Edward Gunter Davis

Sept^r. 1824.

A

HISTORY

OF

INVENTIONS AND DISCOVERIES.

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TRANSLATED FROM THE GERMAN,

BY WILLIAM JOHNSTON.

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CAREFULLY CORRECTED, AND ENLARGED BY THE ADDITION OF SEVERAL NEW ARTICLES.

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OF

THE THIRD VOLUME.

HISTORY

OF

INVENTIONS.

GARDEN-FLOWERS.

SOME of the flowers introduced into our gardens, and now cultivated either on account of their beauty or the pleasantness of their smell, have been procured from plants which grew wild, and which have been changed, or, according to the opinion of florists, improved, by the art of the gardener. The greater part of them however came originally from distant countries, where they grow, in as great perfection as ours, without the assistance of man. Though we often find mention of flowers in the works of the Greeks and the Romans, it appears that they were contented with those which grew in their own neighbourhood. I do not remember to have read that they ever took the trouble to form gardens for the particular purpose of rearing in them foreign flowers or plants.

But even supposing that I may be mistaken, for I do not pretend to have examined this subject very minutely, I think I may with great probability venture to assert, that the modern taste for flowers came from Persia to Constantinople, and was imported thence to Europe, for the first time, in the sixteenth century. At any rate, we find that the greater part of the productions of our flower-gardens were conveyed to us by that channel. Clusius and his friends, in particular, contributed very much to excite this taste; and the new plants brought from both the Indies by the travellers who then continued still more frequently to visit these countries, tended to increase it. That period also produced some skilful gardeners, who carried on a considerable trade with the roots and seeds of flowers; and these likewise assisted to render it more general. Among these were John and Vespasian Robin, gardeners to Henry IV of France,* and Emanuel Sweert, gardener to the emperor Rodolphus II,† from whom the botanists of that time procured many rarities, as appears from different passages of their works. As this taste for flowers prevails more at present than at any former period, a short history of some of the objects of it may not be disagreeable, perhaps, to many of my readers.

* See Haller's Bibliotheca botan. i. p. 398.

† Ibid. p. 411.

Simon de Tovar, a Spanish physician, brought the tuberose to Europe before the year 1594 from the East Indies, where it grows wild in Java and Ceylon, and sent some roots of it to Bernard Paludanus*, who first made the flower publicly known, in his annotations on Linschoten's voyage.† The full tuberoses were first procured from seed by one Le Cour, at Leyden, who kept them scarce for some years, by destroying the roots, that they might not become common,‡ The propagation of them in most countries is attended with difficulties; but in Italy, Sicily, and Spain, it requires no trouble; and at present the Genoese send a great many roots to England, Holland, and Germany. The oldest botanists classed them among the hyacinths, and their modern name *polianthes tuberosa* was given them by Linnæus in his *Hortus Cliffortianus.*

The auricula, *primula auricula*, grows wild among the long moss covered with snow, on the confines of Switzerland and Steyermark,§ whence it was brought to our gardens, where, by art and accident, it has produced more varieties than any other species of flower. I do not know who first transplanted it from its native soil. Pluche‖ says

* Papons Reise durch die Provence. Leipzig 1783, 8vo. p. 332.

† Navigatio et itinerarium in Orientalem Indiam. Hagæ 1599, fol.

‡ Miller's Gärtner-Lexicon, iii. p. 633.

§ Haller, Histor. Stirpium, i. p. 272, n. 612.

‖ Schauplatz der natur, ii. p. 49.

only that some roots were pulled up by Walloon merchants, and carried to Brussels. This much, at any rate, is certain, that it was first cultivated with care by the Flemings, who were very successful in propagating it. Professor Weismantel, who deserves to be ranked amongst the principal writers on flowers,* says, that the auricula was described and celebrated by Ovid, Pliny, and Columella; but this I much doubt. The botanists even of the 17th century, who searched for plants in the works of the ancients with great diligence, and who took the liberty of making very bold assertions, were not able to find any name that would correspond with the auricula; for the conjecture of Fabius Columna, that it is the *alisma* of Dioscorides, is highly improbable, as that Grecian author extols his plant, which was fond of water, on account of its medicinal virtues only. In the time of Clusius, most of the varieties of the auricula were scarce.

The common fritillary, or chequered lily, *fritillaria meleagris*, was first observed in some parts of France, Hungary, Italy, and other warm countries, and introduced into gardens about the middle of the sixteenth century. At first it was called *lilium variegatum;* but Noel Capperon, an apothecary at Orleans, who collected a great many scarce plants, gave it the name of *fritillaria*, be-

* Des Blumisten zweyter theil. Erfurt 1783, 8vo. p. 5.

cause the red or reddish-brown spots of the flower form regular squares, much like those of a chess-board. It was first called *meleagris* by Dodonæus, because the feathers of that fowl are variegated almost in the same manner.*

The roots of the magnificent crown imperial, *fritillaria imperialis*, were about the middle of the sixteenth century brought from Persia to Constantinople, and were carried thence to the Emperor's garden at Vienna, from which they were dispersed all over Europe. This flower was first known by the Persian name *tusac*, until the Italians gave it that of *corona imperiale*,† or crown imperial. I have somewhere read, that it has been imagined that the figure of it is to be found represented on coins of Herod, and that, on this account, it has been considered as the lily so much celebrated in the Scripture.

The Persian lily, *fritillaria Persica*, which is nearly related to it, was made known almost about the same time. The bulbs or roots were brought from Susa to Constantinople, and for that reason it was formerly called *lilium Susianum*.‡

African and French marygolds, *tagetes erecta* and *patula*, were, according to the account of Dodonæus and others, brought from Africa to

* Clusii Hist. plant. ii. p. 154.

† Clusii Hist. plant. i. p. 128. Dodonæi Pempt. p. 202.

‡ Clusii Hist. plant. i. p. 130.

Europe, at the time when the emperor Charles V carried his arms against Tunis. This however is improbable; for these plants are indigenous in South America, and were known to botanists before that period under the name of *caryophyllus Indicus*, from which is derived the French appellation *oeillet d'Inde*. Cordus calls them, from their native country, *tanacetum Peruvianum*.*

Among the most beautiful ornaments of our gardens, is the bella-donna lily, *amaryllis formosissima*, the flower of which, composed of six petals, is of a deep-red colour, and in a strong light, or when the sun shines upon it, has an agreeable yellow lustre like gold. The first roots of it ever seen in Europe were procured in 1593, on board a ship which had returned from South America, by Simon de Tovar, a physician at Seville. In the year following, he sent a description of the flower to Clusius; and as he had at the same time transmitted some roots to Bernard Paludanus, and count d'Aremberg, the former sent a dried flower, and the latter an accurate drawing of it to Clusius, who published it in 1601.† One of the Robins gave in 1608 a larger and more correct figure, which was afterwards copied by Bry, Parkinson, and Rudbeck; but a complete description, with a

* Dodonæi Florum historia, p. 62. Bauhini Histor. plant. iii. 1. p. 98.

† Hist. plantar. i. p. 157.

good engraving, was published in 1742, by Linnæus,* who in 1737 gave to that genus the name by which they are known at present.† Sweert, Bauhin, and Rudbeck, are evidently mistaken in assigning the East Indies as the original country of this plant; and Broke,‡ who was not a botanist, but only a florist, is equally wrong in making it a native of the Levant. Tovar received it from South America, where it was found by Plumier and Barrere, and at a later period by Thiery de Menonville also.§ At first it was classed with the narcissus, and it was afterwards called *lilio-narcissus*, because its flower resembled that of the lily, and its roots those of the narcissus. It was named *flos-Jacobæus*, because some imagined that they discovered in it a likeness to the badge of the knights of the order of St. James in Spain, whose founder, in the fourteenth century, could not indeed have been acquainted with this beautiful amaryllis.

Another species of this genus is the Guernsey lily, *amaryllis Sarniensis*, which in the magnificence of its flower is not inferior to the former. This plant was brought from Japan, where it was found

* Abhandlungen der Schwedischen Akademie, iv. p. 116.

† Hortus Cliffort, p. 135.

‡ Beobachtungen von einigen blumen. Leipzig 1769, 8vo.

§ Barrere, Hist. naturelle de la France Equinoxiale, spec. 8. Traité de la culture du Nopal, par Thiery de Menonville. Au Cap-François 1787, 8vo.

by Kæmpfer,* and also by Thunberg,† during his travels some years ago in that country. It was first cultivated in the beginning of the seventeenth century in the garden of John Morin, at Paris, where it blowed, for the first time, on the 7th of October 1634. It was then made known by Jacob Cornutus, under the name of *narcissus Japonicus flore rutilo.*‡ After this it was again noticed by John Ray§ an Englishman, in 1665, who called it the *Guernsey lily*, which name it still very properly bears. A ship returning from Japan was wrecked on the coast of Guernsey, and a number of the bulbs of this plant, which were on board, being cast on shore, took root in that sandy soil. As they soon increased and produced beautiful flowers, they were observed by the inhabitants, and engaged the attention of Mr. Hatton, the governor's son, whose botanical knowledge is highly spoken of by Ray, and who sent roots of them to several of his friends who were fond of cultivating curious

* Amœnitat. exoticæ, p. 872.

