranfverfe ligaments at both ends. At the carpal end thefe are found on the palmar and dorfal furfaces; on the firft of thefe the fuperficial ligaments form a continued layer, paffing from the fecond to the laft, the more deeply feated paffing from bone to bone. The dorfal ligaments pafs acrofs between each bone. Befides thefe, we find immediately below the articulations ftrong ligaments paffing deeply between the bones, uniting them moft firmly together. At the digital end is a ftrong tranfverfe ligament on the palmar fide, the fuperficial fibres paffing from the firft bone to the laft, thofe more deeply feated between each individual bone. It is covered in front by tendons and veffels, behind it fupports the interoffei mufcles, and is united to the ligaments connecting the metacarpus with the fingers.

Among the bones of the metacarpus, the firft enjoys very extenfive motions in every direction. The moft important motion is that which brings the thumb in oppofition to the fingers, and enables us to grafp the object before us; an office which made Albinus beftow on it the emphatic name of "manus parva majori adjutrix." The freedom of this motion depends on the extent and obliquity of the articular furfaces, between it and the trapezium, and is favoured alfo by their being on a plane anterior to the reft of the hand.

Circumduction of the thumb is very free towards the palm, very much lefs fo in the oppofite direction. The interval between this and the other metacarpal bones is highly advantageous in allowing of all its motions. The four laft bones of the metacarpus are bound fo clofely together, as to allow of much individual motion. They can be brought clofer together below, and bent a little forwards, fo as to increafe the hollow of the hand; this motion is moft evident in the two laft, thofe of the ring, and little fingers. The four laft bones of the metacarpus hold a middle rank, as to motion and folidity, between the carpus and fingers; above they partake of the firmnefs of the carpus, below approach nearer the mobility of the fingers.

The fingers, including the thumb,—are five in number. They are either reckoned numerically from the radial to the ulnar fide, or diftinguifhed by proper names. The latter are in common acceptation. We count, therefore, the thumb as the firft; the fore-finger or index as the fecond; the middle finger as the third; the ring finger as the fourth; and the little finger as the fifth. By this arrangement we can immediately compare their relations to the metacarpal bones, which have been defcribed alfo in a fimilar numerical order. The fingers are compofed of rows of long bones, placed vertically one beyond another, called *phalanges*; of thefe we find three in the fingers, properly fo called, and two only in the thumb, the middle phalanx being wanting. They are diftinguifhed by the names of the firft or metacarpal phalanx, the fecond or middle, and the third or unguinal. As the correfponding bones of the feveral rows are effentially alike in all, we fhall include them in one defcription, noticing the peculiarities of each. We divide them into two extremities, and a body.

The firft, or metacarpal phalanges,—are the largeft, and longeft of the three; of different lengths and fize, the third being the longeft, and all diminifhing fucceffively in volume from the firft to the laft. They are convex on the dorfal furface, the tranfverfe convexity forming nearly half a circle; concave anteriorily, with fharp angular edges laterally. At the fuperior extremity we obferve an articular furface, oblong tranfverfely, flightly hollowed, articulated with the correfponding bone of the metacarpus; a broad tubercle on each fide giving attachment to lateral ligaments, divided anteriorly by a depreffion, in which the flexor tendons pafs. In the thumb this extremity gives attachment to the abductor, the flexor brevis, and the adductor. The bodies of the phalanges are convex pofteriorly, covered by the extenfor tendons; concave on the palmar fide with projecting edges, fo as to form a kind of gutter, in which the flexor tendons are partly lodged; the edges give attachment to ligamentous fheaths confining the tendons in their fituation. The lower extremity offers an articular pulley, extended further and much broader on the palmar fide than on the oppofite, and the edges diverging confiderably from behind forwards. On each fide are depreffions, which give attachment to lateral ligaments.

The fecond, or middle phalanges,—are fmaller and fhorter than the firft, which they refemble much in general figure. The thumb poffeffes none. As to individual comparifon, they differ but little, that of the middle finger is the longeft, the laft belonging to the little finger the fhorteft and fmalleft.

fmalleft. The upper extremity offers an articular furface croffed antero-pofteriorly by a rifing line, correfponding to the oppofite pulley of the firft phalanx; on each fide are tubercles giving attachment to ligaments. The body refembles that of the metacarpal phalanx. About the middle of the anterior furface are two rough prominences, giving attachment to the divided tendon of the flexor fublimis, and to a fibrous fheath, which croffes over it from fide to fide, confining alfo the tendon of the flexor profundus. Its pofterior furface gives attachment to a portion of the tendon of the extenfor communis. The lower extremity refembles that of the firft.

The third, or unguinal phalanges—are found, in all, five, diminifhing in fize from the thumb to the little finger, that of the former being by far the largeft of the whole. The upper extremity or bafe (from a comparifon of the bone to a pyramid with its apex downwards), forms an articular furface, oval tranfverfely, with a convex line croffing from before backwards, accommodated to the pulley of the middle phalanx; is tuberculated for ligaments on each fide, giving attachment behind to extenfor tendons. The body is contracted; on its anterior furface the flexor profundus is fixed in the fingers, and flexor longus in the thumb. The lower extremity, or point, is flat, rounded, broader than the body, fcabrous at the edges and on the anterior fide, fmoother behind, where it fupports the nail.

The bones of the fingers have nothing peculiar in ftructure or formation: the firft and fecond phalanges are formed from three offifying points, the third from only two. At the time of birth, their figure is well marked, and their formation very confiderably advanced.

The articulations of the thumb and fingers with the metacarpus.—The convex heads of the metacarpal bones are covered by articular cartilages, in contact with thofe lining the concave furfaces of the firft digital phalanx. They are bound together by lateral ligaments, and ftrengthened in front by the fheaths of the flexor tendons, behind by the expanfion of the extenfors, on each fide by the interoffei mufcles. The lateral ligaments are attached above to the fides of the lower end of the metacarpal bones, and divide as they defcend into two diftinct bands, which are fixed to the fides of the correfponding bones of the firft phalanx. They are ftrong, formed of parallel fibres, lined on the inner furface by the fynovial membrane. In front of the joint we find the tranfverfe ligament of the lower end of the metacarpus, which has been already defcribed. The fynovial membrane is loofe, particularly before lining the extenfor tendon in its paffage behind over the joint, and appearing between the ligaments, which it alfo covers in front and on the fides. In front of the joint of the thumb we find two fefamoid bones developed in the tendons of the flexor brevis, leaving a furrow between them, in which the tendon of the flexor longus paffes. They reft on the head of the metacarpal bone, gliding up or down, as the joint is bent or extended. They are fometimes found in the articulations between the metacarpus and fingers. The motions enjoyed by this joint are thofe of flexion, extenfion, abduction, and adduction; of thefe the firft is by far the moft confiderable, the thumb poffeffing it in the leaft, the little finger in the moft extenfive degree.

The articulations between the phalanges are alike in all; the condyles, at the lower extremities of the firft and fecond phalanx, are covered by cartilage, and correfpond to the little hollows at the upper ends of the fecond and third. They are covered by a fynovial membrane, and connected by lateral ligaments, which pafs from bone to bone, refembling thofe of the preceding articulation. The fynovial membrane is fupported by thefe, as alfo by the extenfor and flexor tendons. It is fo clofely united to the extenfor tendon, at the upper end of the fecond and third phalanx, that it is almoft impoffible to feparate them. It is continued much further down on the bone on the palmar, than on the dorfal furface, forming a little bag in front of the joint. The thumb has but one of thefe articulations, which is in every refpect fimilar to the joints between the phalanges of the fingers.

In this laft part of the hand we obferve an evident decreafe of firmnefs, when compared with the metacarpus and carpus, and a proportionate increafe of facility and extent of motion. The fhortnefs of the bones, however, fcarcely offering a refifting point to external impulfes, fecures their relations, and leffens the chance of fracture, though the fingers are more immediately within the action of furrounding bodies, and more expofed to injuries than any other part of the limb. The joints of the phalanxes of the thumb and fingers allow only of flexion and extenfion; the latter cannot be carried beyond the ftraight line, the former is very free; an effect which depends on the continuation of the articular furfaces in front, far beyond their extent on the dorfal furface, and which is provided for by a correfponding laxity of the fynovial membrane. The advantages of this difpofition, for the important functions of the fingers, is fo confpicuous as to require no comment. In opening the hand, the fingers cannot be extended beyond the plane of the hand; from this fituation they may be bent in various degrees, until their points touch the lower end of the metacarpus. This general flexibility, derived from the fucceffive rows of firm bones, and their peculiar modes of articulation, allows of the fingers being applied accurately to any body whofe qualities we wifh to examine, whatever be its figure. The decreafing length and fize of the feveral phalanxes permit us to feize objects conveniently and firmly, to retain them, however fmall. The power we poffefs of moving them fingly, or in different degrees, of touching the palm of the hand at any point of its furface, of fpreading them laterally, of feparating one from another, &c. enables us to adapt their pofition to every poffible ufe. In all the actions of the hand, the thumb holds a confpicuous rank. Alone, it oppofes the efforts of the other fingers, which are much longer, and bend, as it were, to meet the thumb, whenever we clofe them on the object. With regard to the different lengths of the thumb, and feveral fingers, we may obferve, that when feparated moft widely from each other, by gently bending the points they may be brought to defcribe nearly a circle on a plane furface, forming with the hollow of the palm a concave hemifphere; from which fituation they may be further contracted, till the feveral points meet: from this conftruction they are fuited to grafp equably and firmly bodies of a rounded form. The fenfe of touch owes, in a great meafure, its delicacy and perfection to the readinefs and precifion with which the fingers can be applied to the object whofe qualities we wifh to examine. It would be almoft endlefs to defcribe the different motions of which they are fufceptible; they are fo rapid in fucceffion, fo varied in direction, extent, and power, fo exquifitely adapted to the innumerable offices they have to perform, as to conftitute an inexhauftible, not to fay an inexplicable fubject for difcuffion.

We conclude our hiftory of the upper extremity, by fome remarks on its powers of refiftance and fufceptibility of motion, as a complete member, enjoying the affemblage of all the properties we have defcribed as refulting from the mechanifm of each divifion.

The cafes in which the upper extremities are required to fupport ſupport great efforts, or to oppoſe a powerful impulſe, are by no means ſo numerous or ſo frequent as in the lower limbs, where conſiderable exertion and reſiſtance are neceſſary, to ſupport the body in the ordinary attitudes. In the action of puſhing, the hand is applied to an object, the fore-arm and arm extended between it and the trunk forming a ſtraight lever, which conveys the weight of the latter on the body to be puſhed. In this motion the hand being inflected backwards on the fore-arm, the joint of the wriſt is ſoon fatigued by the diſtenſion and preſſure in front; the ſigmoid cavity of the ulna bears directly againſt the lower end of the humerus, the latter reſts on the glenoid cavity of the ſcapula, which is fixed firmly by its muſcles and the clavicle.

It is only, however, when the arm is directed outwards, that it bears directly on the glenoid cavity; if it be turned forwards or backwards, the capſular ligament and the ſurrounding muſcles ſuſtain the effort. The firſt circumſtance is moſt favourable to firmneſs and continued reſiſtance; and we may obſerve, that when at liberty to chooſe our attitude in puſhing with one arm, we always place it in ſuch a direction as to bring it to bear directly on that cavity. For inſtance, if the object be in front, we turn ourſelves ſo as to bring the ſide of the body correſponding to the limb we are about to exert oppoſite to the object. In preſſing downwards, in reſting on the arm, &c. the mechaniſm is nearly the ſame, as far as regards the hand, which is ſo much extended on the fore-arm as to form an angle with it behind, while the fore-arm is placed in the ſame line with the arm, the joint of the elbow being fixed and immoveable. The difference depends only on the change of ſituation which takes place in the joint of the ſhoulder, the head of the humerus preſſing more or leſs advantageouſly, as the direction of the preſſure varies from the relative poſition of the object on which the limb reſts.

The beſt poſſible direction is where the arm is extended laterally, ſo as to bear on the glenoid cavity, the ſcapula being at the ſame time ſupported directly by the clavicle. It is underſtood that in every caſe the poſition of the limb is preſerved by muſcles, which are called on to act more or leſs, as that poſition is more or leſs favourable for ſuſtaining the effort, and become tired in the ſame proportion. This obſervation is more particularly applicable to the caſe in which the upper extremities have to ſuſtain the whole weight of the body, as in the inſtance of tumblers, when the hands are placed on the ground, and the body raiſed into the air, the upper exerting for a time the functions of the lower extremities. This attitude is both difficult and painful, from the want of ſufficient muſcles to maintain it, and from the ſmall extent of the articular ſurfaces. The wriſt ſuffers more particularly, as in marching on all-fours, becauſe theſe ſurfaces do not bear on each other, but on the front of the joint; the elbow is not ſo much diſtended from the conſtruction of the articulation; the ſhoulder-joint ſuffers almoſt equally with the wriſt, from the preſſure on its capſule. The upper extremities are articulated with the trunk in a plane poſterior to the lower; the line of gravity in the attitude above-deſcribed is anterior to the ſupport, and we find, conſequently, that to preſerve the balance, to counteract the tendency to fall forwards, the lower extremities are thrown conſiderably backwards.

The motions of the upper extremity are ſo numerous and varied, as ſcarcely to admit of claſſification; they are ſo familiar as not to require deſcription. The mechaniſm by which they are performed has been conſidered in treating of the ſeveral articulations, and may readily be applied to any caſe; we ſhall now only briefly recapitulate the more material points. The ſhoulder is the centre of motion of the whole limb; the arm gives the general movement, the parts below thoſe which are more partial. The motions of the ſhoulder affect the whole limb; as we deſcend, the actions are more and more confined. A finger may be employed while the arm is motionleſs; if the latter is moved, all below muſt partake of the motion. It is from the combination of the ſeveral partial motions that the increaſe and variety of the whole are derived, and theſe are multiplied the lower we go. The hand enjoys the individual motions of its component parts; a general motion from the joint of the wriſt; a more general ſtill from the connection of the bones of the fore-arm and the elbow, which is increaſed to a ſtill greater extent by the ſhoulder joint and ſhoulder. The motions then may be more compound as we deſcend, as well as more partial, becauſe each part enjoys the motion reſulting from its proper articulation, in conjunction with all thoſe above it. This general action of the parts of the upper extremity is obſervable in ſeizing or graſping any body, or in embracing, where all the articulations are *bent*, or in the oppoſite actions of ſpreading the arms, or *extending* the whole limb in different directions, &c. It is more commonly ſeen under caſes where the different joints are inflected variouſly at the ſame time, ſome extended, and others bent, theſe motions being often alternate. All theſe modifications of action may be obſerved in puſhing, pulling, climbing, graſping a diſtant object, ſwimming, ſtriking, &c. &c. In ſhort, in all the familiar exerciſes of the upper extremity we are conſtantly in the habit of performing. We cannot conclude without hinting at thoſe impreſſive actions of the upper extremity, which form a mute language employed moſt emphatically in aiding the expreſſions of our paſſions, or our will; it is enough to ſay, they are as numerous and varied as the feelings which bring them into play.

The lower extremity—is divided, as the upper, into four parts, *viz.* the hip, the thigh, the leg, and the foot, each of which has a more or leſs ſtriking analogy with the correſponding diviſions of the upper extremity. We ſhall examine their points of reſemblance and difference more minutely hereafter; at preſent, we would obſerve only, that the bones, which form the baſis of the lower extremity, are more maſſy and ſolid in their forms, and are hence adapted to their functions, as organs by which the reſt of the body is ſupported and moved. Their prominent character is ſolidity and firmneſs; in the upper extremity every thing is conſtructed for variety and quickneſs of motion.

The lower extremity is connected with the trunk by the articulation of the hip bone with the baſis of the vertebral column, the ſacrum; through which the whole weight of the body is tranſmitted to the bones of the hip. The connections of the two hip bones with the ſacrum behind, and with each other in front, form a bony cavity called the *pelvis*, the principal uſes of which are, to contain ſome important viſcera, to offer a baſis of ſupport to the trunk above, and two fixed points for the motions of the limbs below. It is in the laſt functions only that we ſhall have occaſion to notice the pelvis here; we ſhall not, therefore, enter into a deſcription of it as a whole, but attend to thoſe of its parts which bear on the preſent ſubject, and correſpond to analogous portions of the upper extremity.

The os coxæ, os innominatum, hip, or haunch bone, is the largeſt of the broad bones, placed laterally at the lower end of the trunk, connected with its fellow in front, by means of cartilage, and ſeparated from the oppoſite bone behind by the intervention of the ſacrum. The hip-bone is very irregular in figure, broad and flattened above, con-

 tracted

tracted and maſſy in the middle, and apparently more ſlender in the anterior and lower portions: it is curved ſo as to have its flat ſurfaces in almoſt oppoſite directions; the upper diviſion is flattened from ſide to ſide, the lower from back to front, the change of direction taking place in the middle portion. In young ſubjects this bone is formed of three ſeparate pieces; a ſuperior, called the *ilium*, an anterior, the *pubes*, and an inferior, the *iſchium*. In the adult they are ſo intimately united, that we can with difficulty trace their former line of ſeparation. We can ſee therefore no reaſon for deſcribing as diſtinct, what in its perfect ſtate forms but one ſolid bone. We ſhall conſider it as ſuch; but, not to deviate too much from common uſage, ſhall notice the different diviſions as we proceed, and afterwards particularly deſcribe their lines of union. We diſtinguiſh in the os innominatum two ſurfaces; an internal or pelvic, an external or femoral, and a circumference or border, which is again ſubdivided into ſeveral parts.