† Flora Japonica, p. 132. The author says that the Japanese consider the bulbs as poisonous.

‡ Inter omnes narcissos, qui hactenus invisi apud nos extiterunt, prima, ut arbitror, auctoritas nobilissimo huic generi debetur, quod paucis abhinc annis ex Japonia allatum, strenui admodum et nullis sumptibus parcentis viri Johannis Morini cultura, tandem in florem prosiluit septimo mensis Octobris, anno Dom. 1634. *Jac. Cornuti Canadensium plantarum aliarumque nondum editarum historia.* Paris 1635, 4to. p. 157.

§ A complete Florilege, furnished with all the requisites belonging to a florist. London 1665, fol. lib. i. cap. 10, p. 74.

plants.* Of this elegant flower Dr. Douglass gave a description and figure in a small treatise published in 1725,† which is quoted by Linnæus in his *Bibliotheca*, but not by Haller.

Of the numerous genus of the ranunculus, florists, to speak in a botanical sense, have obtained a thousand different kinds;‡ for, according to the manner in which they are distinguished by gardeners, the varieties are infinite and increase almost every summer, as those with half-full flowers bear seed which produces plants that from time to time divide themselves into new kinds that exhibit greater or uncommon beauties. The principal part of them, however, and those most esteemed were brought to us from the Levant. Some were carried from that part of the world so early as in the time of the Crusades;

* Ejus radices ex Japonia allatæ, et ex nave naufraga, Batavica an Anglica incertum, ejectæ in littus arenosum insulæ Guernsey;—ibi, inquam, bulbi incuria projecti in littus arenosum, inter sparta maritima, et vento fortiore arenam eo pellente, qua demum prædicti bulbi tecti post aliquot annos summa cum admiratione flores nitidos amplos et elegantes sponte dedere. Hoc flore detecto, aliquot annis postea radices plurimas communicavit botanicis et elegantium florum cultoribus dominus Carolus Hatton, filius natu secundus nobilissimi viri Christophori Hatton, baronis de Hatton, et insulæ Guernsey prædictæ gubernatoris. *Rob. Morisoni Plantarum historia*, pars secunda, Oxonii 1680, fol. sect. 4, p. 367.

† Lilium Sarniense, or a Description of the Guernsey lily. To which is added the botanical dissection of the coffee-berry. By Dr. James Douglass, London 1725, fol. Linnæi Bibliotheca botanica. Halæ 1747, 8vo. p. 32.

‡ Miller's Gärtner-Lexicon, iii. p. 761.

but most of them have been introduced into Europe from Constantinople since the end of the sixteenth century, particularly the Persian ranunculus,* the varieties of which, if I am not mistaken, hold at present the first rank. Clusius describes both the single and the full flowers as new rarities.† This flower was in the highest repute during the time of Mahomet IV. His Grand Vizir, Cara Mustapha, well known by his hatred against the Christians and the siege of Vienna in 1683, wishing to turn the Sultan's thoughts to some milder amusement than that of the chase, for which he had a strong passion, diverted his attention to flowers; and, as he remarked that the Emperor preferred the ranunculus to all others, he wrote to the different Pachas throughout the whole kingdom to send him seeds or roots of the most beautiful kinds. The Pachas of Candia, Cyprus, Aleppo, and Rhodes paid most regard to this request; and the elegant flowers which they transmitted to court were shut up in the Seraglio as unfortunate offerings to the voluptuousness of the Sultan, till some of them, by the force of money, were at length freed from their imprisonment. The ambassadors from the European courts, in particular, made it their business to procure roots of as many kinds as they

* Ranunculus Asiaticus Linnæi.

† Histor. plant. rar. i. p. 241.

could, which they sent to their different sovereigns. Marseilles, which at that period carried on the greatest trade to the Levant; received on this account these flowers very early, and a person there, of the name of Malaval, is said to have contributed very much to disperse them all over Europe.*

LENDING-HOUSES.

It appears singular to us, at present, that it should have been once considered unlawful to receive interest for lent money; but this circumstance will excite no wonder when the reason of it is fully explained. The different occupations by which one can maintain a family without robbery and without war, were at early periods neither so numerous nor so productive as in modern times; those who borrowed money required it only for immediate use, to relieve their necessities or to procure the conveniencies of life; and those who advanced it to such indigent persons did so either through benevolence or friendship. The

* Tournefort, Voyage du Levant, vol. ii. p. 15. *Traité des renoncules (par D'Ardene)*, Paris 1746, 8vo.; and an extract from it in *Hamburg. magazin*, i. p. 596. *Pluche, Schauplatz der natur*, i. p. 71.

case now is widely different. With the assistance of borrowed money people enter into business, and carry on trades, from which, by their abilities, diligence, or good fortune, so much profit arises that they soon acquire more than is requisite for their daily support; and under these circumstances the lender may, undoubtedly, receive for the beneficial use of his money a certain remuneration, especially as he himself might have employed it to advantage; and as by lending it he runs the risk of losing either the whole or a part of his capital, or at least of not receiving it again so soon as he may have occasion for it.

Lending on interest, therefore, must have become more usual in proportion as trade, manufactures, and the arts were extended; or as the art of acquiring money by money became more common: but it long continued to be detested, because the ancient abhorrence against it was by an improper construction of the Mosaic law converted into a religious prejudice,* which, like many other prejudices more pernicious, was strengthened and confirmed by severe papal laws. The people, however, who often devise means to render the faults of their legislators less hurtful, concealed this practice by various inventions, so

* J. D. Michaelis Dissertatio de mente et ratione legis Mosaicæ usuram prohibentis, in Syntagma commentationum, ii. p. 9; and his Mosaisches recht. iii. p. 86.

that neither the borrower nor lender could be punished, nor the giving and receiving of interest be prevented. As it was of more benefit than prejudice to trade, the impolicy of the prohibition became always more apparent; it was known that the new-invented usurious arts, under which it was privately followed, would occasion greater evils than those which had been apprehended from lending on interest publicly; it was perceived also that the Jews, who were not affected by papal maledictions, foreigners, and a few natives who had neither religion nor conscience, and whom the Church wished least of all to favour, were those principally enriched by it.

In no place was this inconvenience more felt than at the Romish court, even at a time when it boasted of divine infallibility; and nowhere was more care employed to remove it. A plan, therefore, was at length devised, by which the evil, as was supposed, would be banished. A capital was collected from which money was to be lent to the poor for a certain period on pledges without interest. This idea was indeed not new; for such establishments had long before been formed and supported by humane princes. The emperor Augustus, we are told, converted into a fund the surplus of the money which arose to the State from the confiscated property of criminals, and lent sums from it, without interest, to those who could pledge

effects equal to double the amount.* Tiberius also advanced a large capital, from which those were supplied with money for three years, who could give security on lands equivalent to twice the value.† Alexander Severus reduced the interest of money by lending money at a low rate, and advancing sums to the poor without interest to purchase lands, and agreeing to receive payment from the produce of them.‡

These examples of the ancients were followed in modern Italy. In order to collect money, the Popes conferred upon those who would contribute towards that object a great many fictitious advantages, which at any rate cost them nothing. By bulls and holy water they dispensed indulgences and eternal salvation; they permitted burthensome vows to be converted into donations to lending-

* Quoties ex damnatorum bonis pecunia superflueret, usum ejus gratuitum iis qui cavere in duplum possent, ad certum tempus indulsit. *Sueton. Vita Augusti*, cap. 41.

† Tulit opem Cæsar, disposito per mensas millies sestertio, factaque mutuandi copia sine usuris per triennium, si debitor populo in duplum prædiis cavisset. Sic refecta fides, et paulatim privati quoque creditores reperti. *Taciti Annal.* vi. 17, p. 361. Publice munificentiam bis omnino exhibuit: proposito millies HS. gratuito in triennii tempus. *Sueton. Vita Tiberii*, cap. 48, p. 558. Tiberius rem fœnerariam temperavit, milliesque sestertium reipublicæ largitus est, quam pecuniam senatorii ordinis viri indigentibus sine usura ad tres annos mutuo darent. *Dio Cassius*, lviii. 21, p. 893.

‡ Fœnus publicum trientarium exercuit, ita ut pauperibus plerisque sine usuris pecunias dederit ad agros emendos, reddendas de fructibus. *Ælius Lamprid. Vita Alex. Severi*, cap. 21, p. 528.

houses; and authorised the rich who advanced them considerable sums to legitimate such of their children as were not born in wedlock. As an establishment of this kind required a great many servants, they endeavoured to procure these also on the same conditions; and they offered, besides the above-mentioned benefits, a great many others not worth notice, to those who would engage to discharge gratis the business of their new undertaking; but in cases of necessity they were to receive a moderate salary from the funds. This money was lent without interest for a certain time to the poor only, provided they could deposit proper pledges of sufficient value.

It was, however, soon observed that an establishment of this kind could neither be of extensive use nor of long duration. In order to prevent the secret lending of money, by the usurious arts which had begun to be practised, it was necessary that it should advance sums not only to those who were poor in the strictest sense of the word, but to those also who, to secure themselves from poverty, wished to undertake and carry on useful employments, and who for that purpose had need of capitals. However powerful the attractions might be, which, on account of the religious folly that then prevailed, induced people to make large contributions, they gradually lost their force, and the latter were lessened in proportion, especially as a spirit of reformation began soon after to break out

in Germany, and to spread more and more into other countries. Even if a lending-house should not be exhausted by the maintenance of its servants, and various accidents that could not be guarded against, it was still necessary, at any rate, to borrow as much money at interest as might be sufficient to support the establishment. As it was impossible that it could relieve all the poor, the only method to be pursued was to prevent their increase, by encouraging trade, and by supplying those with money who wanted only a little to enable them to gain more, and who were in a condition and willing to pay a moderate interest. The pontiffs, therefore, at length resolved to allow the lending-houses to receive interest, not for the whole capitals which they lent, but only for a part, merely that they might raise as much money as might be sufficient to defray their expenses; and they now, for the first time, adopted the long-established maxim, that those who enjoy the benefits should assist to bear the burthen—a maxim which very clearly proves the legality of interest. When this opening was once made, one step more only was necessary to place the lending-houses on that judicious footing on which they would in all probability have been put by the inventor himself, had he not been under the influence of prejudice. In order that they might have sufficient stock in hand, it was thought proper to give to those who should advance them money a moderate interest,

which they prudently concealed by blending it with the unavoidable expenses of the establishment, to which it indeed belonged, and which their debtors, by the practice a little before introduced, were obliged to make good. The lending-houses, therefore, gave and received interest. But that the odious name might be avoided, whatever interest was received, was said to be *pro indemnitate;* and this is the expression made use of in the papal bull.

All this, it must be confessed, was devised with much ingenuity: but persons of acuteness still discovered the concealed interest; and a violent contest soon arose respecting the legality of lending-houses, in which the greatest divines and jurists of the age took part; and by which the old question, whether one might do any thing wicked, or establish interest, in order to effect good, was again revived and examined. Fortunately for the pontifical court, the folly of mankind was still so great that a bull was sufficient to suppress, or at least to silence, the spirit of inquiry. The Pope, declared the holy mountains of piety, *sacri monti de pietà* to be legal; and threatened those with his vengeance who dared to entertain any further doubts on the subject. All the cities now hastened to establish lending-houses; and their example was at length followed in other countries. Such, in a general view, is the history of these

establishments: I shall now confirm it by the necessary proofs.

When under the appellation of *lending-house* we understand a public establishment where any person can borrow money upon pledges, either for or without interest, we must not compare it to the *tabernæ argentariæ* or *mensæ numulariæ* of the Romans. These were banking-houses, at which the State and rich people caused their revenues to be paid, and on which they gave their creditors orders either to receive their debts in money, or to have the sums transferred in their own name, and to receive security for them. To assign over money and to pay money by a bill were called *perscribere* and *rescribere;* and an assignment or draft was called *attributio.* These *argentarii, mensarii, numularii, collybistæ* and *trapezitæ* followed the same employment, therefore, as our cashiers or bankers. The former, like the latter, dealt in exchanges and discount; and in the same manner also they lent from their capital on interest, and gave interest themselves, in order that they might receive a greater. Those who among the ancients were enemies to the lending of money on interest brought these people also into some disrepute; and the contempt entertained for them was probably increased by prejudice, though those *numarii* who were established by government as public cashiers held so exalted a rank, that some of them

became consuls. Such banking-houses occur in the Italian States in the middle ages, about the year 1377. They were called *apothecæ seu casanæ feneris*,* and in Germany *wechselbanke*, banks of exchange; but they were not lending-houses in the sense in which I here understand them.

Equally distinct also from lending-houses were those banks established in the fourteenth century, in many cities of Italy, such, for example, as Florence, in order to raise public loans. Those who advanced money on that account received an obligation and monthly interest, which on no pretext could be refused, even if the creditor had been guilty of any crime. These obligations were soon sold with advantage, but oftener with loss; and the price of them rose and fell like that of the English stocks, but not so rapidly; and theologists disputed whether one could with a safe conscience purchase an obligation at less than the stated value, from a proprietor who was obliged to dispose of it for ready specie. If the State was desirous or under the necessity of repaying the money, it availed itself of that regale called by Leyser *regale falsæ monetæ*, and returned the capi-

* Osservazioni istoriche di Dominico M. Manni circa i sigilli antichi dei secoli bassi, vol. xxvii. p. 86. The author here quotes from an ancient city-book the following passage: Franciscus fenerator pro se et apotheca seu casana fenoris, quam tenebat in via Quattro Pagoni, &c.

tal in money of an inferior value. This establishment was confirmed, at least at Florence, by the pontiff, who subjected those who should commit any fraud in it, to ecclesiastical punishment and a fine, which was to be carried to the Papal treasury: but long before that period, the republic of Genoa had raised a loan by mortgaging the public revenues. I have been more particular on this subject, because Le Bret* calls these banks very improperly lending-houses; and in order to show to what a degree of perfection the princely art of contracting and paying debts was brought so early as the fourteenth century.

Those who have as yet determined the origin of lending-houses with the greatest exactness place it, as Dorotheus Ascianus, that is Matthias Zimmermann,† does, in the time of Pope Pius II or Paul II, who filled the papal chair from 1464 to

* Algemeine Welthistorie, xlv. p. 10.

† This theologian, born at Eperies in Hungary, in 1625, was driven from his native country on account of his religion, and died superintendant at Meisse in 1689. He wrote, besides other works: *Dorothei Asciani Montes pietatis Romanenses historice, canonice, et theologice detecti.* Lipisiæ 1670, 4to. This book is at present very scarce. I shall take this opportunity of mentioning also the following, because many who have written on lending-houses have quoted it, though they never saw it: *Montes pietatis Romanenses, das ist, die Berg der Fromkeit oder Gottesforcht in der stadt Rom.* Durch Elychnium Gottlieb. Strasburg 1608, 8vo. It contains nothing of importance that may not be found in Ascianus.

1471; and the reason for supposing it to have been under the pontificate of the latter is, because Leo X, in his bull, which I shall quote hereafter, mentions that pope as the first who confirmed an establishment of this kind. As the above account did not appear to me satisfactory, and as I knew before that the oldest lending-houses in Italy were under the inspection of the Franciscans, I consulted the Annals of the Seraphic Order, with full expectation that this service would not be omitted in that work; and I indeed found in it more materials towards the history of lending-houses than has ever been collected, as far as I know, by any other person.

As complaints against usury, which was practised by many Christians, but particularly by the Jews, became louder and more public in Italy in the fifteenth century, Barnabas Interamnensis, probably of Terni, first conceived the idea of establishing a lending-house. This man was originally a physician; had been admitted to the degree of doctor; was held in great respect on account of his learning; became a Minorite, or Franciscan; acquired in that situation every rank of honour, and died, in the first monastery of this order at Assisi (*in monte Subasio*),* in the year

* Of this Barnabas I know nothing more than what I have here extracted from *Waddingii Annales Minorum*, tom. xiv. p. 93. Wadding refers to *Marian.* lib. v. c. 40, § 17; and *Marc.* 3. p. lib. 5. cap. 58. The former is *Marianus Florentinus*, whose *Fas-*

1474. While he was employed in preaching under Pope Pius II at Perugia, in the territories of the Church, and observed how much the poor were oppressed by the usurious dealings of the Jews, he made a proposal for raising a capital by collections, in order to lend from it on pledges to the indigent, who should give monthly, for the use of the money borrowed, as much interest as might be necessary to pay the servants employed in this establishment, and to support it. Fortunatus de Copolis, an able jurist of Perugia, who after the death of his wife became also a Franciscan, approved of this plan, and offered to assist in putting it into execution. To be assured in regard to an undertaking which seemed to approach so near to the lending on interest, both these persons laid their plan before the university of that place, and requested to know whether such an establishment could be allowed; and an answer being given in the affirmative, a considerable sum was soon collected by preaching, so that there was a sufficiency to open a lending-house. Notwithstanding this

eiculus chronicorum Ordinis Minorum, which consists of five books, was used in manuscript by Wadding in composing his large work, and in my opinion has never been printed. *Marc.* is *Marcus Ulyssoponensis*, whose *Chronica Ordinis Minorum tribus partibus distincta* I have not been able to procure, though it is translated into several languages. See *Waddingii Scriptores Ordinis Minorum.* Romæ 1650, fol. p. 248, 249. What is said on this subject in *Argelati Bibliotheca Scriptor. Mediolanens.* Mediolani 1745, fol. i. p. 352, has been taken from Wadding.