The external ſurface looks outward above, and forwards below; it is covered by ſtrong and numerous muſcles. The outſide of the broad upper diviſion, the dorſum of the ilium, is convex and concave in different parts; at the poſterior and ſuperior part is a rough eminence, which gives attachment to the gluteus maximus; below this a ſurface, concave and broad behind, convex and gradually narrowing in front, gives attachment to the fibres of the gluteus medius; it is bounded by the eminence juſt mentioned, by the upper edge or criſta of the ilium, and below by a ſemi-circular line, with the convexity upwards, paſſing forwards from a deep notch behind, (the great ſacroſciatic,) and terminating in the criſta of the ilium in front. The ſpace compriſed between this curved line and the deep articular cavity below, gives origin to the gluteus minimus; it is concave behind, and gibbous in front. At the anterior part, immediately above this cavity, is a rough impreſſion, where the curved tendon of the rectus cruris is fixed. The portion of the external ſurface, which is directed downwards and forwards, is very irregular in figure. Above is a deep and large cavity, called the acetabulum or cotyloid cavity; it forms nearly the half of a ſphere, lined by cartilage in its upper two thirds, the lower part a little deeper, lodging ſome cellular tiſſue, and the ſtrong ligament paſſing to the head of the thigh-bone. The margin of the cavity is irregular and waving, more prominent above than below, ſurmounted by a ligamentous ring, which makes the acetabulum ſtill deeper, interrupted towards the inner ſide by a notch, completed by a ligament which leaves only a ſmall opening for the paſſage of the articular veſſels; it gives attachment to the capſular ligament of the hip joint. The bone ſurrounding the cotyloid cavity is thick and maſſy, eſpecially at the upper and outer ſides; the cavity itſelf is directed obliquely outwards, downwards, and forwards. Below, and on the inner ſide of this cavity, is a large hole, of an oval ſhape, the foramen ovale, obturatorium, or thyroideum. Its long diameter is from above downwards, its edges are acute and rough, except at the upper part, where there is a ſmooth gutter directed obliquely from above inwards and downwards, in which the obturator nerve and veſſels are lodged. The groove is formed by the internal and external edges of the circumference croſſing each other at the top of the oval, the latter paſſing in front to a point called the ſpine of the pubes, leaving the oblique hollow between itſelf and the internal margin which paſſes up in the oppoſite direction. The foramen ovale is cloſed by a ligament attached to its edges every where but at the groove juſt mentioned, where it leaves a vacancy for the paſſage of the obturator veſſels, &c. In the female this foramen is ſmaller than in the male, and of a triangular figure. On the inner ſide of the foramen is a rough and unequal ſurface, broader above and below than in the middle, giving attachment to portions of the triceps, and the external obturator muſcle.

The internal or pelvic ſurface is concave, correſponding in its direction to the external or femoral, covered by muſcles which ariſe from it. The anterior part of the upper diviſion, the foſſa iliaca, is occupied by the iliacus internus muſcle; the poſterior is very ſcabrous and unequal, divided into two portions, of which the anterior is covered by cartilage, and articulated with the ſacrum, forming the ſacro-iliac ſymphiſis, reſembling ſomewhat in outline the human ear, the poſterior is convex and very rough, giving attachment to the ſtrong and numerous ligamentous fibres which connect this bone with the ſacrum above. Below the iliac foſſa, croſſing from the articular ſurface to the anterior angle of the bone, is a prominent angular line, forming a part of the ſuperior aperture of the pelvis, ſeparating the upper diviſion from the lower. The latter preſents a plane ſurface behind, broader above than below, giving attachment to the obturator internus and levator ani; in front of this is the obturator foramen, and in the inſide of the latter a narrower ſurface correſponding to the bladder above, giving origin to a part of the obturator internus below.

The circumference of the os innominatum is exceedingly irregular, with alternate prominences and hollows, and is divided into four portions, *viz.* a ſuperior, an inferior, a poſterior, and an anterior. The ſuperior margin bears the name of the criſta of the ilium; is convex, narrower in the middle than at the ends, and inclined outwards. The inner edge, or labium, gives attachment to the tranſverſalis abdominis, and quadratus lumborum; the external to the obliquus externus, the latiſſimus dorſi, and the faſcia of the thigh; the middle convex portion to the obliquus internus. The anterior margin is concave, and its lower half nearly horizontal. Its union with the criſta forms the anterior ſuperior ſpine of the ilium, which gives attachment to the tenſor vaginæ femoris, the ſartorius, and the upper end of that part of the tendon of the external oblique, called Poupart's ligament. Below this point is a ſlight notch, riſing again into another eminence, the anterior inferior ſpine of the ilium, from which the rectus crucis ariſes. This is ſucceeded by a ſmooth hollow, over which paſs the pſoas magnus, and iliacus, bounded by a protuberance called eminentia ileo-pectinea, into which the tendon of the pſoas parvus is implanted, when it exiſts. On the inſide of this there is an oblique ſurface, concave, triangular, with the baſe outwards, and the point inwards, bounded in front by a line which is continued from the external margin of the obturator foramen, behind by a ſharp ridge, the criſta of the pubes, which is continued from the tranſverſe line deſcribed as croſſing the pelvic ſurface. Over this concave ſpace paſs the crural veſſels. The anterior margin terminates by uniting with the inferior, at a right angle, called the angle of the pubes. A little before its end we obſerve on it a projecting point, the ſpine of the pubes, giving attachment to the pyramidalis, and the external pillar of the abdominal ring, formed by the tendon of the external oblique. The inferior margin is the ſhorteſt, preſenting above a perpendicular oblong ſurface, forming with the oppoſite bone, by the intervention of cartilage, the ſymphyſis pubis; below this the edge is thinner, forming with the oppoſite one the arch of the pubis, affording attachment to the gracilis, to portions of the triceps, to the corpus cavernoſum, the tranſverſalis perinei, and the erector penis, or clitoridis. The upper half of this bony plate is called the deſcending ramus of the pubis, the lower the aſcending ra-

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mus of the iſchium. The poſterior margin is the moſt irregular in its outline. Beginning from above we obſerve the angle formed by its junction with the ſuperior margin, the ſuperior poſterior ſpine of the ilium, an hollow ſeparating it from the eminence below, the inferior poſterior ſpine; a very deep notch forming part of the ſacro-ſciatic notch; a ſharp prominence, the ſpine of the iſchium, giving attachment to the ſuperior gemellus, the coccygeus, and the leſſer ſacro-ſciatic ligament; a ſmooth concave ſurface, over which the tendon of the obturator internus plays; and a broad eminence where it joins the inferior margin, the tuberoſity of the iſchium giving attachment, externally, to the quadratus femoris, and the great head of the triceps; within to the great ſacro-ſciatic ligament, and the inferior gemellus, in the interſpace to the biceps, the ſemi-tendinoſus, and ſemi-membranoſus.

The os innominatum is in ſtructure like the other flat bones; the two compact tables, encloſing the more cellular parts, touch each other in the middle of the iliac foſſa, and again at the depreſſion in the acetabulum. It is developed from three points of oſſification, at the angle of the pubis, the tuberoſity of the iſchium, and the middle of the upper diviſion, or ilium. The union of the bony plates proceeding from theſe points takes place between the ilium and pubes at the eminentia ileo-pectinea; between the latter and the iſchium, in the middle of the branch which forms the inner ſide of the foramen ovale, and the half of the arch of the pubes; between the iſchium and the ilium at the great ſacro-ſciatic notch. The junction of the three takes place in the acetabulum, which forms the principal point of union; the ilium makes the upper part of the cavity, the pubes the anterior, the iſchium contributing the principal ſhare, and completing it at the inferior and poſterior portions. The part which either bone takes in forming any of the principal features of the os innominatum will be immediately ſeen, by obſerving their lines of union with each other. At the time of birth the acetabulum, being far removed from the centres of oſſification, is wholly cartilaginous, as are alſo the different eminences, the ſpines, and the criſtæ. It is not till the time of puberty that all traces of cartilage are obliterated. The os innominatum is articulated with the ſacrum, by the ſacro-iliac ſymphyſis; with its fellow, by the ſymphyſis pubis; and with the thigh-bone by means of the cotyloid cavity. We ſhall ſay nothing of the two former of theſe connections, but that they are exceedingly ſtrong, and the bones bound ſo cloſely together, as not to allow of any perceptible motion; we ſhall deſcribe the laſt after having gone through the hiſtory of the thigh bone.

In commenting on the mechaniſm of the ſhoulder, we had to notice its articulation with the trunk, and the motions reſulting from its peculiar mode of connection; in the preſent inſtance we find an immoveable adherence of ſurfaces, which allows of no deviation from one determined poſition. In conſequence of this total want of motion, we ſhall not enter on the detail of the connections of the hip bone with the trunk, or with its fellow; they can influence the functions of the lower extremity no farther than by tranſmitting to it the weight of the body.

The oblique direction of the articular ſurfaces of the ſacrum, which gives it the form of a wedge driven between the two oſſa innominata, is well adapted to the purpoſe of tranſmitting ſecurely the weight of the trunk to the latter bones: the ſtronger the depreſſing impulſe, the more cloſely the ſurfaces are brought together; the ſhock muſt be violent indeed, which can in anywiſe looſen their connection. It is then through the medium of the ſacrum that every effort is propagated to the two hip bones, which in ſome poſitions are the immediate baſe of ſupport, while in others they continue the impulſe to the limb below. In the common attitude of ſitting, the trunk is ſupported on the tuberoſities of the iſchia; in progreſſion, or in ſtanding, on the cotyloid cavities. Theſe being at a diſtance from each other, facilitate the motions of the thighs, and increaſe their extent, the pubes executing one of the offices of the clavicle, in keeping the hip joints far aſunder, as the clavicle does thoſe of the ſhoulder. It will be ſeen, from the deſcription of the hip bone, that its ſurfaces and circumference give attachment to numerous and powerful muſcles, by far the greater number of which are deſtined to regulate, or to give vigour and effect to the motions of the thigh and leg, and to balance the varying weight above them.

The thigh—is the diviſion of the lower extremity between the hip and the leg. It is formed by a ſingle bone, called the *femur*, or *thigh bone*.

The femur is the longeſt bone of the body, the largeſt in volume, and the ſtrongeſt. It has a conſiderable curve forwards, is contracted in the middle, wider and more bulky at each extremity, one of which is called the upper, or *iliac*, the other the lower, or *tibial*.

The upper extremity includes three remarkable eminences; the head, ſupported by a long neck, and the great and little trochanters. The rounded head of the femur is received into the cotyloid cavity of the os innominatum; it forms more than half of a ſphere, directed upwards, inwards, and a little forwards; ſo that the greateſt part of its convexity is above, and its axis the ſame as that of the neck, which ſuſtains it. The convex ſurface is ſmooth, except juſt below the centre, where we find an hollow, which gives attachment to an inter-articular ligament; it extends further in front than behind, above than below, and terminates in a waving line at the neck. The latter contracts immediately below the head, and becomes a little flattened vertically, the upper edge remaining the wideſt; it is longer below and behind, on which aſpects it is alſo hollowed, than above and in front; joined by a broad baſis to the body of the bone, from which it ſtands off in a direction ſlanting upwards and inwards, advancing at the ſame time a little forwards, forming with it an angle more or leſs obtuſe. The length and obliquity of the neck vary conſiderably in different ſubjects, being in ſome nearly horizontal. The great trochanter is on the outer ſide, directed a little backwards, below the level of the head, riſing above the hollow of the neck, quadrilateral, convex on the outſide, and exceſſively rough for the attachment of ſtrong tendons, the tendon of the gluteus maximus paſſing over the ſmooth ſurface at the poſterior part; hollow, and of much leſs extent on the inſide, giving attachment above to the tendons of the gemelli, the obturator internus, and the pyramidalis below, and towards the back part to the obturator internus. It has rough and irregular borders; to the anterior is fixed the tendon of the gluteus minimus; to the lower part of the poſterior the quadratus; to the upper the gluteus medius; to the lower the vaſtus externus. The attachments of theſe muſcles are hardly, however, confined to the edges of the trochanter; their tendons are implanted alſo to a greater or leſs extent over the outer ſurface, for which purpoſe its roughneſs, as mentioned above, ſeems particularly deſigned. The little trochanter is placed at the internal and poſterior part of the baſe of the neck, oblong and ſomewhat pyramidal in ſhape, its rough ſummit giving attachment to the united tendon of the pſoas magnus and iliacus. From its baſe we trace two prominent lines proceeding obliquely upwards to the great trochanter, one uniting them

them in front, the other behind. Thefe, in conjunction with the two trochanters, mark the circumference of the bafis of the neck, and give attachment, more efpecially the anterior, to the capfular ligament of the hip joint. The body of the thigh bone is convex forwards, and hollowed behind, appearing nearly cylindrical when viewed in front, but almoft triangular above, and flattened tranfverfely towards the lower end. It has been divided in defcriptions into three furfaces and as many angular lines; thefe characters, however, are not ftrongly marked; the furfaces are univerfally fmooth, the dividing lines blunt and rounded, if we except the pofterior ridge formed by the union of the internal and external furfaces, called with great propriety the linea afpera, or fpina femoris. This is formed by two converging rough lines, commencing from each trochanter above; that which proceeds from the trochanter major is the moft prominent and rough, giving attachment to the gluteus maximus; the pectineus is affixed to the other; and the interfpace is occupied by the quadratus and a portion of the triceps. The double ridge, formed by the approach of the two rough lines, is continued down the bone, when it again divides into two lefs remarkable lines, which terminate in the condyles at the lower extremity. The whole middle of the linea afpera gives attachment to the triceps; a portion of the biceps has its origin at the lower part, which is continued along the line diverging towards the external condyle; the line going to the internal condyle is fcarcely obfervable for a little way below the point of bifurcation. Thefe two branches of the linea afpera leave a triangular interval between them, fmooth and fomewhat concave, correfponding to the popliteal veffels. Befides the mufcles fixed to different parts of the linea afpera, the vaftus externus is attached to almoft the whole extent of the line, proceeding from the great trochanter to the external condyle; and the vaftus internus is connected in a fimilar manner to the line from the little trochanter to the internal condyle. The furfaces of the body of the femur are covered by thefe mufcles, and by the crurcus, which cover the bone at every point, excepting towards the lower end, and the fpace intercepted between the bifurcation of the linea afpera. The nutrient arteries of the body of the bone are found in the courfe of the linea afpera; the principal one about the point of convergence above.

The lower extremity much exceeds the upper in volume, and prefents two eminences called condyles, the internal and external. They are both convex, project more behind than in front, are fmooth below for articulation with the tibia, this furface being terminated behind by two hollows, which give origin to the heads of the gaftrocnemius. They diverge behind, leaving a deep notch between them, where the crucial ligaments of the knee joint are fixed; on the front they are joined by a continued articular furface, which is hollowed to receive the knee-pan or patella; the edge of the pulley formed by the outer condyle being more elevated than the oppofite one. The articular furface terminates abruptly in the lateral direction, in the perpendicular rough fides of the condyles; in front it is continued a little way up the bone, ending in a flightly prominent edge. The internal condyle gives attachment on the inner fide to a lateral ligament, and to the tendon of the triceps. The external furface of the outer condyle is marked by a depreffion to which the popliteus is affixed, and by an eminence for the external lateral ligament of the knee. The articular furface of this condyle is broader than that of the internal, and not fo convex, the anterior part being nearly plane; and it is continued much higher up in the front than on the oppofite fide. The internal condyle, when the thigh bone is placed perpendicularly, appears to defcend much lower than the external; but in the natural oblique direction of the femur, the bottom of the two condyles will be found nearly in the fame horizontal plane, the internal ftill exceeding a little.

The femur is compact in its ftructure in the middle part, reticular and fpongy at the extremities, which are yet cartilaginous at the time of birth. Offification commences in the middle of the bone, and it is not till after this has reached the extremities that we obferve three centres of offification above, in the great, the little trochanter, and the middle of the head, and two below, one for each condyle. The cartilages between them and the body of the bone gradually decreafe in thicknefs, and they become united, the two trochanters the firft, then the head, and laft of all the conjoined condyle. It is not till the bone has nearly arrived at its complete and adult form that the line of feparation is entirely obliterated. In infancy the neck of the bone is nearer at right angles to the body than at any after period; as the age advances the angle becomes more and more obtufe in the majority of fubjects; in fome few it fcarcely alters its direction. This alteration, from an horizontal to an oblique line, is a proof among many others how little the functions or growth of the animal body are fubject to phyfical laws; we fee the neck of the thigh bone rifing, as it were, in direct oppofition to the weight of the fuper-incumbent body. This portion of the femur is alfo proportionally fhorter than in the adult, and wholly cartilaginous. The body of the bone is ftraight, inftead of being curved forwards, as in the adult; and the inferior extremity is comparatively of larger dimenfions. Thefe characters of the infantile bone are loft as it gradually becomes developed, and acquires its remarkable denfity and firmnefs. The thigh bone is articulated above with the os innominatum, below with the tibia and patella.

The articulation of the femur with the os innominatum, the hip joint.—The furface of the cotyloid cavity of the hip bone is lined by an articular cartilage, of which the central parts are thinner than the circumference. It terminates at the edge of the depreffion obferved at the inner and lower parts of the cavity, which is filled up by a fatty cellular tiffue, fupplied by numerous veffels. The bony margin of the cavity is completed by a ligament croffing the notch, and the whole rim of the acetabulum is furmounted by a circular ligament, called the cotyloid ligament, which much increafes its depth. In this round articular cup, or acetabulum, the head of the thigh bone is lodged. The latter is covered by cartilage thinner at the circumference than towards the centre, where it is partially interrupted by the infertion of a ligament, and accommodated exactly to the oppofite furface of the acetabulum; the cartilaginous head, however, is fo deep as not to be wholly embraced by this cavity in any pofition; and hence fome part of its margin always appears expofed on turning back the enveloping ligament. The contiguous furfaces are fecured in their relations by a very ftrong capfular ligament, fupported by fibres from the neighbouring parts, and furrounded on all fides by mufcles; and by an inter-articular ligament. The oppofed furfaces are covered by a fynovial membrane.

The cotyloid ligament adheres firmly to the edge of the acetabulum at every point, excepting the great notch which it croffes. It is thick at the border next the bone, thin at the oppofite prominent margin, broader above, and externally thin in the contrary directions, and partially broader wherever there is any depreffion in the offeous rim, fo that the unconnected margin of the ligament is exactly plane throughout. It is formed by ligamentous fibres arifing from

from the edges of the cavity without, inclining gently towards it in their progrefs, and inferted again into the fides of the margin within at a greater or lefs diftance from their point of origin. Thefe fibres receive an addition above from the curved tendon of the rectus cruris; below they are confounded with the fibres of another ligament, completing the great notch. The latter is formed by two crofs planes of fibres paffing from one edge to the other; they decuffate each other in their courfe, one band correfponding to the furface of the joint, the other to the edge of the obturator foramen, from the ligament occupying which it partly takes its origin. They leave a vacancy below for the paffage of veffels into the joint; towards the brim of the cavity they are continuous with the cotyloid ligament in the manner above-mentioned; they give a partial attachment alfo to the ligamentous capfule. The cotyloid ligament, in conjunction with thefe bands, completes the figure of the acetabulum, and by increafing its depth fecures the joint without in any degree diminifhing the motions of the head of the femur, to the preffure of which it readily yields. They are both lined towards the joint by the fynovial membrane, which is continued over the edge of the cotyloid ligament a little way down the oppofite furface, before it is reflected to the capfular ligament. Thefe two laft are oppofed to each other in part by its intervention; towards their mutual attachment to the brim of the cavity they are intimately united. Into the articular hollow thus conftituted, the head of the femur is received, and fecured by an orbicular and internal ligament.