sanction, many were displeased with the design, and considered the receiving of interest, however small it might be, as a species of usury. Those who exclaimed most against it were the Dominicans (*ex ordine Prædicatorum*): and they seem to have continued to preach in opposition to it, till they were compelled by Leo X to be silent; while the Franciscans, on the other hand, defended it, and endeavoured to make it be generally adopted. The dispute became more violent when, at the end of a year, after all expenses were paid, a considerable surplus was found remaining; and as the managers did not know how to dispose of it, they at length thought proper to divide it amongst the servants, because no fixed salaries had been appointed for them. Such was the method first pursued at Perugia; but in other places the annual overplus was employed in a different manner. The particular year when this establishment began to be formed I have no where found marked; but as it was in the time of Pius II, it must have been in 1464, or before that period.* It

* This is confirmed by *M. B. Salon*, in t. ii. *Contr. de justit. et jure* in ii. 2 *Thom. Aquin.* qu. 88. art. 2. controv. 27: Hujus modi mons non erat in usu apud antiquos. Cœpit fere a 150 annis, tempore Pii II. Hic enim pontifex est qui primus omnium legitur montem approbasse, cœpitque, Prædicatoribus hortantibus, respublicas et populos ad illum instituendum hortari, ne pauperes ab Hebræis acceptis consumerentur. The Dominicans, or *Prædicatorcs*, however, opposed it. The precise year when this institution was formed, may, perhaps, be mentioned in the particular his-

is very remerkable that this pontiff confirmed the lending-house at Orvieto (*Urbs Vetus*) so early as the above year; whereas that at Perugia was sanctioned, for the first time, by Pope Paul II in 1467.* It is singular also that Leo X, in his confirmation of this establishment, mentions Paul II, Sixtus IV, Innocent VIII, Alexander VI, and Julius II; but not Pius II. Pope Sixtus IV, as Wadding says, confirmed in 1472 the lending-house at Viterbo, which had, however, been begun so early as 1469, by Franciscus de Viterbo, a Minorite. †

In the year 1479, Sixtus IV confirmed the lending-house which had been established at Savona, the place of his birth, upon the same plan as that at Perugia. The bull issued for this pur-

tory of the city of Perugia; but the *Storia di Perugia* by Pompeo Pellini I have not been able to search; and in *Perugia augusta descritta da Cesare Crispolti,* in Perugia 1648, 4to. p. 182, I find only: Monte detto della pietà, instituto di un venerabile padre dell' ordine Osservante, chiamato Fra Giacomo da monte Feltro; - - - fa di lui mentione il Gonzaga. Gonzaga, notwithstanding the above account, ascribes this service not to any Jacob, but to the well-known Bernardino de Feltro. *De origine seraphicæ religionis Franciscanæ.* Romæ 1587, fol. p. 338. In C. L. Richard's *Analysis conciliorum generalium et particularium,* Venetiis 1776, 4 vol. fol. iv. p. 98, I find that the first lending-house at Perugia was established in the year 1450; but Pius II, under whose pontificate it appears by various testimonies to have been founded, was not chosen Pope till the year 1458.

* Wadding, xiv. p. 94.

† Bussi, Istoria della città di Viterbo. In Roma 1742, fol. p. 271.

pose is the first pontifical confirmation ever printed; * for that obtained for Perugia was not, as we are told by the editor, to be found in the archives there in 1618, the time when the other was printed. I have never found the confirmation of those at Orvieto and Viterbo. Ascianus sought for them, but without success, in *Bullarium magnum Cherubini*, and they are not mentioned by Sixtus. This pontiff, in his bull, laments that the great expenses to which he was subjected did not permit him to relieve his countrymen with money, but that he would grant to the lending-house so many spiritual advantages as should induce the faithful to contribute towards its support; and that it was his desire that money should be lent from it to

* It may be found in *Bolle et privilegi del sacro monte della pietà di Roma.* In Roma 1618: ristampati l'anno 1658. This collection is commonly bound up with the following work, which was printed in the same year and again reprinted: *Statuti del sacro monte della pietà di Roma.* This bull is inserted entire by Ascianus, p. 719: but in the Collection of the pontifical bulls it is omitted. I shall here give only the following extracts from it. Ut hujusmodi incommodis (*the usurious practices of the Jews*) obvient, cupiunt, ad instar dilectorum filiorum civium civitatis nostræ Perusinæ, in prædicta civitate Savonensi, ex piis Christi fidelium suffragiis, ac alias colligere, et in unam massam, quæ mons pietatis nuncupetur, redigere aliquam non parvæ pecuniæ summam, de qua personis pauperibus et egenis, per officiales, examinata caussa necessitatis eorum, ac receptis pignoribus ab eisdem, opportune valeat proportionabiliter subveniri eo modo, quo subvenitur ex pecuniis montis pietatis in Perusina civitate dudum apostolica auctoritate interveniente ordinati, dummodo eis desuper per nos licentia concedatur.

those who would assist gratis during a year in the business which it required. If none could be found to serve on these conditions, a moderate salary was to be given. He added a clause also respecting pledges; but passed over in silence that the debtors were to contribute any thing for the support of the institution by paying interest, which Barnabas, whose name does not occur in the bull, introduced however at Perugia, and which the Pope tacitly approved.

The greater part of the lending-houses in Italy were established in the fifteenth and following centuries by the Minorites Marcus Bononiensis, Michael a Carcano,* Cherubinus Spoletanus, Jacobus de Marchia, Antonius Vercellensis, Angelus a Clavasio, and, above all, Bernardinus Tomitano, named also *Feltrensis* and *Parvulus*. This man was born at Feltri, in the county of Treviso, in the year 1439. His father was called Donato Tomitano, and his mother Corona Rambaldoni; they were both of distinguished families, though some assert that he was of low extraction, and a native of Tomi, a small place near Feltri, on which account he got the name of Tomitano. The name of *Parvulus* arose from his diminutive stature, which he sometimes made a subject of pleasantry.†

* This Michael travelled and preached much in company with Bernardinus, and died at Como in 1485. *Wadding*, xiv. p. 396.

† The Piccolimini, nephews of the Pope, having once paid their

This much at any rate is certain, that he had received a good education. In 1456, when seventeen years of age, he suffered his instructors, contrary to the inclination of his father, to carry him to Padua, to be entered in the order of the Minorites; and on this occasion he changed his christian-name Martin into Bernardinus.* As he was a good speaker, he was employed by his Order in travelling through Italy and preaching. He was heard with applause, and in many parts the people almost paid him divine honours. The chief object of his sermons was to banish gaming, intemperance, and extravagance of dress; but he, above all, attacked the Jews, and excited such a hatred against them, that the governments in many places were obliged to entreat or to compel him either to quit their territories or not to preach in opposition to these unfortunate people, whom the crowds he collected threatened to massacre; and sometimes when he visited cities, where there were rich Jews, and persons who were connected with them in trade, he was in danger of losing even his own life. Taking advantage of this general antipathy to the Jews, he exerted himself, after the example of Barnabas, his brother Minorite, to get lending-

respects to him at Siena, he told them he was their namesake. *Wadding*, xiv. p. 447.

* Wadding, xii. p. 442. In *Lettere dell' agricoltura, dell' arti, e del commercio*, by Anton. Zanon, vol. vi. p. 149, the year 1459 is given, which perhaps is an error of the press.

houses established, and died at Pavia in the year 1494. The Minorites played a number of juggling tricks with his body, pretending that it performed miracles, by which means they procured him a place in the catalogue of the saints; and to render his name still more lasting, some of his sermons have been printed among the works of the writers of the Franciscan order.*

The lending-houses in Italy, with the origin of which I am acquainted, are as follows: The lending-house at Perugia was inspected in 1485, by Bernardinus, who enlarged its capital.

The same year he established one at Assisi, which was confirmed by pope Innocent, and which was visited and improved by its founder in 1487.†

In the year 1486, after much opposition, he established a lending-house at Mantua, and procured for it also the Pope's sanction.‡ Four years

* Waddingii Scriptores ordinis Minorum, p. 58. *Fabricii Biblioth. mediæ et infimæ æt.* i. p. 586.

† Wadding, xiv. p. 398 and 433.

‡ It may be found entire in *Wadding*, xiv. p. 411. It was ordered that the pledges should be worth double the sum lent, and that they should be sold if not redeemed within a year. The regulations made respecting the interest I shall here insert: Liceretque eis pro hujusmodi salariorum solutione, ac etiam pensione domus ad præmissa in loco commodo et honesto conducenda in civitate prædicta, libris et subhastationibus, aliisque expensis necessariis pro executione eis commissorum officiorum hujusmodi, a personis mutuo recipientibus pecunias dicti montis, illasque restituentibus intra annum, præter summam mutuatam, duos denarios pro qualibet libra mutuata ejus summæ, pro quolibet mense petere et recupe-

after, however, it had declined so much, that he was obliged to preach in order to obtain new donations to support it.*

At Florence he met with still more opposition; for the rich Jews bribed the members of the government, who wished, in appearance, to favour the establishment of the lending-house, to which they had consented eighteen years before, while they secretly thwarted it; and some boys having once proceeded, after hearing a sermon, to attack

rare, et a non restituentibus de pretio venditorum pro tempore pignorum retincre; et si dicti duodenarii pro libra sic collecti, in fine anni non ascenderent ad summam opportunam pro salariis et aliis expensis prædictis, voluerunt id quod deficeret, suppleri de summa anni sequentis; et si summa dictorum duorum denariorum pro libra sic collecta, in fine anni transcenderet summam opportunam pro salariis et expensis prædictis, voluerunt id quod superabundaret, eisdem solventibus proportionabiliter et pro rata, pro qua solvissent, ultra restitui, si recuperare vellent, et ad hunc effectum publice sæpius proclamari per civitatem prædictam, quod quicunque intenderent rehabere portiones eis contingentes, de superabundantia prædicta collecta per exactorem duorum denariorum pro libra, debeant protestari officialibus prædictis infra quindecim dies ad minus a die sibi facti mutui, recepisse mutuo animo rehabendi talem portionem eis contingentem, quantumcumque parvam; alioquin, decursis dictis quindecim diebus, protestatione prædicta non facta, intelligerentur, post tot proclamationes repetitis vicibus factas, tales mutuo recipientes, et non protestantes, velle, immo mandare ac injungere dictis officialibus, quod dispensent pauperibus, vel convertant in alias pias causas, illas parvas quantitates et portiones, quæ ipsos protestantes contigebant de dicta quantitate superabundanti, amore Dei, et pro suæ ac suorum prædecessorum animarum salute, de consilio duorum religiosorum, vel aliorum saeerdotum aut aliorum bonæ opinionis et famæ.

* Wadding, xiv. p. 516.

the houses of the Jews, the Minorites were ordered to abstain from preaching and to quit the city.* It was, however, completely established; but by the Dominican Hieronymus Savonarola.†

In the year 1488, Bernardinus established a lending-house at Parma, and procured for it the Pope's sanction,‡ as well as for one at Cesena, where the interest was defined to be *pro salariis officialium et aliis montis oneribus perferendis.* § About the conclusion of this year, he was at the other end of Italy, where he re-established the lending-house at Aquila in the kingdom of Naples. ‖

In the year following he established one at Chieti, (*Theate*) in the same kingdom, another at Rieti (*Reate*) in the territories of the Church, a third at Narni (*Narnia*); ¶ and a fourth at Lucca, which was confirmed by the bishop, notwithstanding the opposition of the Jews, who did every thing in their power to prevent it.

In the year 1490, a lending-house was establish-

* Wadding, xiv. p. 446.

† Osservazioni di D. Manni circa i sigilli antichi, tom. xxvii. p. 92; where much information respecting this subject may be found.

‡ Wadding, xiv. p. 445. *La historia della città di Parma, di Bonaventura Angeli.* In Parma 1591, 4to. p. 429.

§ This bull of Innocent VIII may be found in the before-quoted *Bolle et privilegi del sacro monte della pietà di Roma*, p. 10.

‖ Wadding, xiv. p. 451.

¶ Ibid. p. 462. Ibid. 465.

ed at Piacenza (*Placentia*) by Bernardinus, who at the same time found one at Genoa which had been established by the before-mentioned Angelus a Clavasio.* At this period also, a lending-house was established at Verona,† and another at Milan by the Minorite Michael de Aquis.‡

In 1491, a lending-house was established at Padua, which was confirmed by Pope Alexander VI, in 1493;§ and another was established at Ravenna.‖

In 1492, Bernardinus reformed the lending-house at Vicenza, where, in order to avoid the reproach of usury, the artifice was employed of not demanding any interest, but admonishing the borrowers that they should give a remuneration according to their piety and ability. As people were by these means induced to pay more interest than what was legally required at other lending-houses, Bernardinus caused this method to be

* Wadding, xiv. p. 480, 481.

† Ibid. p. 517. *Cronica di Verona, descritta da Pier. Zagata.* In Verona 1747, 4to. ii. 1. p. 202; and ii. 2. p. 88.

‡ Il Ritrato di Milano, di Carlo Torre. In Milano 1714, 4to. p. 229.

§ Wadding, xiv. p. 93, 482. *Merula Cosmograph.* p. ii. lib. iv. p. m. 950. The confirmation is given by Zanon, *lettere* vi. p. 152.

‖ Wadding, p. 514. *Hieron. Rubei Historiæ Ravennates.* Ven. 1590, fol. lib. vii. *Il forestiere instruito della cose notabili della città di Ravenna; di Franc. Beltrami.* In Ravenna 1783, 8vo. p. 119.

abolished.* He established a lending-house also the same year in the small town of Campo S. Pietro, not far from Padua, and expelled the Jews who had lent upon pledges. At this period there were lending-houses at Bassano, a village in the county of Trevisi, and also at Feltri, which he inspected and improved.†

In the year 1493, Bernardinus caused a lending-house to be established at Crema, in the Venetian dominions; another at Pavia, where he requested the opinion of the jurists, whom he was happy to find favourable to his design; and likewise a third at Gubbio, in the territories of the Church. At the same time another Franciscan established at Cremona a *mons frumenti pietatis*, from which corn was lent out on interest to necessitous persons; and it appears that there had been an institution of the like kind before at Parma.‡

In the year 1494, Bernardinus, a short time before his death, assisted to establish a lending-house at Montagnana, in the Venetian territories,§ and to improve that at Brescia, which was likely to decay, because the servants had not fixed

* Wadding, xv. p. 6, 65.

† Ibid. xv. p. 7, 12, 9.

‡ Ibid. xv. p. 37, 45, 46.

§ Ibid. xv. 67.

salaries.* The same year another Franciscan established the lending-house at Modena.†

In the year 1506, pope Julius II confirmed the lending-house at Bologna.‡ That of Trivigi was established in 1509;§ and in 1512, Elizabeth of the family of Gonzaga, as widow of duke Guido Ubaldus, established the first lending-house in the duchy of Urbino at Gubbio, and procured permission for it to coin money.‖

The historical account I have here given, displays in the strongest light the great force of prejudice, and particularly of the prejudice of ecclesiastics. Notwithstanding the manifest advantages with which lending-houses were attended, and though a great part of them had been already

* Wadding, xv. p. 68. Bernardinus considered the giving of wages as a necessary evil. Speciosius et religiosius fatebatur Bernardinus fore, si absque ullo penitus obolo et pretio mutuum daretur, libereque commodaretur pecunia, sed pium opus et pauperum subsidium exiguo sic duraturum tempore; non enim, inquit, tantus est ardor hominum, ut gubernatores et officiales montium ministerio necessarii velint laborem hunc omnem gratis subire; quod si remunerandi sint ex sorte principali, vel ipso deposito, seu exili Montium ærario, brevi exhaurietur, et commodum opportunumque istud pauperum refugium ubique peribit. *Wadding*, xv. p. 41.

† Wadding, xv. p. 88.

‡ The bull may be found in *Bolle e privilegi del sacro monte della pietà di Roma*, before quoted, p. 13; and in Ascianus, p. 775.

§ Istoria di Trivigi; di Giovanni Bonifaccio. In Venezia 1744, fol. p. 501.

‖ Della zecca di Gubbio, e delle geste de' conti e duchi di Urbino; opera di Rinaldo Reposati. In Bologna 1772, 4to. ii. p. 96. 132.

sanctioned by the infallible court of Rome, many, but chiefly Dominicans, exclaimed against these institutions, which they did not call *montes pietatis*, but *impietatis*. No opposition gave the Minorites so much uneasiness as that of the Dominican Thomas de Vio, who afterwards became celebrated as a cardinal under the name of Cajetanus. This monk, while he taught at Pavia, in 1498, wrote a treatise *De monte pietatis*,* in which he inveighed bitterly against taking pledges and interest, even though the latter was destined for the maintenance of the servants. The popes, he said, had confirmed lending-houses in general, but not every regulation that might be introduced into them, and had only given their express approbation of them so far as they were consistent with the laws of the church. These words, he added, had been wickedly left out in the bulls which had been printed; but he had heard them, and read them, in the confirmation of the lending-house at Mantua.†

* It is to be found in the well-known large collection of juridical writings quoted commonly under the title, *Tractatus tractatuum*. Venetiis 1584, fol. p. 419, vol. vi. part 1. It has also been printed separately.