The capfular ligament of the hip joint, (l. orbiculare, membrana capfularis femoris, Soemm.) extends from the circumference of the acetabulum to the bafe of the neck of the femur. It is fixed to the bony margin of the former from the line of infertion of the cotyloid ligament, to a fhort fpace beyond it, fo as to furround the latter, which projects freely into the joint. Its infertion extends further beyond the cotyloid ligament in front and on the outer fide than it does internally, where it may be almoft faid to arife from its very edge. From this circular attachment the capfule defcends, enveloping in its courfe the chief part of the neck of the femur, to the circumference of whofe bafe it is finally fixed. In front it reaches the oblique line between the trochanters, the linea inter-trochanterica; behind, fome of its fibres only reach fo far, the greater number are implanted into the neck between the pofterior oblique line and its middle; above, it is fixed to the root of the great trochanter; below, it extends nearly to the little. The capfular ligament is in general very thick, and of a clofe and condenfed texture; it is thinneft internally and behind, thicker externally, and moft decidedly fo in front, where it is ftrengthened by a layer of longitudinal fibres arifing from the anterior margin of the os innominatum, and from the anterior inferior fpine, and fixed below to the anterior linea inter-trochanterica. In other parts of the ligament the courfe of the fibres is lefs diftinctly marked; from the margin of the acetabulum they follow different directions, decuffating each other, and leaving occafional intervals, more efpecially below, through which veffels pafs to the fynovial membrane. This laft is occafionally expofed and bare on the fide next the obturator foramen. The capfular ligament is covered in front by the rectus cruris, pfoas magnus, and iliacus internus, a fynovial burfa lying between them; on the internal fide, by the obturator externus and pectineus; behind, by the quadratus femoris, the gemelli, the tendon of the obturator internus, and the pyramidalis; above and without, by the gluteus minimus, which is more clofely connected with it than any other of thefe mufcles.

The interior, or round ligament, (ligamentum teres, internum) is entitled to almoft any name rather than round; it is flattened, and of a triangular figure, the bafe towards the acetabulum, the fummit next the head of the femur. It is fixed at one end to the extremities or corners of the great notch of the colytoid cavity, and to the pofterior edge of the tranfverfe ligament occupying the vacancy; from thence it mounts obliquely backwards, and is attached to the depreffion noticed towards the centre of the head of the thigh bone. It appears as if compofed of two bands of fibres, one arifing from the fuperior, the other from the inferior extremity of the great cotyloid notch, which approach each other towards their oppofite infertion. The upper of thefe is by far the weakeft; in many cafes it appears only as a duplicature of the fynovial membrane, enclofing only a fmall number of ligamentous fibres. It muft reftrain the head of the femur from quitting the cavity upwards and outwards, and muft be partially, if not entirely, ruptured in the luxations in thofe directions; in the difplacement towards the obturator foramen it would not apparently fuffer much injury.

The fynovial membrane lines the cotyloid cavity, is fpread over the fatty cellular tiffue, occupying the finus at its bottom, is reflected from thence over the internal ligament, which it wholly encafes, adhering to it more or lefs intimately in different parts: it covers the articular cartilage of the head of the femur, is continued over the periofteum of the neck, which appears through it as if formed of parallel fibres; at the bafe of the neck it turns back over the inner furface of the capfular ligament, lines it to its attachment round the brim of the acetabulum, and from thence paffes over the cotyloid ligament. The hip joint is very much ftrengthened by the furrounding mufcles, efpecially by thofe which immediately cover it.

The motions which take place in the hip joint refemble thofe in the fhoulder; they are, however, with the exception of rotation, lefs extenfive, owing to the immobility of the cotyloid cavity, its great depth, and the comparative tightnefs of its capfular ligament. The femur can be bent on the hip bone, extended, brought nearer to, or removed further from, the mefial plane, moved between thefe directions, or carried round in a circular direction (*circumduction*), and rolled inwards and outwards. In the moft common pofition, with the thigh in the fame line as the body, the fummit of the great trochanter, which can be always felt externally under the integuments, is in the fame horizontal line with the fpine of the pubis, and about the middle of an oblique line extended between the fuperior anterior fpine of the ilium, and the tuberofity of the ifchium. By a previous knowledge of the relative pofition of this eminence to points which can be eafily felt, we fhall be competent to decide on any accidental difplacement, as well as to follow the alteration of pofition in the different motions of the femur.

When the thigh is bent, the head rolls in the acetabulum in the axis of the neck, the fummit of the trochanter recedes from the fpine of the ilium, and approaches the tuber of the ifchium, and the lower end of the bone is advanced. In moderate flexion there is but little alteration in the relations of the articular furfaces; when carried to its greateft degree, a portion of the head of the femur quits the acetabulum, and refts on the pofterior part of the capfular ligament, which undergoes confiderable diftenfion. Extenfion of the thigh is the replacement of the limb in its former ftate, from the pofition of flexion. The very clofe manner in which the head of the bone is covered in front by the ftrong ligamentous fibres, which proceed from the anterior and inferior fpine

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of the ilium, and the neighbouring anterior portion of the cotyloid line, entirely prevent us from carrying the limb backwards beyond a perpendicular line drawn from the pelvis downwards, if the latter part be preserved immoveable. The degree of motion in this direction, if it exist at all, is very trifling, supposing the trunk to be erect, and the pelvis fixed; the apparent freedom of motion in the direction of extension arises from the pelvis being ordinarily moved in the opposite direction.

In abduction, or removing the thigh from its fellow, the great trochanter rises towards the fossa of the ilium, which it touches, if the motion be continued as far as possible, and thereby limits the extent of that motion. The internal surface of the head abandons the acetabulum, while the external sinks deeper into it; the capsular ligament is made very tense on the inner side, where it supports the head and opposes its tendency to any displacement in that direction. In adduction nothing remarkable occurs; it is merely the return of the thigh from the last position to its natural one; the limb may, however, be carried, in this direction, across the opposite one. Besides these four motions in opposite lines, it will be readily understood that the femur can be moved through all of the intermediate points. Circumduction is not so free as in the shoulder joint, as may be gathered from the preceding observations: rotation is, on the contrary, less confined, on account of the length and obliquity of the neck of the femur, so strikingly different from that of the humerus. In the latter rotation is nearly in the axis of the bone, on account of the extreme shortness of the neck; in the femur, where the axis of the bone is so far removed from the centre of motion, this motion passes round a line extended from the upper part of the head to the middle point or interval between the condyles. In rotation inwards, which is more confined than that outwards, the great trochanter describes the arc of a circle from behind forwards, and the head of the bone is buried deeper in the cavity; the motion of the trochanter is more sensible and more extensive as the neck is proportionally longer. In rolling the thigh outwards the great trochanter sinks under the muscles, and the head of the bone distends the capsule somewhat in front. In its most natural position the thigh is turned a little outwards, which contributes, with the direction given to the foot by the construction of the ankle joint, to point the toes moderately outwards. As the leg and foot necessarily follow the rolling motions of the thigh, and more perfectly so when the leg is extended on the latter, it will be seen that the rotation of this bone inwards and outwards will imply a corresponding alteration in the position of the foot; and the great power we enjoy of turning the toes outwards, and the narrow limits to which we are confined in directing them inwards, will be found to result from the difference observed in the powers of rotation of the thigh.

The motions of the hip bone on the thigh, when the latter is the fixed point, will require no particular detail after the preceding remarks. It is sufficient to say they may be made in every direction, and with tolerable facility, particularly lateral inclination, in which one hip bone is lowered, and the opposite one elevated, and rotation; motions executed with promptness and to a great extent in the *pirouettes* of our stage dancers. We shall have occasion to speak at length of the flexion and extension of the hip bones on the thigh, when we examine the mechanism of the whole in the attitude of standing.

The leg—is the part of the lower extremity placed between the thigh and the foot; the bones which it contains are the tibia, the fibula, and the patella.

The tibia, the largest of the three, alone supports the weight placed on the leg from above; it comes next to the femur in size, is larger above than below, nearly triangular throughout, divided into an upper, femoral extremity, or head, a middle part or body, and a lower or tarsal extremity.

The upper extremity is nearly oval, with the long diameter transverse, large, and spreading.

The vertex or top presents two articular hollows or sinuses; of which the internal is oblong from before backwards, and deeper than the external, which is nearly circular. They correspond to the condyles of the femur by the intervention of moveable cartilages; and are divided from each other by a middle eminence, terminating in a rough depression before and behind, which completes the separation. This protuberance, placed nearest to the posterior edge of the head, is not much elevated; it slopes into the articular surfaces at the base, and is bifid at the summit, with a rough groove in the interval. The rough depression in front is larger than that behind; they both give attachment to the semi-lunar inter-articular cartilages of the knee, and to the crucial ligaments of the joint. In front of the upper extremity is a broad, flat, triangular surface, with the base upwards, corresponding to the ligament of the patella. The lateral parts have been called the tuberosities; they project considerably by a convex edge, separated in front by the flat space just mentioned, behind by a notch varying much in depth. The internal protuberance is the largest, and is marked by the attachment of the semi-membranosus behind, the external presents in the same aspect a rounded articular surface inclined downwards, for connection with the fibula.

The body of the tibia is slightly curved outwards above, and inwards below, diminishing in bulk as we trace it from the upper extremity till about one-third from its lower end, from which point its size gradually increases again downwards. It is of a prismatic form, with strongly marked edges. The anterior of these, the crista or spine, commences above at a rough eminence, called the anterior tuberosity of the tibia, into which the inferior ligament of the patella is fixed in front, and the tendons of the sartorius, gracilis, and semi-tendinosus internally; it is sharp above and in the middle, in the latter of which portions it projects a little, and becomes insensibly lost below; it forms by its course a waving line, which gives attachment to the aponeurosis enveloping the muscles of the leg. The internal edge is flattened above, and more angular below; in the first portion it gives attachment to the popliteus, for the lower two-thirds to the long flexor of the toes. To the external ridge, the least prominent of the three, the interosseous ligament is fixed; below it bifurcates and is continued into the edges of the articular cavity, which receives the lower end of the fibula. Of the surfaces between these edges, the internal or the shin is the largest; smooth, slightly convex above, and covered by the tendons of the sartorius, gracilis, and semi-tendinosus; throughout the rest of its extent it lies immediately under the skin. The outer surface is hollowed longitudinally above, and convex below, where it turns a little forward; its upper half is covered by the tibialis anticus, to which it gives attachment, and lower down the tendon of this muscle, with those of the extensor of the great toe, and the common long extensor of the toes, pass over it. The posterior surface is crossed obliquely by a line passing downwards and inwards from the articular surface, at the back of the external tuberosity; above this the popliteus is attached; below, the tibialis posticus, and long flexor of the toes; to the line itself these muscles are fixed, as also the soleus. It is is towards the upper end of the posterior surface that we find the hole which gives passage to the nutrient vessels.

The lower extremity is much less in volume than the femoral or upper; it is nearly quadrilateral with an articular cavity of the same form at the bottom, which rests on the foot. Of the four sides, the anterior and posterior are straight, transversely and nearly parallel, giving attachment at their edges to ligamentous fibres; the latter presents also a groove for the passage of the long flexor of the great toe. The internal is prolonged downwards below the level of the others, forming a broad and strong process, called the malleolus internus. This eminence does not correspond exactly to the inner tuberosity of the femoral end, but is situated a little more forwards from the slightly twisted form of the bone. The circumference of its anterior and lowest parts gives attachment to ligaments; the posterior has a broad and superficial hollow, over which pass the tendons of the tibialis anticus, and the long flexor of the toes; the inner surface is convex, and covered by the skin, the external is smooth, presenting a vertical articular surface, joining above the large articular cavity, the depth of which it considerably increases. On the outer side of the tarsal extremity is a triangular hollow with the summit upwards, smooth below, and covered by cartilage, where it receives the fibula, rough above for the attachment of strong and short ligamentous fibres, which secure the connection: the edges of the cavity are continued above into the external spine of the body of the bone, and give attachment to ligaments which pass to the fibula. The articular surface at the bottom is a little concave, quadrilateral, narrowest and deepest towards the inner side, crossed antero posteriorly by a broad gently rising eminence; it corresponds to the upper surface of the astragalus, the highest of the bones of the tarsus.

The structure and formation of the tibia resemble those of the other long bones. At birth the extremities are cartilaginous, and are not completely ossified and united to the body till a late period; the bony spines in the latter are already very prominent, and better marked than in any other bone. The tibia is articulated with the femur, the fibula, and astragalus.

The patella, rotula, or knee-pan (kniescheibe, Germ.) is situated in front of the knee-joint, or articulation between the femur and tibia, varying as the leg is bent or extended, in its relative position with regard to the femur. It is flattened, of a triangular form, with the base upwards, the upper angles rounded, the lower more acute. The anterior surface is convex, pierced by numerous longitudinal openings, covered by a tendinous expansion from the extensors of the leg, which is partially attached to it, and by the skin. The posterior articular surface is oblong, transversely divided by a blunt elevated line, passing rather obliquely from the upper edge to the lower angle, into two differently inclined concave faces, of which the external is the largest and deepest; they both correspond to the condyles of the femur on which they play. It is terminated below by a rough depression, into which a portion of the ligament of this bone is fixed. Of its circumference, the upper edge is thick, and gives attachment to the tendon of the extensors, the lateral borders slightly convex, to the common aponeurosis of these muscles. In the lower angle the strong anterior ligament which connects the patella to the tuber in front of the tibia is firmly implanted.

The substance of the patella is spongy in the middle, covered by a thin crust of compact bone. It is formed in the thickness of the tendon of the extensors, and always preserves the appearance of longitudinal fibres. It is not till some years after birth that bony matter is deposited in room of the cartilaginous substance at first observable, and it is a later period still before it is fully developed. The patella is articulated with the femur, and connected with the tibia by means of a ligament, of which we shall speak below.

The knee joint, or articulation of the femur with the tibia and patella.—This joint, one of the most complicated in the body, results from the contact of the condyles of the thigh bone with the head of the tibia and the posterior surface of the patella. The first of these, as well as the articular pulley formed by their union in front, are covered by cartilage, which is thicker in the middle of the condyles than at their circumference; the cartilage covering the patella is particularly thick, it is thinner on the hollows of the tibia, particularly in their centres. The forms of the articular surfaces of the femur are accommodated to those of the patella and tibia; but in the latter case the correspondence is further maintained by means of two inter-articular semilunar fibro-cartilages, interposed between the femur and tibia in such a manner, that a small portion only of the latter bone comes into actual contact with the condyles of the former. The relations between these parts are secured by muscles, and their tendons, by the ligament of the patella, two lateral, and the same number of crucial or oblique ligaments, a posterior ligament, and by a synovial membrane spread over the whole.

The ligament of the patella, which may be regarded as the termination of the tendons of the extensor muscles, consists of a very strong flat band of fibres attached above to the lower angle of that bone, and to the depression on its posterior surface, from which points it extends about two inches in length, and half as much in breadth to the anterior tuberosity of the tibia. It is covered in front by the skin and an aponeurotic expansion. The posterior surface corresponds above to some fat and cellular tissue lying betwixt it and the synovial membrane, below to a small synovial capsule placed between it and the tibia, a smooth portion of which it covers, just above the insertion of the ligament. The edges are continuous, with an aponeurosis proceeding laterally to the tibia. It is composed of parallel, shining, tendinous fibres, of which the anterior or most superficial are continued in front of the patella to be identified with those of the immediate tendons of the extensors. It is exceedingly strong, and capable of resisting the strongest efforts of these muscles.

The internal lateral ligament is flat and thin, attached above to the internal condyle of the femur, it becomes broader as it descends, part of its fibres is inserted into the edge of the internal semi-lunar cartilage, and into the edge of the head of the tibia, the greater portion contracted in breadth is continued further down, and becomes fixed at the commencement of the body of the bone to the internal edge, where it joins the aponeurotic insertion of the popliteus. It is covered by an aponeurosis descending from the fascia lata of the thigh, and below by the tendons of the sartorius, the gracilis, and semi-tendinosus: it lies over the synovial membrane, the internal semi-lunar cartilage, and a small part of the tibia. The external lateral ligament is placed between the external condyle of the femur, and the fibula, in the form of a long, round, shining cord, covered nearly throughout by the tendons of the biceps. Immediately under it are the inferior articular vessels. It is fixed to the condyle above the attachment of the tendon of the popliteus, and rather behind it; to the fibula on the outside of its upper extremity, adhering to the outer semilunar cartilage in its passage. The posterior ligament is nothing but a tendinous expansion given off from the tendon of the semi-membranosus, which mounts obliquely upwards and outwards behind the crucial ligaments, from which it is feparated by cellular tiffue and the middle articular veffels. It is attached above to the external condyle, and is confounded with the tendon of the outer head of the gaftrocnemius. Independent of this band, which is very irregular in its form and fize, we find other fibrous parcels croffing in different directions above it.

The crucial ligaments are more deeply feated, but may ftill be confidered as external to the joint as they are covered only in front, and on the fides by the fynovial membrane, and are really without the fac which it forms. They are ftrong fibrous bands croffing each other in their courfe, from which they derive their name. The anterior paffes from the pofterior and upper part of the hollow between the condyles, and from the interior fide of the external condyle; obliquely downwards and forwards, narrowing as it defcends, to be fixed in the rough furface, in front of the fpine at the head of the tibia, behind the attachment of the internal femi-lunar cartilage, and on the infide of the external, being partially united to both. The pofterior crucial ligament is attached above to the anterior part of the finus between the condyles, and the outer-fide of the internal condyle. It defcends backwards and inwards, becomes broader, and divides into two pretty diftinct bands, of which the largeft is inferted into the depreffion behind the fpine, the other joins the external femi-lunar cartilage. Thefe two ligaments are feparated from each other by cellular tiffue, and by the fame means from the pofterior ligament behind; they adhere firmly to the fynovial membrane, invefting them on the anterior and lateral furfaces.