† Nota quod mons ipse est simpliciter approbatus et erectus ab ipso Summo Pontifice. Ejus autem capitula supradicta sunt approbata cum hoc adjectivo, scilicet: sacris canonibus non contraria. Unde, si qua capitula sunt sacris canonibus contraria, approbata non sunt. Hæc autem esse ea quæ injustitiam continent, nullus dubitat. Non sunt igitur approbata capitula illa, quæ injusta esse superius monstratum est. Propter quod (si ita est) non parum peccatum fuit facere imprimi Summi Pontificis bullas truncatas absque illa par-

I indeed find, that these words are not in the copy of that bull given in Wadding, which is said to have been taken from the original, nor in the still older confirmation of the lending-house at Savona. But even were they to be found there, this would not justify Cajetan's opposition, as the Pope in both these bulls recommended the plan of the lending-house at Perugia to be adopted, of which receiving interest formed a part. Bernardinus de Bustis,* a Minorite, took up the cause in opposition to Cajetan, and, according to Wadding's account, with rather too much vehemence. Among his antagonists also were Barrianus, and Franc. Papafava, a jurist of Padua.† As this dispute was revived with a great deal of warmth in the beginning of the sixteenth century, it was at length terminated by pope Leo X, who in the tenth sitting of the council of the Lateran declared by a par-

ticula, scilicet, sacris canonibus non contraria. Laqueus siquidem est animarum, in quem ego incidissem, vel saltem absque suspensione non fuissem, nisi viva voce audissem sic habere in originalibus, et calamo scriptam particulam illam in bullæ Mantuanæ copia vidissem. Ex hac quoque eadem radice satisfit illis qui ex privilegiis et indulgentiis concessis a Rom. Pont. illis qui ad montis conservationem aut augmentum manus porrigunt adjutrices arguunt. Jam enim patet, quod mons ipse sanctus est, et in ordine ad illum hæc omnia conceduntur. Annexa tamen mala ex hoc non approbantur, sed potius tolerantur, ad evitationem majoris mali, quo per publicos usurarios res pauperum vorantur.

* His works were printed together, in folio, at Brescia in 1588.

† The work of the former appeared in 1496. The writings of both are printed in the work of Ascianus, or Zimmermann, which has been often quoted already.

ticular bull, that lending-houses were legal and useful; that all doubts to the contrary were sinful, and that those who wrote against them should be placed in a state of excommunication.* The whole assembly, except one archbishop, voted in favour of this determination ;† and it appears, from a decree of the council of Trent, that it also acknowledged their legality, and confirmed them.‡ Notwithstanding this decision, there were still writers who sometimes condemned them; and who did not consider all the decrees, at least the above one of the Lateran council, as agreeable to justice.

* This bull, which forms an epoch in the history of lending-houses, may be found in *Sa. Lateranen. concilium novissimum.* Romæ 1521, fol. This scarce work, which I have now before me from the library of our university, is inserted entire in (*Harduini*) *Acta conciliorum*, tom. ix. Parisiis 1714, fol. The bull may be found p. 1773. It may be found also in *Bullarium mag. Cherubini*, i. p. 560; *Waddingii Annal. Minor.* xv. p. 470; *Ascianus*, p. 738; and *Beyerlinck's Theatrum vitæ hum.* v. p. 603. The Pope, in the bull, refers to Jurisprudence, which says: quod qui commodum sentit, onus quoque sentire debeat.---*He then permits:* alios etiam similes montes cum apostolicæ sedis approbatione erigi posse--- Omnes qui contra hancce declarationem prædicare seu disputare et scribere ausi fuerint, excommunicationis latæ sententiæ pœnam incurrere volumus.

† Responderunt omnes placere, excepto reverendo patre domino Jeremia archiepiscopo Tranensi, qui dixit, non placere, quia didicit per experientiam, quod præfati montes sunt plus damnosi quam utiles. *These words stand in the protocoll.*

‡ This is the conclusion formed by Richard, in *Analysis conciliorum*, because in sess. 22, cap. 8, lending-houses are reckoned among the *pia loca*, and the inspection of them assigned to the bishops.

Among these was Dominicus de Soto, a Dominican.* All opposition, however, in the course of time subsided, and in the year 1565, Charles Borromeo, the pope's legate at the council of Milan, ordered all governments and ecclesiastics to assist in establishing lending-houses.†

Of the lending-houses established after this period in Italy, I shall mention those only of Rome and Naples. It is very remarkable that the Pope's capital should have been without an institution of this kind till the year 1539, and that it should have been formed by the exertions of Giovanni Calvo, a Franciscan.‡ Paul III, in his bull of confirmation, ordered that Calvo's successors in rank and employment should always have the inspection of it, because the Franciscans had taken the greatest pains to endeavour to root out usury.§

The lending-house at Naples was first established in 1539 or 1540. Two rich citizens, Aurelio Paparo, and Leonardo or Nardo di Palma redeemed all the pledges which were at that time in the hands of the Jews, and offered to deliver them to the owners without interest, provided they would return the money which had been ad-

* In Libri x. de injustitia et jure. vi. quæst. 1 & 6.

† Waddingii Annal. Minor. xv. p. 471.

‡ Commissario generale dell' Ordine Minore de' conventuali di S. Francisco.

§ This confirmation may be found in Waddingii Annal. xvi. p. 444, and in Ascianus, p. 766.

vanced on them. More opulent persons soon followed their example; many bequeathed large sums for this benevolent purpose; and Toledo, the viceroy, who drove the Jews from the kingdom, supported it by every method possible. This lending-house, which has indeed undergone many variations, is the largest in Europe; and it contains such an immense number of different articles, many of them exceedingly valuable, that it may be considered as a repository of the most important part of the moveables of the whole nation. About the year 1563, another establishment of the like kind was formed under the title of *banco de' poveri.* At first this bank advanced money without interest, only to relieve confined debtors; afterwards, as its capital increased, it lent upon pledges, but not above the sum of five ducats without interest. For larger sums the usual interest is demanded.*

At what time the first lending-house was established at Venice I have not been able to learn.† This State seems to have long tolerated the Jews;

* (Summonte) Historia della città e regno di Napoli; in Napoli 1749, 4to. vol. iv. p. 179. *Giannone, Geschichte des königreichs Neapel; mit anmerkungen von Le Bret*; Leipzig 1770, 4to. vol. iv. p. 95. *De' banchi di Napoli, e della lor ragione; trattato di Michele Rocco.* Neapoli 1785, 3 vol. 8vo. i. p. 151.

† Vettor. Sandi, in *Principi di storia civile della republica di Venezia.* In Venezia 1771, 4to. vol. ii. p. 436. The author treats expressly of the institution of this bank, but the year when it commenced is not mentioned.

it endeavoured to moderate the hatred conceived against these people, and gave orders to Bernardinus to forbid preaching against them.* It appears to me in general, that the principal commercial cities of Italy were the latest to avail themselves of this invention; because they knew that to regulate interest by law, where trade was flourishing, would be ineffectual or useless; or because the rich Jew merchants found means to prevent it.

The name *mons pietatis*, of which no satisfactory explanation has been as yet given, came with the invention from Italy, and is equally old, if not older. Funds of money formed by the contributions of different persons, for some end specified, were long before called *montes*. In the first centuries of the Christian æra, free gifts were collected and preserved in churches by ecclesiastics, partly for the purpose of defraying the expense of divine service, and partly to relieve the poor. Such capitals, which were considered as ecclesiastical funds, were by Prudentius, in the beginning of the fifth century, called *montes annonæ*, and *arca numinis*.† Tertullian calls them *depo-*

* Waddingii Annal. Minor. xv. p. 67.

† Hymnus ii. in honorem Laurentii. The poet relates, that in the third century, the pagan governor of the city (*præfectus urbis*) demanded the church treasure from Laurentius the deacon. Ver. 53:

Laurentium sisti jubet;
Exquirit arcam ditibus

sita pietatis;* and hence has been formed *montes pietatis*. At any rate I am of opinion that the inventor chose and adopted this name in order to give his institution a sacred or religious appearance, and to procure it more approbation and support.

I find however that those banks employed in Italy, during the thirteenth and fourteenth cen-

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Massis refertam, et fulgidæ
Montes monetæ conditos.

This passage, as far as I know, was first remarked by H. C. Senkenberg in a postcript to. L. J. Meyer's *Dissertat. de montibus pietatis*; Gissæ 1739, 4to. p. 51. He is of opinion that the expression *mons pietatis* was usual even at that period, because the following lines occur, ver. 81,

Hæc occultantur abditis
Ecclesiarum in angulis;
Et summa pietas creditur,
Nudare dulces liberos.

To speak the truth, *pietas* in this passage does not refer to *mons*. The Christians are here reproached in an ironical manner with their parental affection, *pietas*; because they impoverished their children and grandchildren to enrich the church. That the money collected in this manner, however, was not employed merely for ornamenting churches, but distributed also in alms, is well known, and is proved even by what Prudentius says, ver. 140. See *Salmasius de fœn. trapezit.* p. 421, and the preface.