The femi-lunar cartilages, as they are termed, lie on the articular furfaces of the tibia, between them and the correfponding condyles, occupying only the circumference, the femur and tibia touching in the centre of each. They are thick at the convex margin, and become gradually thinner, terminating in a delicate concave edge, increafing thereby the depth of the cavities which receive the gibbous condyles of the femur. The internal is broadeft behind, the external in front; the firft reprefents a portion of an oval, of which the fhort diameter is tranfverfe; the latter forms nearly a circle, correfponding, in this refpect, to the figure of the two articular furfaces of the tibia. The upper furface of each cartilage is concave, accommodated to the convexity of the condyles, the lower is nearly flat. The convex margins are united to the ligaments which crofs them in their courfe, efpecially to the lateral; that of the external has an oblique depreffion in it behind, where it is contiguous but not adherent to the tendon of the popliteus. The concave edges are free, thin, and fharp. The anterior extremity of the internal cartilage paffes in front of the anterior crucial ligament, and is inferted on the outer fide of the depreffion which gives attachment to it; the pofterior is attached behind the fpine, before the infertion of the pofterior crucial ligament. The anterior extremity of the external femi-lunar cartilage is faftened to the depreffion in front of the fpine, but much behind the attachment of the internal, and united in part with the anterior crucial ligament; behind it is implanted into the pofterior depreffion, and is connected with a portion of the pofterior crucial ligament. We have called thefe cartilages, not to depart too much from eftablifhed language, though they are of a fibrous texture. They are formed of curved concentric fibres, which are particularly evident at their extremities and convex margins, lefs fo in the middle, where they are more analogous in their appearance to cartilage. They are fometimes immediately joined by a fhort tranfverfe ligament, continued from the convex borders in front. The internal appears more fixed in its fituation than the external, which has a gliding motion backwards and forwards on the tibia.

The fynovial membrane, if we trace it from above, is reflected from the condyles of the femur, fome way above the termination of the cartilage to the circumference of the patella. In this part it is loofe, covered above by loofe fat and by the cruræus, to the tendon of which it adheres moft firmly, and laterally by an aponeurotic expanfion, from the extenfors paffing from the edges of the patella to the tibia and femur. After lining the pofterior furface of the patella, it paffes on to the upper edge of the tibia in front, lying under the ligament of the former bone, and a large quantity of fat and cellular tiffue placed underneath it, and keeping them at a confiderable diftance. From this part a duplicature of it paffes backwards through the joint, and is attached to the anterior and external part of the finus between the condyles. It has been called the ligamentum alare by Weitbrecht, or l. mucofum, feu adipofum; all names equally unapplicable to it. Laterally, alfo, it defcends towards the tibia, invefting the upper furfaces, and concave edge, and the under furfaces of the femi-lunar cartilages; after which it is continued downwards, covers the articular cartilages at the head of the bone, and is reflected upwards over the crucial ligaments in the middle, lining behind the tendons of the gaftrocnemius on their anterior furface, and enveloping the tendon of the popliteus. It thus reaches the condyles behind, to the edges of which it is attached, leaving the finus between them without the bag, and paffes over the cartilages to the point from which we fet out. It is covered in front by the extenfors and their tendon; by their aponeurofis laterally, as alfo on the infide by the tendons of the fartorius, gracilis, and femi-tendinofus, and by the internal lateral ligament with which it is in contact; on the outfide by the tendon of the biceps and the external lateral ligament, behind by the femi-membranofus and its lateral tendon, by the gaftrocnemius and popliteus. After all, we fhould have a very imperfect idea of the knee joint, if we confidered it in this abftract ftate. It is moft ftrongly fupported by the mufcular powers attached to the tendons we have mentioned, the latter being numerous, and of great ftrength, and the mufcles maffy and exceedingly powerful, fecuring moft effectually, when in action, the relations of the oppofite bones.

The motions of the leg on the thigh—are thofe of flexion, extenfion, and under particular circumftances of rotation. In flexion, the tibia and femi-lunar cartilages glide backwards on the condyles of the femur; the patella quits the articular pulley, and defcends in front of the joint, fo as to be oppofite to the finus between the condyles: the tendon of the extenfors occupies its place, and is much diftended if the flexion be carried far back, as is alfo the ligament of the patella; and the crucial and oblique ligaments, as well as the pofterior, are relaxed. In extenfion, the tibia glides forwards again, and the femi-lunar cartilages are brought oppofite to the inferior inftead of the pofterior furfaces of the condyles, which, in this pofition, reft againft the heads of the gaftrocnemius; the patella mounts again, and, in complete extenfion, if the mufcles are in action, paffes up a little way above the articular pulley; if the mufcles are quiefcent, the tendon of the patella is relaxed; this bone is loofe and may be moved in all directions; the pofterior crucial and lateral ligaments are ftretched, and prevent this motion from being carried beyond the point which brings the femur and tibia in the fame line. The great ftrength of the crucial ligaments, which are effentially diftended at this time, is a powerful obftacle to the luxation, which would throw the head of the tibia backward. When the leg is near the middle ftate,

between

between complete flexion and extenfion, it can be rotated flightly inwards and outwards ; a motion, of which the foot neceffarily partakes, and which carries the toes in correfponding directions. In rotation the articular furfaces of the tibia glide in oppofite curves in the rounded furfaces of the condyles ; not, however, in equal degrees, the moft evident motion occurring on the outer condyle. In rotation inwards the pofterior crucial ligament is brought to crofs the anterior more directly, and is much tightened, fo as effectually to limit it. In rotation outwards, which, on account of the difpofition of thefe ligaments, is more extenfive, we find them fcarcely affected. In both cafes the lateral ligaments are rendered tenfe ; the femi-lunar cartilages undergo little change of pofition, excepting that in rotation inwards, the external one, from its connection with the pofterior crucial ligament, is drawn a little afide. When the leg is bent, the motions by which the toes are carried alternately inwards or outwards take place in the knee joint ; when it is extended, they are effected in the hip, and depend on the rotation of the femur. The patella favours extenfion, by removing the power further from the centre of motion, befides which it glides more readily over the pulley of the femur, than a flexible tendon could have done, and protects materially the front of the joint in flexion, for inftance in kneeling. It fcarcely moves in rotation inwards or outwards.

The fibula—is placed on the external fide of the leg, obliquely with regard to the tibia, being behind it above, and immediately on the outfide below. It is a flender bone, nearly equal in length to the tibia, but very much fmaller, divided into an upper or tibial, or lower or tarfal extremity, and a middle portion or body.

The upper extremity is very irregular ; we remark in it above, and a little on the infide, an oblique, flightly hollowed, articular furface, correfponding to one on the outer tuberofity of the head of the tibia. In every other afpect the furface is rough and unequal, giving attachment to ligaments which connect it with the tibia, to the external lateral ligament of the knee, and to the tendon of the biceps.

The body of the fibula is of an irregular prifmatic figure, fomewhat twifted, and curved a little, fo as to approach nearer the tibia in the middle of the three angles, the anterior rifes gradually from above, is fharp and prominent in the middle, and bifurcates below, where it is covered only by the fkin. It gives origin, in the greateft part of its extent, to an aponeurofis, which feparates the peronei mufcles from the extenfor communis of the toes. The external edge is fpiral in its courfe, running backwards as it defcends. It gives attachment to an aponeurofis, which divides the peronei from the long flexor of the great toe and the foleus. The internal edge becomes anterior as it defcends ; it is very prominent in the middle, and gradually loft above and below. The upper two-thirds give origin to the flexor of the great toe, and the tibialis pofticus, the lower third to the interoffeous ligament. Of the furfaces between thefe borders, the external alters its afpect, becoming pofterior below ; it is covered by the peronei, which are fixed to the two upper thirds. The internal furface looks rather backwards above, and forwards below ; it is divided into two unequal portions by a fpine extending from the upper part of the anterior angle to the lower part of the internal angle, and which gives attachment to the interoffeous ligament. Of thefe two planes the anterior is covered by, and gives origin to, the extenfors of the great and of the other toes, and to the peroneus tertius ; the pofterior, which is hollowed longitudinally, to the tibialis pofticus. The direction of this fpine varies very confiderably, as alfo its length. The pofterior face is inclined outwards above, where the foleus has its attachment ; below it turns inwards, giving attachment by nearly its lower two-thirds to the long flexor of the great toe. About the middle is the opening for the nutrient artery directed longitudinally downwards. It widens towards the lower extremity, where it terminates in a rough convex furface, connected with the tibia.

The lower or tarfal end of the fibula is oblong, flattened tranfverfely, thicker behind than in front ; it forms the outer malleolus, which defcends rather lower, and is more pointed than the inner. The external furface is convex, and covered only by fkin ; the internal prefents, at its anterior part, a fmooth articular furface convex from above downwards, articulated with the external fide of the aftragalus, and behind this a rough depreffion for ligamentous attachments. The pofterior border has in it a fuperficial groove for the paffage of the peronei ; the anterior, as well as the angle below, give attachment to ligaments.

The fibula is in ftructure like the other long bones. It is formed from three points of offification, one for the body and one for each extremity. The latter are ftill cartilaginous at birth.

The articulation between the tibia and fibula—is by actual contact at the two extremities, and by means of an interoffeous ligament in the intervening fpace. The fuperior articulation refults from the contact of two flat cartilaginous furfaces, fecured by ligaments in front and behind, and covered by fynovial membrane. The anterior ligament paffes from the fore part of the upper end of the fibula to the anterior part of the external tuberofity of the tibia. The fibres are tranfverfe, the fuperior ones the longeft, and divided into feveral parcels, with intervening cellular tiffue. It is ftrengthened by a portion of the tendon of the biceps, which embraces the external lateral ligament of the knee, and paffes over this anterior ligament before it is fixed to the tibia. The pofterior ligament is alfo tranfverfe, but not fo ftrong, or fo well marked as the preceding ; it is continued above with fome ligamentous fibres found in the back of the knee-joint ; it is covered by the popliteus. Befides thefe two ligaments, we find a few other fcattered bands below, which help to fecure the articulation. The fynovial membrane lines thefe ligaments, and the cartilaginous furfaces ; it is feparated from the tendon of the biceps by cellular tiffue, and is contiguous behind to the fynovial membrane of the knee. The middle connection is preferved by means of an interoffeous ligament, analogous to the one we have defcribed in the fore-arm. It is thin, compofed of parallel fibres defcending obliquely from the external edge of the tibia to the ridge dividing the internal furface of the fibula, and below to the internal edge of this bone. It is broadeft at the upper part, and terminates in a point beneath, where the bones begin to touch each other. It is pierced by many openings for the paffage of veffels ; of thefe the moft remarkable are, one above, near the edge of the fibula, for the paffage of the anterior tibial veffels ; and another below for a branch from the peroneal artery. The anterior furface ferves for attachment to the tibialis anticus, the extenfors of the great and other toes, and to the peroneus tertius, and fupports the anterior tibial veffels. To the pofterior furface the tibialis pofticus and long flexor of the great toe are fixed. The inferior articulation is compofed of the contact of two cartilaginous furfaces below, a convex for the fibula, and a correfponding concave one for the tibia, lined by a continuation of the fynovial membrane from the ankle joint. The relations are fecured by ligaments before, behind, and between the bones. The anterior ligament is broad, attached to the anterior edge of the tarfal end of the fibula; in crofsing to the tibia it mounts a little upwards, widening in its progrefs, its fibres divided by intervals filled with cellular tiffue, the fuperior the longeft, and is fixed to the neighbouring parts of the tibia. It is covered by the peroneus tertius, aponeurofis of the leg and the fhin; its lower end is confounded with ligamentous fibres paffing from the fibula to the aftragalus. The pofterior ligament refembles it in direction, but it is not fo large, and the lowermoft fibres are the longeft. It paffes immediately from the pofterior part of this end of the fibula to be fixed to the tibia behind the cavity which lodges that bone, is confounded with the furrounding ligaments below, covered behind by the two lateral peronei mufcles. In addition to thefe ligaments we obferve, between the oppofite furfaces of the two bones, juft above their cartilaginous contact, a fibrous fubftance paffing from one to the other, occupying a confiderable fpace, interrupted here and there by cellular tiffue, and continuous above with the interoffeous ligament. It materially fecures the articulation.

The motions of the fibula on the tibia are exceffively limited, very different in this refpect from thofe between the bones of the fore-arm. The upper end of the fibula may glide a little backwards and forwards; the lower is nearly motionlefs from the difpofition of the ligaments, a ftructure neceffary for the ftability of the articulation of the leg with the foot, as refifting the tendency to lateral difplacement.

The foot—forms the laft divifion of the lower extremity; it has fome characters in common with the hand, but is diftinguifhed from it in a remarkable manner by its great depth and firmnefs, by the preponderance of its folid over its moveable parts, the reverfe of which is fo ftrikingly feen in the hand. It varies much in fize, in general is proportionably fmaller in the female than in the male, is elongated in form, broad and flat anteriorly, thick and narrower behind. It is convex on the upper furface, which is called the back of the foot, concave on the lower, called the fole, thin on the outer edge, deeper and longer internally, with a projection behind, named the heel, and terminated by the points of the toes in front. We divide it, as we did the hand, into three portions; the tarfus behind, the metatarfus in the middle, and the toes before.

The tarfus (oberfufs, Germ.) forms about the pofterior half of the foot; it is compofed of feven bones, *viz.* the aftragalus, the os calcis, naviculare, cuboides, and three cuneiform bones.

The aftragalus, (talus of Albinus,) occupies the upper part of the tarfus, rifing far above the level of the other bones; it is of a very irregular form, convex above, hollowed below, flattened at the fides, and running out into a ftrong procefs before, termed the cervix or neck of the bone. It is placed faft between the two bones of the leg, the heel bone, and the os naviculare. On the upper furface, anteriorly, is a rough, tranfverfe depreffion, forming part of what has been called the neck of the bone, for infertion of ligaments; behind this is a large articular furface, broader before than behind, convex in thofe directions, rather concave from fide to fide, fo as to form a fuperficial pulley, fuited to the oppofite furface of the tibia. Below we have two articular furfaces, which reft on the os calcis, feparated by a deep groove, running obliquely from within outwards, widening much in its courfe, and rough for ligamentous attachments. The pofterior articular furface, which is external, is the largeft, concave, and oblong obliquely; the anterior is fmall, oval, and nearly flat. The pofterior fide is narrowed horizontally, and prefents the commencement of an oblique groove, in which the tendon of the long flexor of the great toe glides. In front is a convex rounded articular furface, which has been called the head of the bone; it refts againft the os naviculare, and by a fmall furface on the os calcis. On the outfide a triangular articular furface, concave vertically, correfponding to the lower end of the fibula. On the infide another articular furface, flat, elongated horizontally, adapted to the defcending malleolus internus; below this a rough irregular furface for ligaments. Thefe two articular furfaces are continuous with that on the upper furface, and form part of the ankle joint. It is developed from two points of offification, which are juft appearing at birth.

The os calcis (calcaneus of Albinus,) is fituated at the pofterior part of the tarfus, where it forms the heel. It is the largeft of the feven bones; its greateft extent is from behind forwards, its next is in the depth, and it is narroweft tranfverfely. On the fuperior furface we obferve pofteriorly a concave part occupied by the fat and cellular tiffue in front of the tendo Achillis; next we have a large, convex, oblique articular face, adapted to one in the aftragalus; on the infide of this a groove, which divides it from another fmaller oval, flat, articular facet, correfponding alfo to the aftragalus. This laft is placed on a lateral procefs of the bone, ("fuftentaculum cervicis tali, Alb.") and is rather anterior to the firft. It is fometimes continuous with another fmall articular furface in front of it, though generally feparated by a narrow groove. The reft of the upper furface is flat and rough for ligaments. The under furface is long, much contracted tranfverfely, terminated behind by two tubercles which give attachment to fome mufcles of the toes; the internal is the largeft. There are alfo other eminences further in front to which ligaments are fixed. The pofterior furface is bulging and convex, and forms properly the heel; at the upper part it is fmooth, where it is feparated from the tendo Achillis by a fynovial burfa, and rough below for its infertion. The anterior furface is the fmalleft of the whole; it is articulated with the os cuboides, and is flightly concave. The outfide is flat, much broader behind than before, and marked by two fuperficial grooves for the long and fhort peronei mufcles. The infide is large and hollowed deeply, to lodge the nerves and veffels going to the fole of the foot, and alfo the tendons of the tibialis pofticus, the long extenfor of the toes, and the long extenfor of the great toe, which plays in a peculiar groove obferved at its upper part. The mufculus acceflorius has its origin from this furface, towards the back part. The os calcis is formed from two points of offification, which are vifible at birth. The two bones we have been defcribing have been confidered as the firft row of tarfal bones; the remaining five as the fecond.

The os naviculare is fituated in the middle of the tarfus, of an oval figure, with its longeft diameter tranfverfe; its circumference is rough for ligamentous attachments; broad and convex above, concave below, pointed and projecting internally where the tibialis pofticus is inferted, and narrowed on the outer fide, on which we generally find a flat articular facet oppofed to the cuboides. The anterior furface is convex, divided into three articular planes for the three cuneiform bones; of thefe the internal is broadeft below, and the two external above. The pofterior furface is concave, articulated with the aftragalus.

The os cuboides, (cubiforme, Alb.) is placed at the external and anterior part of the tarfus, and refembles fomewhat a cube in figure. Above is a rough, flightly convex furface, with four unequal fides; below pofteriorly an eminence for ligaments, a fuperficial hollow, and a more marked protuberance for the fame purpofe, in front of which is a deep groove, which gives paffage to the tendon of the peroneus longus, as it croffes the foot. Anteriorly an oblique articular furface nearly plane, fupporting the two outer metatarfal bones. Behind a concave fmooth furface, ftill more oblique, articulated with the os calcis. Externally, a narrow border, in which we obferve the commencement of the groove for the tendon of the peroneus longus. Internally, a fmall articular facet behind, in contact with the os naviculare ; a larger one in the middle for the third cuneiform bone ; the reft of the furface is rough for ligaments.

The firft cuneiform bone (majus five internum) lies at the inner and anterior part of the tarfus, and is the largeft of the three ; it is deeper than it is broad, with the bafe of the wedge below, and the narrower border upwards, of a rhomboid figure viewed laterally. The upper fide is oblique, and gives attachment to ligaments ; the inferior is convex, and gives attachment before to the tibialis anticus, behind to a part of the tibialis pofticus, as well as to ligaments. The pofterior furface, articulated with the naviculare, is concave and pointed above ; the anterior, by which it refts on the firft metatarfal bone, is longer, and of an oblong, or rather femi-lunar figure. Internally, it is convex, rough, and fub-cutaneous ; externally concave, with a fmall articular facet near the upper edge, in contact with the fecond bone of the metatarfus, and another near the pofterior edge, which touches the following bone.

The fecond cuneiform bone (minus five medium) is the fmalleft of the three, and of all the bones of the tarfus ; it well deferves its name both from its figure and fituation. The bafe of the wedge forms the upper furface which is quadrilateral, with the fhort diameter tranfverfe, and rough for ligaments. The edge of the wedge below is fharp, and ferves the fame purpofes ; behind it is articulated by a concave furface, with the middle plane in the front of the os naviculare ; before, by a convex one, with the fecond metatarfal bone. Of the two four-cornered fides the internal is nearly plane, with an articular facet near the upper edge, and another at the pofterior, joined to the laft bone ; the external has a concave articular facet for connection with the third cuneiform bone towards the upper and pofterior angle : they are both rough on the remainder of their furfaces for fibrous attachments.

The third cuneiform bone (externum, or medium, Alb.) is rather larger than the preceding, and longer from before backwards ; it refembles it much in figure and pofition. The bafe, which is above, and the edge below, give attachment to ligaments. Behind is a triangular articular furface, correfponding to one of the planes in front of the naviculare ; before an oblong flat one in contact with the third metatarfal bone. The internal furface is marked by two articular facets, feparated by a rough depreffion for ligaments, of which the anterior correfponds to the fecond metatarfal bone, the pofterior to the fecond cuneiform. The external fide is rough anteriorly, and has a plane articular facet towards the upper and pofterior angle, in contact with a correfponding one on the inner fide of the cuboides.

The laft five bones of the tarfus are wholly cartilaginous at birth, and are gradually and folely developed from fingle points of offification. They are not proportionably larger in this ftate than when in their perfect offeous forms, in which refpect they refemble the carpus.

The articulation of the leg with the foot, the ankle joint.— To form this joint, the upper articular furface of the aftragalus, nearly all the outer fide, and the narrow cartilaginous facet on the infide, are received into the cavity formed by the lower end of the tibia and fibula, and embraced clofely by the two ankles. The correfponding furfaces are covered by cartilage, and united by feveral ligaments, the moft efficient of which are placed at the fides ; the connection is much ftrengthened by the numerous tendons which pafs over or near it to be attached to different bones of the foot.

The internal ligament (l. deltoides) is of confiderable breadth ; attached above to a part of the circumference of the internal malleolus, more efpecially to its point, it defcends a little obliquely backwards, and is fixed to the inner furface of the aftragalus, and the neighbouring parts of the os calcis. It is compofed of a confiderable quantity of longitudinal fibres, of which the anterior and the moft fuperficial are the longeft. On the infide, the tendon of the tibialis pofticus paffes over it, and is connected with it by its fibrous fheath ; it is contiguous alfo to the long flexor of the toes. On the outfide is a ftraight rounded and thick ligament (l. medium perpendiculare) which defcends from the lower extremity of the fibula a little obliquely backwards, paffing under the tendon of the peroneus longus, and is attached to the outer fide of the os calcis ; it is formed of compact, longitudinal fibres. In front of this is another ligament (l. anterius malleoli externi), which paffes from the anterior part of the point of the outer malleolus, forming a ftrong flat band of fibres, frequently divided into two or more portions of confiderable ftrength, and is fixed to the aftragalus in a depreffion before the external articular furface. The front of the joint is ftrengthened alfo by a collection of irregular fibrous bands, which defcends from the anterior part of the lower extremity of the tibia, amidft much cellular tiffue and fat, and are inferted partly into the aftragalus clofe to the termination of the articular pulley, and are partly continuous with the ligaments paffing from this bone to the naviculare. Towards the back of the joint, we have arifing from the fibula a ftrong ligament (l. pofterius malleoli externi) paffing nearly tranfverfely inwards, and fixed to the edge of the articular pulley at the back of the aftragalus, clofe to the outer margin of the groove for the tendon of the long flexor of the great toe. It is ftronger than any of the preceding ligaments, and compofed of numerous diftinct packets of fibres. Immediately above this, and connected intimately with it, at its origin from the back of the external malleolus, is a tranfverfe band of fibres paffing directly acrofs, or mounting a little obliquely, to be attached to the pofterior border of the articular furface of the tibia, and to the inner ankle. It increafes a little the depth of the articular cavity behind, and might be regarded properly as one of the pofterior ligaments connecting the tibia and fibula. The fynovial membrane is diftributed as ufual, lining all the cartilaginous furfaces and the ligaments ; lining alfo the narrow articular facets between the tibia and fibula, making this little joint communicate with that between thefe bones and the aftragalus. It is loofe in front, where we find a confiderable quantity of cellular tiffue and fat ; covered in this afpect by the tendons of the tibialis anticus, the long extenfors of the great, and other toes, and the peroneus tertius ; behind by the tendons of the tibialis pofticus, the flexors of the toes, and the peronei ; partly in thefe fituations, and on the fides by the ligaments juft defcribed. In addition to the many tendons enumerated, this articulation is further ftrengthened by the tendo Achillis behind, a powerful agent in preferving its relations.

The motions which take place between the leg and foot are chiefly thofe of flexion and extenfion ; the lateral inflexions

flexions are extremely limited. In flexion, which is more confined than the oppofite motion, on account of the difpofition of the articular pulley of the aftragalus, this bone glides backwards on the lower end of the tibia, regulated by the two malleoli lying clofe on either fide ; the pofterior ligament is ftretched, the others undergo but little change ; and luxation rarely occurs. In extenfion the motion may be continued, fo as to make the foot form a very obtufe angle with the leg ; the external anterior ligament is diftended confiderably, the others lefs fo, the pofterior is relaxed. In ftanding on the toes this pofition is maintained by mufcular efforts, particularly by means of the tendo Achillis ; the tibia refts on the pofterior part of the pulley of the aftragalus, and tranfmits the principal weight to the naviculare, inftead of the os calcis, as in ordinary ftation. The lateral inclinations of the foot on the leg, as far as this joint only is concerned, are extremely confined, owing to the lateral defcent of the malleoli ; in which refpect they differ much from the lateral motions of the carpus on the fore-arm. The lateral ligaments are here reciprocally ftretched or relaxed, as the foot is turned inwards or outwards. Diflocations to either fide occur more frequently than we might at firft imagine from the apparent fecurity afforded by the malleoli. Luxation outwards is the moft frequent, the fibula breaking two or three inches above its lower end, fo as to allow of the everfion of the foot ; it is generally the confequence of fudden violence, as in jumping, or in falling on the foot from any height.

The articulations between the bones of the tarfus.—The aftragalus is articulated by two, fometimes three cartilaginous planes on its inferior furface, with correfponding ones on the upper furface of the os calcis. Thefe furfaces are preferved in contact by a ftrong collection of ligamentous fibres, paffing directly upwards from the whole length of the oblique groove, between the articular facets on the upper furface of the os calcis to a fimilar depreffion on the under fide of the aftragalus, where it is attached to every point not occupied by articulating cartilage. The internal fibres lie deep between the bones, and are fhort ; the external ones are longer, and more in quantity, buried in the cellular tiffue and fat which contribute to fill the vacancy obferved in this part. Behind there are fome parallel fibres paffing down from the back of the aftragalus to the os calcis, which concur in forming the fheath for the tendon of the long flexor of the great toe ; they are not numerous. This articulation is alfo ftrengthened by the lateral ligaments of the ankle joint, efpecially by the external, which paffes immediately from the fibula to the os calcis. The fynovial membranes offer nothing remarkable. The motions which have place here are always combined with others, and will be confidered farther on.

The anterior convex articular furface of the aftragalus is received into a cavity formed by the concave furface of the os naviculare, a fmall fpot of the os calcis, and completed below by ligaments paffing between thefe two bones. We obferve above a dorfal ligament, thin and flat, compofed of fibres paffing from the depreffion called the neck of the aftragalus to the upper rough furface of the naviculare ; they fometimes reach to the cuneiform bones. It is covered by the extenfors of the toes. Below is a very ftrong ligament, paffing from the anterior and internal parts of the os calcis obliquely forwards and inwards to be attached to the hollow in the lower furface of the naviculare. It is covered on the infide by the tendon of the tibialis pofticus : above it is lined by fynovial membrane, and forms the lower part of the cavity which lodges the head of the aftragalus, to the fupport of which it eminently contributes. It is very denfe in its ftructure. There is alfo a fhort and very firm band paffing from the anterior part of the os calcis to the outfide of the naviculare, completing the cavity externally. This joint is lined by a fynovial membrane, which communicates with the anterior articulation between the aftragalus and os calcis, as before mentioned. It is fpread over the correfponding furfaces and ligaments we have been defcribing.

From what we have faid, it appears that the os calcis is firmly connected with the naviculare, though in contact only by a very narrow fpot ; the ligaments crofs the head of the aftragalus in their courfe, and their apparent ufe is to fupport the latter at a point which appears fo deficient, when examining the mechanifm in the dry fkeleton. The os calcis is more extenfively articulated with the cuboides by cartilaginous furfaces flightly concave and convex in oppofite fenfes. The joint is fecured by two ligaments, a fuperior or dorfal, an inferior or plantar. The firft is broad and thin, compofed of fhort parallel fibres paffing rather obliquely forwards from the upper and external parts of the os calcis, to the fuperior rough furface of the cuboides. It is often formed into two feparate longitudinal bands. It lies under the peroneus tertius. The inferior ligament is the longeft, and ftrongeft of all the ligaments of the tarfus. It is attached behind to the middle of the inferior furface of the calcis, paffes horizontally forwards, and is fixed principally into the oblique protuberance obferved on the lower furface of the cuboides. It is formed of a great number of fibres, divided into feveral bundles, which diverge rather as they approach the cuboides. The inferior ones, or the moft fuperficial, are much longer than thofe more deeply feated, and are continued under the tendon of the peroneous longus, part of whofe fheath they form, to the pofterior extremities of the firft and fecond metatarfal bones. The upper plane is fhorter in its courfe, and fixed behind the groove for the peroneus longus. The ligament is covered below by feveral mufcles of the foot, which have partly their origin from it. It fhould be remembered that this joint is in the fame tranfverfe line with the one between the aftragalus and naviculare.

For the articulation between the naviculare and cuneiform bones we have in the firft a cartilaginous furface divided into three planes, in the latter correfponding furfaces covered by articular cartilages continued laterally into their mutual articulations. It is fecured by three dorfal ligaments, attached to the upper and lateral portions of the circumference of the naviculare, paffing one internally to the firft cuneiform, another in the middle to the fecond, and a third more externally to the outer cuneiform bone. They leave intervals filled by cellular tiffue : the internal is the largeft ; and thicker at its inferior edge. The plantar ligaments have been defcribed as three alfo, but they are too irregular for diftinction, appearing as fibrous bundles paffing between the oppofite bones, confounded at their attachment to the naviculare. This joint is ftrengthened internally by an elongation of the tendon of the tibialis pofticus, which is attached to the bafe of the firft cuneiform bone, and continuous with the more internal of the ligaments we have been defcribing.

The articulation of the naviculare with the cuboides is formed by the contact of two fmall plane cartilaginous furfaces, lined by their proper fynovial membrane, and fecured by numerous fhort ligamentous fibres paffing from bone to bone, occupying the remaining fpace ; they are very clofe and compact. There is alfo a plantar ligament rounded in form, paffing obliquely from the inferior and external part of the naviculare to the oppofite point of the cuboides ; and a dorfal tranfverfe band, croffing from one to the other, covered by the extenfors.

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The cuneiform bones are articulated with each other by cartilaginous facets connected by ligaments paffing from bone to bone, deeply as well as fuperficially. The dorfal ligaments are tranfverfe, and form really but a fingle band, continued over the three, and attached in its courfe to each. The plantar ligaments are alfo tranfverfe, but not fo marked; the one which goes from the firft to the fecond is the ftrongeft: they are covered by an extenfion of the tendon of the tibialis pofticus, one part of which is fixed to the fecond cuneiform, another to the fecond metatarfal bone; thefe are diftinguifhed from the ligaments by the oppofite direction of their fibres. We find alfo many fhort ligamentous fibres paffing between thefe bones, as between many others of the tarfus, attached to the parts not occupied by cartilage; they add much to the ftrength of union.

We have here a fynovial membrane common to thefe joints, and that with the os naviculare above defcribed. It is fpread over the anterior furface of the latter, over the connecting ligaments, and dips between the cuneiform bones, lining their articulation throughout.

The articulation of the third cuneiform with the cuboides is by means of plane cartilaginous furfaces, provided with their diftinct fynovial capfule, and fecured by ligaments. Of thefe the dorfal is oblique, fmall and thin, uniting the oppofite edges of bone; the plantar is confiderably thicker, and more directly tranfverfe. Here alfo are many interoffeous ligamentous fibres, fixed to the parts not covered by cartilage, or where the bones are not in immediate contact.

Motions of the tarfal bones on each other.—The motions which take place between the tarfal bones are very limited, if we except thofe between the aftragalus, and the os calcis and fcaphoides. By this chiefly the foot is turned inwards and outwards; the lateral inflexions of the ankle joint affifting the motion but little. In the movement which carries the point of the foot a little outwards, which depreffes its internal and elevates its external edge, the naviculare glides on the head of the aftragalus, and the os calcis on its lower articulating furfaces: the latter bones approach each other more clofely, the interoffeous ligament, and the external lateral one of the ankle joint are relaxed, the internal lateral ligament is ftretched, efpecially thofe fibres which pafs to the calcaneum. In the oppofite motion of twifting the foot inwards, and bringing the fole to face the other, the bones move in the contrary direction, the inner border of the foot is raifed, and the external becomes inferior; the interoffeous, and external lateral ligaments are diftended. Thefe motions, which are very fenfible, may be accidentally forced beyond their natural limits, and give rife to injuries which are too generally referred to the joint of the ankle. The naviculare and cuboides may be moved up and down on the aftragalus and os calcis, and the cuneiform bones have gliding motions on the naviculare, the cuboides, and between themfelves, by which the concavity of the foot may be a little increafed or diminifhed. The utility of thefe numerous articulations in enabling the foot to refift the fhocks it muft often neceffarily fuffer, and in giving grace and eafe to the motions of the lower extremity in progreffion needs fcarcely be infifted on: their great relative fize and the very powerful ligaments fubfervient to them make difplacement of more rare occurrence than we might at firft imagine, on confidering the efforts they have to fuftain.

The metatarfus (mittelfufs, Germ.)—is compofed of five long bones placed horizontally and nearly parallel to each other, fo as to form a gently convex furface above, and a concavity below. It is fituated between the tarfus and the toes, and is analogous in many points to the metacarpus. The individual bones are diftinguifhed numerically, beginning from the infide. The firft metatarfal bone, that of the great toe, is by much the largeft in volume, though rather fhorter than the reft; the fecond is of the greateft length; the third comes next to it, the two laft differ but little: the four latter differ very little in fize. They all contract a little in the middle, and fwell at each end, particularly towards the tarfus, and are divided into two extremities and a body.

The tarfal, or pofterior extremity of the firft, is oblong vertically, with a femi-circular articular cavity behind, refting on the firft cuneiform bone. The inner edge of the circumference, which is convex, gives attachment about its middle to a part of the tendon of the tibialis anticus; below is a blunt projecting procefs, to which the tendon of the peroneus longus is fixed; and on the outer concave edge a fmall fmooth fpot, which is in contact with the fecond metatarfal bone.

The tarfal are much larger than the digital extremities of the other four, angular, and in clofe oppofition with each other. That of the fecond is placed farther back than the firft, is triangular, with the bafe upwards; it is wedged between the cuneiform bones, refting on the fecond by a concave triangular articular furface behind; on the firft by a fmall fpot on the infide, and on the third by one on its outer fide. In the laft afpect there are two other articular facets in front of the laft joined to the third metatarfal bone, furrounded by afperities for ligaments: the edge above, and the point below are alfo rough, for the fame purpofes. The tarfal end of the third is triangular in the fame direction as the preceding, articulated by a plane furface behind, with the third cuneiform bone. On the infide are two fmall facets contiguous to correfponding ones in the fecond metatarfal; on the outfide a fmooth fpot above, articulated with the following bone, and a rough depreffion beneath for ligaments. It is rough alfo above and below. In the fourth, the tarfal extremity is more quadrilateral: behind it is articulated with the front of the cuboides; on the infide with the fame bone, and with the third; on the outfide with the laft metatarfal. Below, and in front of thefe articular fpots, the bone is rough for ligamentous attachments. The tarfal end of the fifth or laft metacarpal bone is larger than thofe of the preceding, It prefents behind an oblique triangular articular furface for the cuboides; above and below rough and unequal borders, the former giving attachment to the peroneus tertius, and both to ligaments; on the infide a fmall articular facet in contact with the fourth; and on the outfide a rough eminence projecting backwards, to which the peroneus brevis is fixed, and a portion of the abductor of the little toe.

The bodies of the metatarfal bones are concave from before backwards below, and gibbous above, very irregular in form, and fcarcely admitting of regular divifions into furfaces. That of the firft is of a triangular prifmatic form, with the upper furface convex, and inclined a little inwards; the inferior concave, covered by the flexor brevis of the great toe; the external flat and large, correfponding to the mufcles which lie between thefe bones. The bodies of the reft may be regarded in four afpects; the dorfal prefents in each a blunt rifing line, which divides the attachment of the interoffei; the plantar offers a fmooth furface for mufcular attachments; the internal and external exhibit varioufly inclined furfaces, of different breadths, continuous with the two former, fmooth, and covered by the mufcles which arife from them, and fill the interfpaces. In the fifth the body is curved a little from within outwards, and its external fide, or rather edge, gives origin in part to

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the abductor of the little toe; the dorfal furface is inclined confiderably outwards, and terminates on the infide by a prominent line; the plantar furface is coverd partly by the flexor brevis of the fame toe. In all the dorfal furface is covered by the tendons of the long and fhort extenfors, by veffels and nerves, and the plantar by the deep-feated mufcles and tendons in the fole of the foot, by ligaments, and by larger blood veffels and nerves.

The digital, or anterior extremity, is very fimilar in all. It prefents a rounded articular furface, called the head, fupporting the firft phalanx of the toes: this extends further from above below than tranfverfely, in which direction it is compreffed. The circumference is rough, offering above a fenfible groove for ligaments, and on each fide a hollow, in which the lateral ligaments are fixed. The articular furface is prolonged further below than on the dorfal afpect, and terminates on each fide by projecting tubercles. In the firft this lower furface is divided by a prominent line into two pulleys, on which the fefamoid bones glide, which are placed below this joint of the great toe. In this bone alfo the articular furface has a much greater proportional breadth.