* This passage, with which Senkenberg was not acquainted, may be found in Tertullian's *Apolog.* cap. 39, edition of De la Cerda, p. 187: Hæc quasi deposita pietatis sunt; nam inde non epulis, non potaculis, nec ingratis voratrinis dispensatur; sed egenis alendis humandisque, et pueris ac puellis re ac parentibus destitutis, jamque domesticis senibus, item naufragis, et si qui in metallis, et si qui in insulis, vel in custodiis, duntaxat ex caussa Dei sectæ, alumni confessionis suæ fiunt.

turies, to borrow money in the name of States, for which the public revenues were mortgaged and interest paid, were also called *montes*.* In this sense the word is used by Italian historians of much later times; and those are greatly mistaken, who, with Ascian and many others, consider all these *montes* as real lending-houses. These loan-banks, or *montes*, received various names, sometimes from the princes who established them, sometimes from the use to which the money borrowed was applied,

* This word however is not to be found in *Glossarium manuale*. The following passage from *Leonardi Aretini Histor. Florentinarum libri* xii. Argentorati 1610. fol. lib. vii. p. 145, may serve as a proof. Eodem anno maximum est reipublicæ fundamentum parvo ex principio jaci cœptum. Civibus resp. debebat auripondo circiter LXX.M. dudum mutuo sumta ob Lucæ redemtionem. Ea igitur summa cum ob angustiam ærarii dissolvi non posset, ac iniquum videretur suo fraudari cives, qui fidem publicam secuti mutuo dederant; media quædam inter has difficultates reperta est via. Nominibus enim eorum, quibus debebatur, tributim descriptis annui reditus e publico constituti sunt, quina singulis centenis. Quantitates vero ipsas in unum coacervatas, a similitudine cumulandi, vulgo Montem vocavere. Idque in civitate postea servatum. Quoties resp. indiget, cives tributa persolvunt; solutorum vero pensiones annuas percipiunt. Hi montes cumulationesque pecuniarum bellis quidem crescunt, pace minuuntur, propterea quod abundante rep. dissolutio sit crebra atque peremtio. Quantitatum vero descriptarum et venditio est civibus inter se et permutatio, atque (ut in cæteris mercimoniis) pro tempore, pro ope, pro commodo, minuitur earum precium atque augescit. In emtorem eadem commoda, quæ solutus ipse percepturus erat, transferuntur. Ea res facit, uti cives ad crebras tributorum solutiones perdurent, non pereunte omnino quod solutum est; sed utilitatem, si non magnam attamen aliquam, afferente.—Compare Le Bret in *Algem. Welthistorie*, xlv. p. 10, who however relates some circumstances not to be found in Aretin.

and sometimes from the objects which were mortgaged. Of this kind were the *mons fidei*, or loan opened by pope Clement VII, in the year 1526, for defending his capital;* the *mons aluminarius*, under pope Pius IV, for which the pontifical alum-works were pledged; the *mons religionis*, under Pius V, for carrying on the war against the Turks; and the *montes farinæ, carnium, vini*, &c. when the duties upon these articles were pledged as a security. To facilitate these loans, every condition that could induce people to advance money was thought of. Sometimes high interest was given, if the subscribers agreed that it should cease, and the capital fall to the bank, after their death; and sometimes low interest was given, but the security was heritable and could be transferred at pleasure. The former were called *montes vacabiles*, and the latter *montes non vacabiles*. Sometimes the State engaged to pay back the capital at the end of a certain period, such for example as nine years, as was the case in regard to the *mons novennalis*, under Paul IV; or it reserved to itself the option of returning the money at such a period as it might think proper, and sometimes the capital was sunk and the interest made perpetual. The first kind were called *montes redimibiles*, and the second *irredimibiles*.† One can here clearly

* See the bull in Bullarium mag. Cherub. n. 17.

† See Petr. Gregorius Tholosanus de republica. Francof. 1609, 4to. lib. xiii. c. 16. p. 566; and Ascianus, p. 753.

discover the origin of life-rents, annuities, tontines, and government securities; but the further illustration of this subject I shall leave to those who may wish to employ their talents on a history of national debts. I have introduced these remarks merely to rectify a mistake which has become almost general, and which occasioned some difficulties to me in this research; and I shall only observe further, that the popes gave to their loans, in order to raise their sinking credit, many of those spiritual advantages which they conferred on the *montes pietatis.* This error therefore was more easily propagated, as both were called *montes;* and hence it has happened that Ascianus and others assert that many lending-houses were misapplied by the popes in order to raise public loans.

From the instances here adduced, one may see that the first lending-houses were sanctioned by the pontiffs, because they only could determine to the Catholics in what cases it was lawful for them to receive interest. This circumstance seems to have rendered the establishment of them without Italy difficult. At any rate the Protestants were at first averse to imitate an institution which originated at the court of Rome, and which, according to the prevailing prejudice of the times, it alone could approve; and from the same consideration they would not adopt the reformation which had been made in the calendar.

The first mention of a lending-house in Germany, which I have as yet met with, is to be found in the permission granted by the emperor Maximilian I, to the citizens of Nuremberg, in the year 1498, to drive the Jews from the city, and to establish an exchange-bank. The permission further stated, "That they should pro-" vide for their bank proper managers, clerks, and " other persons to conduct it according to their " pleasure, or as necessity might require; that " such of their fellow-citizens as were not able to " carry on their trades, callings, and occupations " without borrowing, and without pledging their " effects, should, on demand, according to their " trade and circumstances, receive money, for " which pledges, caution, and security should be " taken; that at the time of payment a certain " sum should be exacted by way of interest; that " the clerks and conductors of the bank should " receive salaries for their service from the in-" terest; and that if any surplus remained, it " should be employed for the common use of " the city of Nuremberg, like any other public " fund."*

It here appears that the lending-houses in Germany were first known under the name of exchange-banks, by which was before understood

* This permission may be found at the end of A. Wurfel's *Historischen nachrichten von der chemaligen Juden-Gemeinde in Nürnberg*. Nürnberg 1775, 4to. p. 152.

any bank where money was lent and exchanged; but it does not thence follow, as professor Fischer thinks,* that they were an Italian invention. The citizens of Nuremberg had not then a lending-house, nor was one established there till the year 1618. At that period they procured from Italy copies of the regulations drawn up for various houses of this kind, in order to select the best. Those of the city of Augsburg however were the grounds on which they built, and they sent thither the persons chosen to manage their lending-house, that they might make themselves fully acquainted with the nature of the establishment at that place.† In the year 1591, the magistrates of Augsburg had prohibited the Jews to lend money, or to take pledges; at the same time they granted 30,000 florins as a fund to establish a lending-house, and the regulations of it were published in 1607.‡

In the Netherlands, France, and England, lending-houses were first known under the name of *Lombards*, the origin of which is evident. It is well known that in the thirteenth and following centuries many opulent merchants of Italy, which at those periods was almost the only part of Eu-

* Geschichte des Teutschen handels, ii. p. 454.

† Gokinks Journal von und für Teutschland, 1784, i. p. 604, where may be found the first and the newest regulations respecting the lending-house at Nuremberg.

‡ P. von Stettens Geschichte der stadt Augsburg. Frank. und Leipzig 1742, 2 vol. 4to. i. p. 720, 789, 833.

rope that carried on an extensive trade, were invited to these countries, where there were few mercantile people able to engage deeply in commerce. For this reason they were favoured by governments in most of the large cities; but in the course of time they became objects of universal hatred, because they exercised the most oppressive usury, by lending at interest and on pledges. They were called *Longobardi* or *Lombardi*, as whole nations are often named after a part of their country, in the same manner as all the Helvetians are called Swiss, and the Russians sometimes Moscovites. They were, however, called frequently also Caorcini, Caturcini, Caursini, Cawarsini, Cawartini, Bardi, and Amanati; names, which in all probability arose from some of their greatest houses or banks. We know, at any rate, that about those periods the family of the Corsini were in great consideration at Florence.* They had banks in the principal towns for lending money; they demanded exorbitant interest; and they received pledges at a low value, and retained them as their own property if not redeemed at the stated time. They eluded the prohibition of the church against interest when they found it necessary, by causing the interest to be previously paid as a present or a premium; and it appears that some sovereigns borrowed money from them on

* See these words in Du Fresne.

these conditions. In this manner did Edward III, king of England, when travelling through France, in the year 1329, receive 5000 marks from the bank of the Bardi, and give them in return, by way of acknowledgement, a bond for 7000.* When complaints against the usurious practices of these Christian Jews became too loud to be disregarded, they were threatened with expulsion from the country, and those who had rendered themselves most obnoxious on that account, were often banished, so that those who remained were obliged to conduct themselves in their business with more prudence and moderation. It is probable that the commerce of these countries was then in too infant a state to dispense altogether with the assistance of these foreigners. In this manner were they treated by Louis IX, in 1268, and likewise by Philip the Bold; and sometimes the popes, who would not authorise interest, lent their assistance by prohibitions, as was the case in regard to Henry III of England in 1240.