The metatarfal bones refemble in ftructure and formation the other long bones, with this exception only, that the fmaller ones are fometimes developed from two points of offification, one for the tarfal extremity, and body, another for the digital: in the firft there are always three.

The articulations of the metatarfus with the tarfus.—The firft bone of the metatarfus is articulated with the anterior furface of the firft cuneiform; the fecond with the three cuneiform bones; the third with the correfponding cuneiform; the fourth and fifth with the cuboides. The oppofite articular furfaces are covered by thin cartilage, and their relations preferved by ligaments above and below; they are all lined by fynovial membranes common in general to thefe joints, and to the articulations of the metatarfal bones between themfelves.

The dorfal ligaments pafs from each metatarfal bone to thofe bones of the tarfus with which they are articulated. From the firft there paffes a broad and thin band to the firft cuneiform, attached to the fuperior furface of each. From the fecond, which is let in between the three cuneiform bones, we find three ligaments croffing, one internally to the firft, another in the middle to the fecond, a third externally to the third cuneiform: the firft and laft are oblique in their courfe, the fecond paffes directly from before backwards. The dorfal ligament of the third is fhort, and goes ftraight to the third cuneiform; thofe of the third and fourth are attached to the upper furface of the cuboides; they are more or lefs oblique, and by no means conftant in their forms or fituation, the dorfal ligament of the fourth being often attached to the third cuneiform. They are all covered by the extenfor tendons.

Of the plantar ligaments, which are analogous in direction and attachment to the dorfal, that paffing from the firft metatarfal is very ftrong, and the joint is ftrengthened alfo by an extenfion of the tendon of the tibialis anticus, which is fixed to the infide of the tarfal end of that bone. The plantar ligaments of the fecond are fimilar to thofe above. That which paffes from the firft cuneiform is thicker, and larger than the other, reaching to the bafe of the third metatarfal; the other two are covered and ftrengthened by a portion from the tendon of the tibialis pofticus. The inferior ligaments of the others are fmall, yet diftinct, and of various lengths. The plantar ligaments are much ftrengthened by the numerous tendinous fheaths which are found in the fole of the foot, and particularly by that of the peroneus longus, which croffes moft of them as it paffes along to reach the firft metatarfal bone. The ligaments, both above and below, are compofed of fhort and clofe parallel fibres, following longitudinal, oblique, or tranfverfe directions, according to the relations between the points to which they are fixed. They are feparated by intervals filled with cellular tiffue, and giving paffage to veffels. The fynovial membrane, lining the joint between the firft metatarfal and cuneiform bones, is diftinct, and offers nothing remarkable in its diftribution. That lining the triple articulation, formed by the fecond with the three cuneiform bones, is continuous with the fynovial membrane, lining the articulation between the two firft of thefe bones. A feparate one is found fpread over the joint of the third metatarfal and cuneiform, and fending off two fmall lateral elongations, which dip between the articulations of the third with the fecond, and fourth metatarfals. It often communicates with the former at the point where they are in contact. Another fynovial membrane belongs to the articulation of the two laft metatarfals with the cuboides, common alfo to that between the two former of thefe bones.

The articulations between the metatarfal bones,—are formed behind by the contact of lateral articular facets, with the exception only of the firft, which touches the fecond without being articulated with it. Thefe two bones are united by fhort ligamentous fibres paffing from one to the other, of confiderable ftrength; the others are connected by dorfal, plantar, and interoffeous ligaments. The dorfal are tranfverfe, and three in number, paffing from one bone to the next, irregular in form, and attachment, appearing in fome fubjects as a fingle tranfverfe band. The plantar are fimilar in number and direction, but in addition we find feveral fmall flips paffing from the fifth to the three next metatarfals, feparated by cellular tiffue. The interoffeous ligaments between the pofterior ends of thefe bones are formed by numerous fhort fibres, occupying the parts not covered by cartilage, and tending very materially to fecure their relations. The anterior extremities of the metatarfal bones are not in abfolute contact, but they are firmly connected together by a tranfverfe ligament paffing below them, and attached to each bone, refembling the ligament defcribed as paffing between the digital ends of the metacarpal bones in its form and direction.

The metatarfal bones have but an obfcure motion on the tarfus, on which they may be flightly elevated and depreffed. They may be moved alfo fo as to approach each other in front, and augment the depth of the concavity of the fole; this effect is produced chiefly by the motion of the firft and laft towards the long axis of the foot, and is in confequence of mufcular action: when the foot is flattened by preffure they are forced farther apart mechanically.

The toes, forming the laft divifion of the foot, are five in number, placed horizontally fide by fide, compofed of rows of fmall bones extending longitudinally one beyond another. We reckon them numerically, beginning from within. The firft and laft are known alfo by the names of the great and little toe. The fecond is rather longer than the firft, the other three diminifh fucceffively in length. We find three bones, named phalanges, in all, excepting the firft, which has only two; thefe are termed, from their fituation, the firft or metatarfal phalanx, the fecond or middle, and the third or unguinal; in the great toe the bone of the middle phalanx is deficient. The two bones of this laft are very ftrong, and exceed very much in volume the different rows of the other toes which are flender in form, and comparatively weak. The bones of the firft phalanx are the longeft; thofe of the fecond are very fhort, as alfo the third. They all

all ſwell conſiderably at the extremities, and are contracted in the middle part or body. They reſemble the fingers very nearly in the material points of their formation, differing from them chiefly in ſize and mobility.

The firſt phalanges are by much the longeſt, and the bones are more rounded than the correſponding ones in the fingers. They are hollowed below, particularly near the extremities, where the flexor tendons lie, the edges giving attachment to the ſheaths which confine them. The poſterior extremities are concave for the heads of the metatarſal bones, the anterior have condyles, and a middle depreſſion for the ſecond phalanx. The two oppoſite articulating ſurfaces between theſe bones and the correſponding ones of the metatarſus, are cruſted by cartilage, and ſecured by lateral ligaments, as in the fingers. Theſe are thick and ſtrong, paſſing from the end of one bone to the oppoſite. The joint is ſtrengthened below by a tranſverſe ligament, covering it from ſide to ſide, contributing to the ſheath of the flexor tendons; and is further ſupported by theſe laſt, by the extenſors, and the ſmaller muſcles which ſurround them. The ſynovial membrane is looſe and extenſive; in the joint of the great toe it lines the two ſeſamoid bones. Theſe ſmall bones are unequal in ſize; the internal is the largeſt, oblong, gibbous below, concave longitudinally above, and a little convex tranſverſely, covered in the laſt aſpect by cartilage, and reſting on the head of the metacarpal bone in the two hollows already mentioned, ſo as to be ſeparated by a ſmall interſpace. They are connected by ligaments to the firſt bone of the great toe, as the patella is to the tibia, and glide backwards and forwards in the different motions of the joint, defending it effectually below, giving an advantageous purchaſe to the muſcles which are fixed to them, and preſerving from preſſure the tendon of the long flexor, which runs between them. Theſe bones are rarely met with in the other articulations. The motions between theſe bones and the metatarſus may be effected in every direction, except rotation, and are in general more limited than in the fingers. The toes, however, can be inflected backwards, or extended on the metatarſus to a greater degree than they can be bent. The advantages of this mechaniſm, ſo widely different from what we noticed in the hand, may be particularly noticed in ſtanding on the toes, and in progreſſion, and will be examined hereafter.

The ſecond phalanges of the four leſſer toes are ſo ſhort and compreſſed longitudinally, as to have ſcarcely the uſual characters of the long bones. This is a diſtinguiſhing point, in comparing them with the ſecond phalanges of the fingers, which they otherwiſe reſemble in miniature, giving attachments in a ſimilar manner to flexor and extenſor tendons, and to the fibrous ſheaths of the former. The articulations are alſo analogous; the motions, which are thoſe only of flexion and extenſion, are more limited.

The laſt, or unguinal phalanges, five in number, reſemble thoſe of the fingers both in ſtructure and formation. That of the great toe is ſtrong and broad; the others are more than proportionably ſmall. This laſt difference is the principal one between them and the fingers; the articulations and motions are very nearly the ſame; the latter may be a little more limited. In children they are very moveable: this mobility diminiſhes as we grow up, and is often completely deſtroyed in advanced age, owing moſt probably to the confinement of our ſhoes. The metatarſal rows have three points of oſſification, the others have two, and very frequently only one.

From the aſſemblage of the bones we have been deſcribing, there reſults a long, broad, and partly vaulted baſis, for the ſupport of the weight above, ſecured by numerous and ſtrong ligaments binding the arch beneath. The principal points of bearing are on the lower part of the heel bone; the outſide of the foot in nearly its whole length, eſpecially the poſterior end of the metatarſal bone of the little toe; the anterior ends of all the metatarſal bones, and moſt conſpicuouſly that of the great toe, which is proportionably ſtrong. When the heel is elevated from the ground, the whole preſſure is on theſe laſt mentioned points, and on the toes, which compenſate, by their augmented breadth, their comparative want of ſolidity. The vaulted form gives a ſpace in which the veſſels and nerves can paſs free from compreſſion; and the number of the articulations, by diſtributing the ſhock over numerous ſlightly yielding ſurfaces, prevents the injurious effects which might otherwiſe ariſe from leaps, or falls on the feet.

Mechaniſm of the lower extremities.—In ſupporting the trunk, the hip bones are placed between two oppoſite efforts; *viz.* the weight of the body tranſmitted by the ſacrum; and the reſiſtance oppoſed by the limb below in the direction of the cotyloid cavity. The depreſſing impulſe acts in a plane poſterior to that of ſupport, tending to make the hip bones move backwards on the thighs, if they were not counterbalanced by muſcular efforts. The baſe of ſupport, as far as regards the oſſa innominata, is contained between the plane of the vertebral column behind, and that of the thigh bones in front; a ſpace which varies in different individuals, and which is comparatively narrow in infancy, from the more oblique direction of the hip-bones, which brings the thighs more immediately under the vertebral column. As the oſſa innominata become more horizontal, the baſe of ſupport is rendered wider, and the muſcles being at the ſame time more fully developed, give it additional ſecurity. This is one ſource of the difference in gait in manhood and infancy. Another is found in the diſpoſition of the cotyloid cavities. As they are at a diſtance from the points of oſſification, they are almoſt wholly cartilaginous for ſome time after birth, and therefore can offer but a feeble reſiſtance to the thighs, quite inſufficient for ſtanding or progreſſion, until the place of cartilage is ſupplied by bone. Add to this, that the two joints are comparatively nearer to each other; which circumſtance, though it give facility, muſt neceſſarily diminiſh firmneſs. The greater proportional diſtance in the adult throws the thighs further apart above. In females this diſtance is greater than in the male, which gives a peculiarity to their walk, a more obſervable rolling of the hip in the ſucceſſive advancement of each limb. This is not to be ſeen in the infant female, where the poſition and form of the hip bones differ but very little from thoſe of the male of the ſame age.

The femur, which is the only bone in the thigh, is curved conſiderably forwards in the middle; hence a larger ſpace is left behind for muſcles; and the baſe of ſupport, afforded by this bone to the trunk, is directed forwards, ſo that the latter is ſuſtained in the direction, in which it has the greateſt tendency to fall. The neck of the bone, beſides increaſing the extent of rotation, enlarges tranſverſely the baſe of ſupport; gives the body a greater firmneſs in ſtanding, without impeding progreſſion, ſince the head of the bone, and not the body, is the centre of motion. If the thigh bones poſſeſſed no neck, but were kept equally far apart, by increaſing the diſtance between the cotyloid cavities, the attitude of ſtanding would be equally ſecure, the tranſverſe baſe of ſupport being ſtill the ſame; but progreſſion would be impeded, as it actually is in the female, from the greater tranſverſe diameter of the pelvis. The head of the femur, ſunk into a deep cavity, is forced, in ſupporting

ſupporting the trunk, againſt the moſt reſiſting part of this cavity, *viz.* under the anterior ſpines. The ſtrong ligamentous bands which ſtrengthen the capſule in front and above, are ſo diſpoſed as to augment the reſiſtance to any effort of the thigh-bone in that direction, and to reſtrain any part of the head which may not be contained in the acetabulum. The interior ligament alſo adds to the firmneſs of the joint; preventing, by its tenſion, the diſplacement of the articular ſurfaces in every effort which forces the head upwards; an effort which, from the preſſure of the trunk, is almoſt conſtantly operating. In the infant, the body of the bone is nearly ſtraight, a conformation unfavourable to ſtanding, according to the reaſons above alledged: the neck is ſhorter, and conſequently the baſe of ſupport diminiſhed; it is cartilaginous, and therefore leſs able to endure, for any time, an attitude which demands ſolidity in the ſuſtaining parts. Theſe are other reaſons for the inſecurity of the ſtation and progreſſion of young children, and ſhew by contraſt the advantages of the form of the adult bone.

In the knee, we are ſtruck with the extent of the articular ſurfaces, and the number and ſtrength of the ligaments which connect them, ſo well adapted to ſuſtain the weight tranſmitted by the thighs; the crucial ligaments limiting and maintaining the extenſion of the leg, preventing it from paſſing in this direction beyond the axis of the thigh; the patella in ſome meaſure reſtraining its flexion, protecting the joint, and more particularly favouring the action of the extenſor muſcles, which play ſo important a part in the functions of the lower extremity. The perpendicular direction of the leg is very advantageous in giving firmneſs; to this end alſo the immobility of the two bones which compoſe it ſeems directed. The tibia, ſolid and broad at either end, alone receives the preſſure and continues it to the foot; the fibula ſerves principally to afford attachments to muſcles. This diſpoſition, ſo different from that obſerved in the analogous part of the upper extremity, bears an obvious relation to its different function. In infancy the patella is ſcarcely perceptible; its abſence muſt be unfavourable to the power of the extenſors, and may be one cauſe of the feebleneſs obſervable at that period; and further, its want is felt in kneeling.

The foot is admirably adapted to its office of ſuſtaining every effort continued from above. It is articulated at right angles with the leg, through which it receives the weight of the body in a perpendicular direction, bearing directly on the upper ſurface of the aſtragalus, the whole length of the foot reſting on the ground. The articulation is ſituated nearer to the poſterior than to the anterior part of the feet, which gives to the baſe of ſupport a greater extent forwards, a direction towards which the line of gravity naturally inclines. The lateral deſcent of the malleoli materially ſecures the firmneſs of the ankle joint The breadth of the foot, increaſing gradually towards the front, the length of the metatarſal bones, the direction of that which ſuſtains the great toe, its ſituation and want of mobility, are other circumſtances marking the diſtinction between the hand and foot, and adapted to increaſe the ſolidity and extent of baſe afforded by the latter. The functions of the foot are aſſiſted alſo by its concave form, which enables it to gain a kind of hold of the bodies on which it reſts, and to accommodate itſelf to unequal ſurfaces, an advantage almoſt deſtroyed by the uſe of ſhoes, but eminently conſpicuous in thoſe people whoſe feet are not cramped by artificial means of defence. In its poſterior half nearly it reſts on the ground by its outer ſide, compoſed of the ſolid bone of the heel, and the os cuboides, the inner ſide repreſenting an arch, and placed at a diſtance from the plane below; in the anterior half the weight is principally ſupported by the inner ſide, where we find the ſolid bones of the great toe very little aſſiſted by the external edge.

Every thing in the ſtructure of man evinces that he is deſigned by nature for the erect poſture: we ſhall notice here thoſe proofs only which are deducible from the framing of the extremities. One of the moſt obvious is the great diſproportion in the reſpective lengths of the upper and lower limbs, and the greater comparative ſtrength of the lower. Other marks are found in the width and direction of the hip bones, in that of the neck of the femur, in the articulation of the leg at right angles with the foot, in the ſize and length of the latter, and the predominance of its ſolid over its moveable parts. We may remark alſo the flattened cheſt, and the ſhoulders ſet off by long clavicles, ſo very different from the conſtruction of theſe parts in quadrupeds, where the cheſt is compreſſed laterally, and the anterior extremities approach each other in front for the better ſupport of the body. The form of the hand, and the modes of articulation between the ſeveral bones of the upper extremity, are among the numerous and evident arguments that the erect poſture is natural to man, and we believe we may add, peculiar to him. In all the poſitions, produced by different motions, this poſture is more or leſs preſerved; ſo that, before we enter on progreſſive movements, it will be well to conſider ſeparately the ſimple act of ſupporting the body, which they neceſſarily include.

Station—or the act of ſtanding, in man, as far as the lower extremities are concerned, will be the firſt point for our obſervation. In this attitude it is neceſſary that the perpendicular line, which paſſes through the centre of gravity of the whole body, ſhould fall ſomewhere in the ſpace intercepted between the two feet, or on the ſole of the foot itſelf, if we are ſupporting ourſelves on one only. This centre of gravity, when the body is erect, has been proved by Borelli to be placed between the hip bones, "inter nates et pubem," in the human ſubject. To favour this diſpoſition, we find a vertebral column curved alternately in oppoſite directions, and placed obliquely with regard to the direction of the oſſa innominata, by which means the diſtribution of the ſoft parts is more eaſily managed, the balance preſerved, and permanent ſtation much facilitated. If this obliquity did not exiſt, and the vertebral column had been ſtraight, it would approach too nearly the line of direction of the leg and thigh, a diſproportionate quantity of the maſs of the body would be placed in front of the line paſſing through the centre of gravity, which would continually tend to make the body fall forwards in prolonged ſtation or progreſſion. In the orang outang the angle, which the vertebral column raiſed perpendicularly makes with the hip bones, is much more obtuſe than in man, and the equilibrium is preſerved by the length of the arms; the ſame may be obſerved of the gibbon, the ſimia lar of Linnæus. In quadrupeds this angle, under ſimilar circumſtances, is ſtill more obtuſe, and the efforts they make to remain upright on the hinder feet are continued with difficulty, more eſpecially if not aſſiſted by ſome other peculiar advantages of conſtruction, as in the bear, for inſtance, by the length of the heel. In man, the hip bones united to the ſacrum form a circular ſupport, by means of which the columns below are not inclined to the trunk, but ſuſtain it in perpendicular lines. If they had converged above, they would have formed an angular ſupport, not ſo capable of reſiſting the preſſure, and requiring a conſtant and powerful exertion on the part of the adductor muſcles. As it is, the columns are preſſed on perpendicularly by the tranſverſe width of the hip bones,

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ſo that the preſſure may be ſaid to render them more firm and ſteady. The long bones of the lower extremity in man are placed nearly vertically on each other, and on the foot. And we may juſt remark, that even in ſtation a ſucceſſion of columns of the ſame ſize is probably more advantageous than a ſingle one, equal in bulk and length to the whole: this has been demonſtrated in the caſe where the weight is upheld by columns ſuppoſed to be flexible. The direction of the head and neck of the femur has been already mentioned as increaſing the baſe of ſupport, and we may add that the oblique poſition of the latter decompoſes, in ſome meaſure, the preſſure of the trunk from above, and renders it leſs ſenſible than if it had been vertical; avoiding at the ſame time the diſadvantages ariſing from an inclined poſition of the whole columns, as mentioned above. By the arch of the necks alſo the thigh bones are projected from under the hips, and ſuſtain the trunk with greater conſtancy and freedom than if they had been placed vertically beneath it during its different inclinations. The thighs, charged with the whole weight above, tranſmit it to the leg at the knee joint; ſomewhat differently, however, in the adult, and in the aged. In the latter the ſpine is bent forwards, and to preſerve the balance the thighs are neceſſarily alſo bent, and preſs obliquely on the leg, a diſadvantageous bearing, as requiring greater muſcular efforts, and ſoon becoming on this account weariſome. It is through the tibia alone that the preſſure is communicated to the foot, which finally ſupports the whole weight. The arch of the latter is favourable to ſtation only inaſmuch as it favours the adaptation of the ſole to inequalities of ſurface. In progreſſion it may give eaſe and grace, but the long and ſomewhat flattened foot is probably beſt ſuited to firmneſs of ſtation. The concavity is leſſened by the preſſure, which acts moſt ſenſibly on the anterior and more moveable part: it is very evident, when the foot comes with force to the ground, and it may be proved alſo by the aching and uneaſineſs produced by wearing ſhort ſhoes, which impede the elongation of the foot. A queſtion has ariſen concerning the moſt advantageous baſe of ſupport, or what opening between the two feet is beſt ſuited to ſecurity of ſtation. An anſwer equally applicable to every caſe cannot readily be found; the nearer it approaches a ſquare, including the feet, the better. Still different individuals muſt require different baſes as ſuited to their own form. In every caſe, if the ſeparation be too wide, the limbs loſe their perpendicular bearing, and become inclined to the trunk. The ſmaller the angle made by two lines produced backwards in the direction of the feet, the better: it ſeems, indeed, that a parallel direction of the two feet is the moſt natural, as we ſee it in children and in the greateſt number of adults, eſpecially of thoſe who have not been inſtructed by art. The body has a tendency to fall forwards, which is partly counteracted by the length of the foot; increaſing the baſe of ſupport in the anterior direction. Now if the foot be turned much outwards, the baſe is neceſſarily ſhortened towards the front; and, as in ſtation, the trunk has no diſpoſition to fall laterally, what the baſe gains in that direction is in no degree equivalent to what is taken away from the other. The ſame obſervation applies to turning the toes inwards; but as this never takes place to any conſiderable degree, an abuſe of it is leſs to be apprehended. The unnatural poſition, in which education teaches us to place our feet, with the heels forming an obtuſe angle behind, is contrary to the whole mechaniſm of the limbs, is uneaſy, and inſecure. In different gymnaſtic exerciſes the feet are placed ſo as to offer the greateſt poſſible reſiſtance to the probable direction of the effort they will have to withſtand. In wreſtling, where the force in the firſt inſtance is generally applied laterally, we obſerve the feet parallel, and at a conſiderable diſtance from each other. Conſtant attention, however, is abſolutely neceſſary to change this baſe, if any unexpected impulſe be made in a contrary line. A deficiency in this reſpect is the reaſon why inexperienced wreſtlers are ſo readily pulled down forwards, or thrown on their backs, their exertions being uniformly directed to oppoſe the expected ones of their adverſaries; if theſe be ſuddenly altered, there is no adequate power of reſiſtance. In boxing, the baſe is increaſed from before backwards, the feet are placed nearly at right angles and far apart, the knees are bent a little, and the trunk lowered. Here the impulſe is expected in front, and the attention is particularly directed to oppoſe it in that point. This, in ſhort, is one of the great principles obſerved not only in theſe exerciſes, but in every laborious exertion, as in puſhing or pulling, where the line of oppoſition does not vary. Whatever be the direction or diſtance of the feet from each other, no muſcular effort can prevent the fall of the body, whenever the perpendicular line from the centre of gravity falls without the quadrilateral ſpace intercepted between the feet. And a man can ſupport a weight much heavier than himſelf, provided that the line from the centre of gravity of ſuch body fall within the baſe of ſupport.

Our obſervations hitherto are principally applicable to ſtation, with the trunk erect. Let us now ſuppoſe the feet fixed ſecurely on the ground, and the trunk moving in different directions by means of the articulations of the hip with the thigh-bones. In bending forwards, if the motion be prolonged conſiderably, the centre of gravity is no longer ſupported, and a fall is the immediate and neceſſary conſequence. We have before remarked, that the articulation of the ſacrum with the oſſa innominata is in a plane poſterior to that of the feet. Now, if in bending forwards, the hip-bones move on the thighs, ſo as to bring the two baſes into the ſame plane, the centre of gravity is eaſily thrown forwards beyond them, and a fall is the reſult. To counteract this, when the trunk is bent much forwards, we at the ſame time carry the upper part of the lower extremities backwards, the feet remain advanced, the leg and thigh are inclined backwards, ſo as to form an angle with the body. In extending the body on the thighs, and carrying it back beyond the perpendicular, as there is no extended baſe of ſupport behind, analogous to that formed by the feet in front, we are obliged to bend the knees, in order to bring the centre of gravity within the ſpace occupied by the feet. If the lower extremities are maintained in an upright poſition, while the trunk paſſes behind the perpendicular line, a fall is inevitable. Lateral inclinations of the trunk on the thighs are neceſſarily confined; ſince, in order to lower it on one ſide, the oppoſite limb muſt be proportionably raiſed; when both feet touch the ground, it is almoſt completely prevented, ſo that the lateral balance is ſeldom loſt, eſpecially as we can at pleaſure widen the baſe of ſupport.

The power of ſtanding on the toes reſults from the mode of their articulation with the metatarſus, which allows of extenſion or inflection upwards, beyond the axis of the latter. By this mechaniſm we reſt on the whole length of the toes, not merely on their points, which would be utterly incapable of ſupporting the weight; here too the ſeſamoid bones are eſſentially uſeful, the preſſure bearing directly on them, as it does on the patella in kneeling. In this attitude the feet are extended on the leg, and form an obtuſe angle with the toes, which conſtitute the baſis of ſupport; the legs and thighs are in the ſame ſtraight line, and the trunk is projected a little forwards by the elevation, ſo that the centre of gravity is brought over the contracted plane, which now forms the base of support, lessened very much in length posteriorly by the loss of the tarsus and metatarsus. The same difficulties occur if we stand on any pointed, or narrow body, and for the same reason, *viz.* the diminution of the space in which the vertical line from the centre of gravity must fall, in order to preserve the equilibrium. This applies also, and more forcibly, to the cases in which we stand on the toes, or heel of one foot only. In the last instance the foot is bent, the sole elevated, the rounded heel alone touches the ground by a very limited surface, great muscular exertion is required to keep the line of gravity vertical, the body vibrates on every side, and the attitude is necessarily soon lost or discontinued. We have not so much difficulty in standing on the heels of both feet, though this is far less easy than on the toes, on account of the points on which the weight rests. Standing on a single foot, with the whole sole on the ground, is an attitude more easily maintained, on account of the greater length of contact, and the less muscular exertion necessary to inflect or erect the trunk so as to bring the line of gravity within it. In this position the body is more or less inclined on the limb which supports it, and may be moved with facility in every direction by means of the joint at the hip. The long neck of the thigh-bone is here eminently useful, by widening the base of support afforded above to the trunk; and the position cannot for an instant be maintained by animals, who, besides other obstacles, have a very short neck to the femur. It is obvious that station on one foot must be more difficult than on two, as in the last case it is not only the feet, but the plane intercepted by them, which form the base, and much less exertion is required to keep the line from the centre of gravity within it. We must have observed also, that when in station on one foot, the trunk is much inclined in any direction, we throw out the other limb in the opposite one, in order to keep the centre of gravity vertical to the base: and if we stand on the toes or heel of one foot, not only the other leg, but the arms also, are called into action to preserve the equilibrium, which is perpetually lost and regained by the tottering trunk, and shuffling base. A fixed stability is utterly prevented by the difficulty of keeping the balance even under the greatest muscular exertions.

In sitting, the support is afforded by the tuberosities of the ischia, the thighs and the interval between them, and by the legs also, if we sit on the ground with them extended. This is a firm position, easily continued, especially if the body is inclined a little forwards over the base; if it is inflected backwards a fall may easily take place. On this account we have generally backs to our seats, to allow the trunk to recline, when the muscles are fatigued by supporting it in its position of inclination forwards. The legs and thighs are concerned only in a secondary way in this posture, as the principal support is afforded by the tuberosities of the ischia resting immediately on the surface below.

Kneeling is another attitude in which the lower extremities are employed, but the base of support is extended posteriorly, consisting of the space included by the legs, which are projected backwards under the trunk. Hence the body, if erect, is disposed to fall forwards; we require a resting place in front, as we throw the hips backwards, to bring the line of gravity over the legs. This posture is far from an easy one, since it requires a constant and unfavourable exertion of muscular force. The use of the patella has been already explained.

The importance of the general law, by which it is necessary that a vertical line passing through the centre of gravity should fall on some point within the base of support, is strikingly exemplified by the following observations. If we stand with our back and feet touching a wall, and then make a profound bow forwards, we inevitably fall, as the vertical line from the centre of gravity soon over-reaches the base of support. Again, when sitting with the trunk and legs perpendicular to an horizontal plane, we cannot rise from our seat; because the centre of gravity of the trunk falls far behind the feet: we are obliged consequently either to incline the trunk very much forwards, or draw the feet backwards under it, in the first case changing the centre of gravity, in the latter the base of support; and then by muscular efforts the thighs are easily extended on the legs, the trunk suspended, and the whole body erected; operations extremely difficult, if not impossible, supposing the original position had been preserved. Our notions of station would be very imperfect if we did not take muscular exertions into the account; it is in vain that we place a dead body so as to bring the centre of gravity over the base of support; the bony columns are no longer regulated by the varied efforts of numerous muscles, as in the living subject; the machine is incomplete, and instantly gives way to the pressure. The same phenomena occur if fainting comes on in the erect posture; the head and neck incline forwards, as also the trunk; the bones bend on the thighs, the latter on the legs, and these again on the feet. We must not therefore confine our attention to the idea of bony columns pressing vertically on each other, but recollect that they have highly moveable articulations, which require some strong external efforts to give them positive stability. These exertions are more or less powerful as the bones depart more or less from a vertical bearing on each other. Hence the anterior extremities of quadrupeds possess fewer and less powerful muscles than the posterior: as, in the first instance, the bones are directly extended on each other, and press vertically on the ground; in the last, they form angles more or less open, which can be preserved only by a constant exertion of muscular force. The elephant is an illustrative exception to this observation; his hind limbs are nearly vertical columns; a mechanism which diminishes the quantity of muscle otherwise necessary to support his enormous bulk. In insects, on the other hand, the joints are bent at very acute angles; a structure less inconvenient than we might at first suppose, as on account of the smallness of their body, the weight is diminished in a sub-duplicate ratio to their size. In birds who sleep perched on trees there is a peculiar construction, by which the mere cessation of muscular action, the allowing the body to sink, and the knees to bend, induces a mechanical contraction of the toes, which grasp firmly the body on which they rest, and secure their position when at roost. In the grallæ tribe, in the stork for instance, who stands motionless for hours waiting for his prey, there is a particular construction in the articulation of the knee, which enables him to stand without much muscular exertion.

Progression—may be effected in many different ways, of which we shall examine only the most ordinary and simple. In walking, the action, which carries the body forwards, backwards, or to either side, consists in alternate motions of the lower extremities, in which each of them becomes, in its turn, the fixed point on which the whole weight of the body is supported; the limb which moves, giving in its elevation an impulse to the trunk by means of the hip bone. Each of these motions is called a step, and a sustained succession of them constitutes progression: and in order to understand the latter, we shall examine the mechanism of the step under different conditions. In walking, if we suppose both

both feet to be on the fame tranfverfe line, the limb (fay the left) which makes the firft ftep, is raifed from the ground and advanced, by bending the hip joint; it is then extended, and laftly, the foot preferving its advanced pofition, is fixed on a different fpot; fo that the centre of gravity of the body which, during the advance of the left leg, was fuftained by the right, is moved forwards by a fimultaneous movement of the trunk; and the line of gravity falls between the two feet. If the ftep is fhort, the hip and trunk move but little; if it be long, and the left leg carried far beyond the right, there is an evident rotation of the right hip, and confequently of the trunk on the correfponding thigh. By this horizontal rotation, which carries the left fide of the body obliquely onwards, the extent of the ftep is greater than it would have been by the fimple bending the thigh; and we fee it in fact moft evidently in long ftrides, where the rotation is fo great, as to bring the fhoulder of the advanced fide immediately in front, the hip moving through the quarter of a circle, giving thereby an additional impulfe to the limb below. As the ftep is fhorter, this lateral rotation is lefs obfervable, till in fome cafes it can be no longer noticed. It is more evident in the female, from the greater tranfverfe diameter of the pelvis; and is particularly ftriking in individuals who have a ftiff, or anchylofed hip joint, where the limb cannot be advanced by bending the thigh. The fhort ftep is effected, on the contrary, chiefly by the alternate flexions and extenfions of the joints of one extremity, uninfluenced by any movement of the trunk on the other.

If the feet are not in the fame tranfverfe line at the commencement, the limb, which is behind, and inclined to the trunk, is the one to be moved forwards. Here the foot rifes, each part quitting the ground fucceffively, from the heel to the toes, by a kind of circular motion. The limb is thus elevated and advanced, and the centre of gravity is carried in the fame direction, which latter is effected with greater facility, as the body at the fame time leans a little forwards. When this impulfe is carried to its full extent, the toes are detached from the ground by the thigh being fuddenly bent on the hip, which has been moved forwards, and the limb is carried on as in the former cafe, the other remaining fixed as the temporary fupport. The hip and knee joints are then extended, and the foot bent on the leg. The foot touches the ground firft by the heel: this is fucceeded by a circular motion of the anterior part of the foot round this fixed point, and a correfponding motion of the leg in the fame direction, which brings it to a vertical line at the time that the toes begin to bear on the plane below. In thefe circular motions the foot is fenfibly elongated, and its concavity leffened by the preffure, its vaulted form, and the number and mode of its articulations imparting a degree of eafe and grace to the whole motion which we look for in vain, where the foot is flat and ftiff, and the whole fole quits, or reaches the ground at the fame inftant. There is, in this cafe, an awkwardnefs of gait, and a real inability of walking with promptitude and vigour. This ftep we have been defcribing takes place fucceffively in each limb in progreffion; and differs from the preceding in being more extenfive, and depending more importantly on the foot. The impulfe which its elevation communicates to the trunk will be influenced however materially by the knee: if this is bent in proportion as the foot rifes, the limb lofes in one action what it gains by another; the impulfe will be ftronger as the knee is kept more extended. And when the foot is detached at once, without this rotation, no impulfe will be given to the hip by the limb in motion: if the pelvis roll on the thigh which is fixed, it muft be by an independent mufcular action, as in the former cafe. In every cafe, as foon as the foot has left the ground, the trunk fupports the limbs; and carries it forwards. The mechanifm of the ftep backwards will be eafily underftood from what has been faid: we obferve only that the foot is raifed more immediately by bending the knee; and that when the ftep is prolonged, there is an evident horizontal rotation of the trunk in the fame direction. The fide ftep is produced by gently bending the knee to detach the foot from the ground, and then abducting the thigh; or by lifting the whole limb by a lateral inclination of the trunk on the oppofite one, and then feparating them, the knee being all the while extended.

Walking is a fucceffion of thefe motions, and requires for its regularity an equal length of both limbs; a fhortnefs of either limb induces a finking and relative inclination of the whole trunk to the correfponding fide, every time that the deficient extremity touches the ground. In the moft natural mode of walking, one foot does not quit the ground entirely, until the other touches it wholly, or in a great part of its length: the latter begins to fix itfelf while the former ftill refts on its point; the vertical line from the centre of gravity, which fell on one foot during the tranfportation of the other, being carried forward, and dropping at this time between the two. When the advanced foot is firmly fixed, we throw on it the centre of gravity; the fame motion neceffarily projects the whole body forwards, and a fucceffion of fimilar phenomena takes place. At each ftep the impulfe given to the trunk by the limb which has juft quitted the ground produces an undulatory motion up and down, and at the fame time an horizontal rotation alternating from one fide to the other. It is the latter which, from not being fuftained equally, produces the deviation from the ftraight line in walking forwards, fo conftantly obferved if we walk blind folded, where confequently we cannot correct incidental errors by the fight. The beft chance of walking ftraight in this cafe is by taking very fhort fteps, and for the reafons infifted on above. In fact, the centre of gravity is not, when we carefully endeavour to attain it, moved forward in the fame ftraight line, but varies more or lefs between the lines defcribed by the feet at every ftep, in a degree proportionate to the extent of each. This is fcarcely noticed, but is evident from this fimple experiment. If we ftand at any diftance from a fmall perpendicular rod, and fix our eyes on any point fome way behind it, and in the fame ftraight line, we fhall, as we advance to the rod, find this point alternately to the right and left of it, as we move each limb. A proof that the trunk is not carried as in a ftraight line, but defcribes a tortuous one, winding from one fide to the other. Another confequence of this rolling of the trunk on the oppofite limbs in fucceffion, is a fwinging motion communicated to the upper extremities: thefe move, moft commonly, in an oppofite way to the feet; that is, the right arm moves on at the fame inftant that the left leg propels the trunk. The ufe of this crofs motion of the arms is fuppofed to be that of correcting the lateral impulfe given to the trunk by the leg in its elevation. In every cafe of progreffion there muft be a regulated degree of flexions and extenfions, which is in fome inftances provided for by the mechanifm of the bones, and their ligaments, but in all depends principally on an uniform fucceffion of fuftained mufcular actions. The greater difficulty and fatigue experienced in walking up an afcending plane depends upon the greater degree of flexion neceffary to raife the limb from the ground; this muft be increafed as the plane becomes more vertical; the heel is at the fame time lower than the toes, and muft pafs through more

more ſpace in each elevation than in the ordinary caſe of walking on plain ground. Walking down hill is for the ſame reaſons leſs difficult; there is leſs occaſion for extenſive muſcular action. The object is to regulate the impulſe which the trunk eaſily acquires, and to keep the centre of gravity over the feet, by throwing the trunk a little backwards, inſtead of leaning forwards, as in the preceding caſe. In aſcending alſo we have each time to elevate the weight of the body by muſcular powers; in deſcending we have only to prevent it from ſinking too faſt. Mounting ſteps, or a ladder, or deſcending either, are ſtill more difficult, as the reaſons above given apply more ſtrongly.

Running differs from walking chiefly in the rapidity and force with which the motions of the lower extremities are executed. The mechaniſm by which they are produced is nearly ſimilar; the remarkable differences are, that the toes only touch the ground, and the whole trunk is inclined very conſiderably forwards. In conſequence of the firſt circumſtance, a ſmall ſurface only is in contact with the ground; and this can be more rapidly applied and detached, while the extenſion of the foot upon the leg adds to the length of the limb. From this ſmall extent of the baſe of ſupport ariſe the frequent falls in running from trifling obſtacles, or ſlight lateral impulſes; and hence, in this mode of progreſſion, we ſhould conſtantly endeavour to preſerve the balance, by preventing the centre of gravity from being removed too quickly from the leg behind, or from being thrown too ſoon on the one in advance. Running is alſo inſecure from the ſhort time allowed for fixing the point of ſupport; and hence poſitive ſtability is leſſened inverſely as the neceſſity for it is increaſed by the quick tranſition of the centre of gravity from point to point. At each ſtep the trunk is ſuddenly and violently carried forwards by the limb which has juſt left the ground, and which muſt be immediately and conſiderably advanced to ſupport the centre of gravity. In running very faſt, eſpecially on a declivity, ſo powerful an impulſe is communicated to the trunk, that it is almoſt impoſſible to ſtop ſuddenly; we gradually ſlacken our pace, ſtill projecting the limbs to ſupport the trunk till the impulſe is weakened. In running up an acclivity we always bend forwards, to aſſiſt the propulſion of the centre of gravity, which is effected under many diſadvantages; we generally do ſo in running on plain ground, though, when we run carefully, the head and ſhoulders are thrown back to counterbalance the impulſe below. When from fear, or inability to continue the muſcular exertions neceſſary to maintain this poſture, the trunk is neither thrown back, nor even kept vertical to the horizon, the runner appears to yield entirely to the impulſe, to commit himſelf almoſt to chance; his only endeavours being to throw his legs out rapidly and to the greateſt extent, to ſuſtain the increaſing velocity with which the centre of gravity is carried onward: the ground covered at each ſtep is really immenſe, the power of balancing is totally loſt, and the ſlighteſt inequality of ſurface is ſufficient to overturn him with the rougheſt violence. If he is ſteady enough to reach the bottom in ſafety, he continues his courſe a very conſiderable way before the impulſe is deſtroyed, and the power of regulating his movements recovered. In running, the lateral rotation of the hip and trunk on the thigh is extenſive, from the length of the ſteps; and the ſame cauſe produces an equally great and rapid motion of the oppoſite arm to preſerve the equilibrium, which is more eaſily loſt than in walking.

In leaping, the body may be raiſed vertically, or with any degree of obliquity. The joints of the lower extremities are firſt cloſely bent, and then ſuddenly extended, ſo as to propel the trunk: for the ground effectually reſiſts the impulſe, which muſt be entirely ſpent on the moveable parts above. The alternate angles, formed by the ankles, knees, and hips, depreſs the centre of gravity, without altering its bearing on the feet; and the ſame mechaniſm enables us to elevate the trunk nearly in a vertical line, the circular motions in oppoſite directions executed with almoſt inſtantaneous velocity, acting in a ſtraight line intermediate to them all. If the flexions were all made in the ſame direction, ſubſequent extenſion would be more laborious, and a perpendicular impulſe, ſuch as produces the vertical leap, would be impoſſible. The mechaniſm of leaping may be illuſtrated by comparing it with other motions. The muſcular powers being the ſame, the leap will be more conſiderable as the levers are longer, and more inclined on each other. Hence animals, whoſe hind limbs appear diſproportionately long, can make the moſt extenſive bounds; we need ſcarcely inſtance the kangaroo, hare, ſquirrel, or graſshopper.

The elevation of the body in a vertical leap is continued ſo long as the communicated impulſe exceeds the power of gravitation; as the former diminiſhes, the latter again begins to operate, and the body deſcends in the ſame line with that in which it had been elevated. It is incapable, while in the air, of altering the general direction derived from the firſt impulſe; although many motions of the extremities may be produced, as we obſerve in dancing. The ground, from its want of elaſticity, communicates no impulſe to the body at the moment of elevation. A certain reſiſtance to the action of the muſcles on the moveable levers is required. If the ground be ſoft or ſandy, it yields too readily to the impulſe of the feet, and leaping is impeded: on the contrary, if the point from which the jumper ſprings be elaſtic, as in the caſe of a flexible board, or a tight rope, there is an evident re-action, conſiderably increaſing the impulſe communicated by the exertion of the lower limbs. In jumping forwards the trunk is inclined, and projected in the ſame direction by the extenſion of the thigh on the leg. This latter motion is counterpoiſed or varied, according to circumſtances; but it is ſo eſſential in every caſe, that we cannot leap if the knees are kept extended, no muſcular action or exertion could then raiſe the body from the ground. The chief effort is to turn the thigh and trunk balanced on it forwards on the tibia; and the impulſe thus given predominates over the others; in leaping backwards, the tibia is the more moveable diviſion of the lever by a variation in the combined action of the muſcles employed, determinable by the will. In the vertical leap the body moves up and down in the ſame line: but if the impulſe is given in a line inclined to the horizon at oblique angles, the line deſcribed by the centre of gravity will be a parabolic curve, compounded of the uniform ſtraight motion of projection, and the force of gravity, as in other projectiles. While the firſt predominates over the laſt, the body aſcends; when they are in equal power, the elevation is the greateſt; from this point, it deſcends, the force of gravity acting with increaſing effect as the impulſe is weakened. The impulſe, in this caſe, may be conſiderably increaſed by a previous motion given to the body by running: the impetus is ſomewhat altered in direction by the violent extenſion of the extremities, but it acts with almoſt undiminiſhed force in projecting the body: there are here two cauſes acting in oppoſition to gravitation. This kind of leap is facilitated by inclining the body forwards; and, in order to afford a point of ſupport to the centre of gravity, we always find, before the body is elevated from the ground, that one of the legs, generally the right, is much before the other; this poſition is preſerved throughout, for the ſame reaſon, or the two legs are brought into parallel obliquely inclined lines, before we reach the

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ground at the end of the leap. If we jump with the feet together, we cannot incl ne the body much forwards, without lofing the balance. In this cafe, to affift the impulfe, we fwing the arms backwards and forwards before we make the fpring, endeavouring to give fome degree of horizontal impetus to the trunk, which muft however always be inferior to that obtained by even a fhort run. The body comes in contact with the ground, at the end of the leap, impreffed by a double force, *viz.*; the projectile impetus, and that acquired by gravitation in the defcent. We extend the feet on the legs, fo as to touch the ground firft by the toes; we then yield fomewhat to the force, and allow the joints to be bent gradually, fo as to weaken and finally deftroy the fhock. In order to deftroy the impulfe given to the centre of gravity, we throw back the head and fhoulders, and flacken our pace by degrees, till the power of balancing is reftored.

The action of dancing, which confifts in a rapid change, in various manners and directions, of the lower extremities, principally refembles, in fome refpects, the *run*, in many others the *leap*. We omit the detail of thofe extraordinary and amazing feats of agility, which aftonifh us in the ftage dancer, or the tumbler; as they depend, not on any peculiarity of mechanifm, but on the powerful, long fuftained, or rapid actions of mufcles, educated to the tafk, and preferved by conftant exercife in the higheft poffible ftate of energy. Hopping is a fucceffion of leaps on one leg only; the actions are otherwife analogous. Skaiting is a fimple motion; the mechanifm of which may be readily conceived after the obfervations we have made: the centre of gravity is brought alternately over the oppofite feet, as each glides on the plane beneath, and the balance is preferved by mufcular action. Swimming is a more compound action of both upper and lower extremities, involving in its difcuffion many interefting queftions, independent of their functions, and which confequently cannot properly be confidered here.

For more detailed information on the fubject of animal mechanics, we refer the reader to Borelli, de Motu Animalium; Haller, Element. Phyfiol. tom. iv.; Barthéz, Nouvelle Mécanique de l'Homme: fee Jour. des Scavans 1782-1783. Bichat, Anatomie Defcriptive, tom. i. Cuvier, Leçons d'Anatomie comparée; tom. i. fur la fin. There is a catalogue of authors on this fubject in Dr. Young's Natural Philofophy v. ii. p. 164.

Comparifon of the upper and lower extremities.—A review of the differences in the conftruction of the upper and lower limbs will illuftrate the mechanifm of their component parts. There is a general refemblance of form throughout; and the effential varieties may be all referred to the principle of mobility in the upper, and to that of firmnefs in the lower. In man, the extremities are nearly parallel to the long diameter of the trunk; and confequently they muft be parallel to each other; but they are not in the fame vertical plane. A line drawn from the glenoid cavity of the fcapula to the acetabulum, will be very oblique from above downwards and forwards, becaufe the plane in which the former lies is pofterior to that in which the latter is found. Hence the arm drops neceffarily behind the thigh. The advantage of fuch a difpofition in the upper extremities is, that the principal motions, which are thofe in the anterior direction, have a greater range than if the glenoid cavity had been feated nearer to the front of the trunk. The extremities differ alfo in the fpace, by which they are feparated from each other. If we judged only by the intervals between the right and left glenoid and cotyloid cavities refpectively, we fhould fuppofe the difference to be great; the long clavicles keeping the firft at a greater diftance than the pubal portions of the hip bones do the fecond. This, however, is compenfated by the length and obliquity of the necks of the thigh bones, which throw the axes of thefe bones far without the cotyloid cavities. We have here fuppofed the legs to be extended, and the arms lying in their natural direction by the fides of the trunk; if the knee and elbow be bent in this pofition, we fhall find the angles are open in nearly oppofite directions, that of the knee backwards, and the elbow forwards. Thefe are the only joints in which the articulations are directly inverfe in their modes of action; in quadrupeds, this condition prevails from the fhoulder and hip to the feet in a very ftriking manner. The lower extremities are nearer together below than above; while the upper are kept afunder by the intervening body. The lower extremities are rather longer than the upper, in confequence of the great length of the thigh and leg, when compared with the arm and fore arm. For the latter, by the long axis of the hand being in the fame line with their length, gain much more than the lower extremity does by the mere thicknefs of the foot. When the arm hangs eafily extended by the fide, the points of the fingers reach to about the middle of the thigh; yet there are many varieties in this refpect. The folid form, and the broad articular furfaces of the lower, are ftrikingly contrafted with the flender make and narrow articulations of the upper; the firft bearing a marked relation to their principal function of fuftaining the body, the latter to their diftinguifhing character of mobility. At the time of birth the upper extremities are more advanced in formation than the lower. This feature is, however, more remarkable, the nearer we mount to the firft developement of the embryo; it is gradually loft after birth, and the ftructure of both is completed nearly about the fame period. The different nature of their functions, thofe of the upper commencing almoft immediately, and thofe of the lower not until a confiderable interval after the birth of the child, explains eafily the reafon of this difpofition.

The bones of the hip and fhoulder differ more in their form and connections than any other parts of the extremities. The fcapulæ are fuftained by mufcles, allowing a great variety of motion, and are kept apart by the two moveable clavicles in front; the hip bones are bound firmly to the fpine, and the articular cavities feparated from each other by an immoveable medium. The fpace between the cotyloid cavities is proportionably greater in the female than in the male. The fame excefs may be obferved in the fhoulders, where it arifes from the greater comparative length of the clavicle. The breadth of the fcapulæ increafes in the male the tranfverfe diameter of the fhoulders, which on this account is particularly ftriking from behind; in front they are not proportionably fo wide as in the female. It is therefore the proportional excefs of width in the hips, and not any decreafe in the breadth of the fhoulders, which gives to the female figure one of its moft prominent features; this diftinguifhes it from the male, in whom the ftrong, though narrow, hips are oppofed to the comparatively fpreading fhoulders. Thefe circumftances are fufficiently evident in examining the difpofition of the bones; but they become ftill more ftriking, by the addition of the foft parts, in the complete fubject, where the ftrongly marked and mufcular form of the fhoulders, and the contracted outline of the hips in the male, is finely contrafted with the delicacy of the firft, and the fwelling roundnefs of the laft in the female. The hip bone exceeds the fcapula and clavicle in volume, as well as in the firmnefs of its articulation; it further gives a fixed point of motion to the thigh, by a deep

deep articular cavity, whereas the ſcapula offers a ſhallow and eaſily moveable one, yielding to a ſlight impulſe.

The femur exceeds the humerus very much in ſize, and length, (this laſt being nearly in the ratio of 46 to 33,) and in the extent of its articular ſurfaces. Although their motions are for the moſt part analogous, ſome differences may be pointed out. The movements of circumduction and rotation exiſt in an inverſe ratio to each other. In the thigh bone, the length of the neck, which is the lever of rotation, gives great extent to this motion, and thus ſupplies the want in the leg of the motions correſponding to the pronation and ſupination of the fore-arm, ſo that all rolling of the foot out and in, when the limb is extended, ariſes from a motion of the whole limb. The ſhort neck of the humerus, on the contrary, by bringing the axis of the bone nearer the centre of motion, limits rotation; which is leſs eſſential, inaſmuch as the hand is moved by the pronation and ſupination of the fore-arm. Circumduction is more confined in the thigh by this very length of the neck, which makes an angular lever of this bone, differing much from the nearly rectilineal one of the humerus. In the firſt caſe the axis of motion is not in the long axis of the bone; in the laſt, it is nearly ſo; and the difficulty of this motion is proportional to the difference between the two axes, while its facility is greater as they approach each other more nearly. The advantages of this diſpoſition, in giving mobility to the upper, and firmneſs to the lower extremities, may be readily perceived.

The leg exceeds the fore-arm in the ſize and length of the bones, the proportions being as 39 to 26. In the orang-outang the ratio of the thigh to the arm is as 9 to 10, and that of the fore-arm to the leg as 9 to 11; which proportions are very different from thoſe of the human ſubject. The exceſs of length in the lower extremity of man is ſeen moſt evidently when he attempts to move on all fours, as we expreſs it. To correct this diſproportion he is obliged to bend the joints of the lower extremities, or to throw them out very obliquely behind the trunk, whilſt the upper are perpendicular to it. The leg and fore-arm reſemble each other leſs than the thigh and arm; in the fore-arm the parts are arranged favourably to mobility; in the leg the object is to procure a firm and ſolid ſupport, which can tranſport the centre of gravity with eaſe and ſafety from one point to another. Of the two bones of the fore-arm, which are nearly equal in every reſpect, one rolls eaſily over the other, and the hand is articulated with the moveable bone. In the lower extremity theſe rolling motions would have been dangerous; to give it firmneſs, the foot is articulated with the tibia, which correſponds to the ulna, and not with the fibula; the latter poſſeſſes no perceptible power of motion.

The hand and foot reſemble each other moſt cloſely in the ſtructure and number of the phalanxes, and of the bones which ſupport them; the principal differences occur in the carpus and tarſus, which are the moſt ſolid portions. That part of the hand in which its ſtrength reſides is leſs developed, and has far leſs volume than the analogous parts of the foot, on which the whole weight of the body in ſtation finally reſts. The moveable phalanges, which are the principal agents in executing the functions of the hand, are much longer, and larger than thoſe of the toes, which are not ſo eſſential to ſtation or progreſſion. The foot and hand are diſpoſed inverſely as to form; the poſterior part of the former, and the anterior part of the latter, is the moſt important, the longeſt, and poſſeſſes the moſt ſtriking characters. The functions of the hand render it neceſſary that its plane ſhould be nearly continuous with that of the fore-arm; otherwiſe the radius could not guide it ſo preciſely over the objects in view. In the foot, the articulation is ſo diſpoſed that its poſterior part offers a powerful lever for muſcular agents, and a ſolid ſupport for the maſs above; it is formed by a ſingle bone of the foot, which neceſſarily adds to its ſolidity. The metacarpus and metatarſus have a much greater ſimilarity to each other; the latter is the more ſolid, and offers this principal difference. The metatarſal bone of the great toe, by far the ſtrongeſt of the whole, has ſcarcely any motion on the tarſus, and is on the ſame plane with the others; while that which ſupports the thumb has a very conſiderable extent of motion, and is anterior to the reſt. This ariſes from the obliquity in the articulating facet of the trapezium, which is directly tranſverſe in the firſt cuneiform bone of the tarſus. Further, this bone in the foot is not ſeparated from the other metatarſal bones, by an interoſſeous ſpace larger than that between all the reſt, as is the caſe with the metacarpal bone of the thumb. Theſe remarkable differences depend wholly on the ſolidity neceſſary for ſtation, and the great mobility required for the important offices executed by the thumb in the human ſubject. In the ape tribe, the great toe on the contrary may be properly regarded as another thumb in its ſtructure and uſes. The toes can be inflected further on the back of the foot than the fingers can be on the hand, a diſpoſition which is accommodated to progreſſion, eſpecially to running ſwiftly; an analogous effect is produced in the hand by the inflection of the carpus backwards on the fore-arm. At the time of birth the important parts of the hand are already well developed; the metacarpus, and more eſpecially the fingers, are ſufficiently formed for the infant to ſeize objects within its reach, and to diſtinguiſh ſome of their qualities. This early developement of the organs of touch would ſeem to bear a marked relation to the correſponding advancement in the formation of two other organs of ſenſe, the eye and ear, they being all aſſociated cloſely in confirming, or correcting external ſenſations. The important part of the foot, the tarſus, is far behind in formation, as it is not called into uſe till ſome time after birth, till the organs of ſenſe have long been exerciſed in common, and can now mutually aſſiſt each other.

Reſpecting this compariſon between the upper and lower limbs, ſee Vicq D'azyr ſur la comparaiſon des extremités entr'elles dans l'homme, et dans les quadrupedes, in the Hiſtoire de l'Acad. des Sciences 1774.

EXTREMUM *Clauſit Diem.* See Diem.

THE END OF VOL. XIII.

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