In the fourteenth century, the Lombards, in the Netherlands, paid to government rent for the houses in which they carried on their money transactions, and something besides for a permission. Of this we have instances at Delft in 1313, and at Dordrecht in 1342.† As in the course of time the

* Fœdera, vol. iv. p. 387.

† Proofs may be found in *Beschryving der Stadt Delft.* Te Delft 1729, fol. p. 553.

original Lombards became extinct, these houses were let, with the same permission, for the like employment;* but governments at length fixed the rate of interest which they ought to receive, and established regulations for them, by which usurious practices were restrained. Of leases granted on such conditions, an instance occurs at Delft in the year 1655. In 1578, William prince of Orange recommended to the magistrates of Amsterdam Francis Masasia, one of the Lombards, as they were then called, in order that he might obtain for him permission to establish a lending-house;† as many obtained permission to keep billiard-tables, and Jews letters of protection. In the year 1611, the proprietor of such a house at Amsterdam, who, during the latter part of his lease, had gained by his capital at least thirty-three and a half per cent. offered a very large sum for a renewal of his permission; but, in 1614, the city resolved to take the lombard or lending-house into their own hands, or to establish one of the same kind. However odious this plan might be, a dispute arose respecting the legality of it, which Marets‡ and Claude Saumaise endeavoured to support. The public lending-house or lombard

* Salmasius de fœnore trapezitico. Lugduni Bat. 1640, 8vo. p. 744.

† De koophandel van Amsterdam. Te Rotterdam 1780, 8vo. i. p. 221.

‡ S. de Marets Diss. de trapezitis

at Brussels was established in 1619; that at Antwerp in 1620, and that at Ghent in 1622.* All these were established by the archduke Albert, when he entered on the governorship, with the advice of the archbishop of Mechlin; and on this occasion the architect Wenceslaus Coberger was employed, and appointed inspector-general of all the lending-houses in the Spanish Netherlands.† Some Italians assert, that the Flemings were the first people who borrowed money on interest for their lending-houses; and they tell us that this practice began in the year 1619.‡ We are assured also, that, after a long deliberation at Brussels, it was at length resolved to receive money on interest at the lending-houses. It however, appears certain, that in Italy this was never done, or at least not done till a late period, and that the capitals of the lending-houses there were amassed without giving interest.

This beneficial institution was always opposed in France; chiefly, because the doctors of the Sorbonne could not divest themselves of the prejudice against interest: and some in modern times who undertook there to accommodate people with mo-

* Ascianus, p. 773, taken from *David a Mauden Discursus morales in decalogum*, p. 936.

† Beyerlinck, Magnum theatrum vitæ. Lugduni, fol. tom. v. p. 602.

‡ Montes e pecunia ad censum sumta instituti, et Belgici nuncupantur, quia in Belgio an. 1619 erecti fuere. *Richard, Analysis concilior.* iv. p. 98.

ney on the like terms, were punished by government.* A lending-house however was established at Paris, under Louis XIII, in 1626; but the managers next year were obliged to abandon it.† In 1695, some persons formed a capital at Marseilles for the purpose of establishing one there according to the plan of those in Italy.‡ The present *mont de pieté* at Paris, which has sometimes in its possession forty casks filled with gold watches that have been pledged, was, by royal command, first established in 1777.§

CHEMICAL NAMES OF METALS.

As those metals earliest known, viz. copper, iron, gold, silver, lead, quicksilver, and tin, received the same names as the nearest heavenly bodies, which appear to us largest, and have been distinguished by the like characters, two questions arise: Whether these names and characters were given first to the planets or to the metals? When, where, and on what account were they made

* An instance may be found in *Turgot's Memoires sur le prêt à intérest, et sur le commerce de fer.* Paris 1789, 8vo. See also *Gunthers Untersuchung über wucher und wucher-gesetze.* Hamburg 1790, 8vo.

† Histoire de la ville de Paris; par Sauval.

‡ Histoire de la ville de Marseille; par Antoine de Rufel. Marseille 1696, fol. ii. p. 99.

§ Tableau de Paris. Hamburg 1781, 8vo. i. p. 78.

choice of; and why were the metals named after the planets, or the planets after the metals? The latter of these questions, in my opinion, cannot be answered with any degree of certainty; but something may be said on the subject which will not, perhaps, be disagreeable to those fond of such researches, and who have not had an opportunity of examining it.

That the present usual names were first given to the heavenly bodies, and at a later period to the metals, is beyond all doubt; and it is equally certain that they came from the Greeks to the Romans, and from the Romans to us. It can be proved also that older nations gave other names to these heavenly bodies at much earlier periods. The oldest appellations, if we may judge from some examples still preserved, seem to have originated from certain emotions which these bodies excited in the minds of men; and it is not improbable that the planets were by the ancient Egyptians and Persians named after their gods, and that the Greeks only adopted or translated into their own language the names which those nations had given them.* The idea that each planet was the residence of a god, or that they were gods themselves, has arisen, according to the

* See *Goguet, Ursprung der gesetze und künste,* ii. p. 363; from which has been taken what Bailly says in the end of his *Histoire de l'astronomie ancienne.* Paris 1775, 4to.

most probable conjecture, from rude nations worshipping the sun, which, on account of his beneficent and necessary influence over all terrestrial bodies, they considered either as the deity himself, or his abode, or, at any rate, as a symbol of him. In the course of time, when heroes, and persons, who by extraordinary services had rendered their names respected and immortal, received divine honours, particular heavenly bodies, of which the sun, moon, and planets seemed the fittest, were assigned to these divinities also.* By what laws this distribution was made, and why one planet was dedicated to Saturn and not to another, Pluche, as far as I know, did not venture to determine,† and on this point the ancients themselves are not all agreed.‡ When the planets were once dedicated to the gods, folly, which never stops where it begins, proceeded still further, and ascribed to them the attributes and powers for which the deities, after whom they were named, had been celebrated in the fictions of their mythologists. This, in time, laid the foundation of astrology; and hence the

* Jablonski, Pantheon Ægyptiorum. Francofurt. ad Viadr. 1750, 8vo. in the *Prolegomena*, p. 49.

† He has however indulged in some conjectures, in his History of the heavens. See *Historie des himmels*. Dresden 1740, 2 vol. 8vo. ii. p. 64.

‡ These contradictions are pointed out by Goguet, in a note, p. 370. A better view of them may be found in *Hygini Poeticon astronom.* xlii. p. 496, of the edition by Von Staveren.

planet Mars, like the deity of that name, was said to cause and to be fond of war; and Venus to preside over love and its pleasures.

The next question is, Why were the metals divided in the like manner among the gods, and named after them? Of all the conjectures that can be formed in answer to this question, the following appears to me the most probable. The number of the deified planets made the number seven so sacred to the Egyptians, Persians, and other nations, that all those things which amounted to the same number, or which could be divided by it without a remainder, were supposed to have an affinity or a likeness to and connexion with each other.* The seven metals, therefore, were considered as having some relationship to the planets, and with them to the gods, and were accordingly named after them. To each god was assigned a metal, the origin and use of which was under his particular province and government; and to each metal were ascribed the powers and properties of the planet and divinity of the like name; from which arose, in the course of time, many of the ridiculous conceits of the alchemists.

The oldest trace of the division of the metals among the gods is to be found, as far as I know, in the religious worship of the Persians. Origen, in his Refutation of Celsus, who asserted that the

* Jablonski, Panth. proleg. p. 55, 56. *Vossius de idololatria*, ii. 34, p. 489. *Bruckeri Histor. philosoph.* i. p. 1055.

seven heavens of the Christians, as well as the ladder which Jacob saw in his dream, had been borrowed from the mysteries of Mithras, says, "Among the Persians the revolutions of the heavenly bodies were represented by seven stairs, which conducted to the same number of gates. The first gate was of lead; the second of tin; the third of copper; the fourth of iron; the fifth of a mixed metal; the sixth of silver, and the seventh of gold. The leaden gate had the slow tedious motion of Saturn; the tin gate the lustre and gentleness of Venus; the third was dedicated to Jupiter; the fourth to Mercury, on account of his strength and fitness for trade; the fifth to Mars; the sixth to the Moon, and the last to the Sun."* Here then is an evident trace of

* Celsus de quibusdam Persarum mysteriis sermonem facit. Harum rerum, inquit, aliquod reperitur in Persarum doctrina Mithracisque eorum mysteriis vestigium. In illis enim duæ cælestes conversiones, alia stellarum fixarum, errantium alia et animæ per eas transitus quodam symbolo repræsentantur, quod hujusmodi est. Scala altas portas habens, in summa autem octava porta. Prima portarum plumbea, altera stannea, tertia ex ære, quarta ferrea, quinta ex ære mixto, sexta argentea, septima ex auro. Κλιμαξ ὑψιπυλος, επι δ' αυτῃ πυλη ογδοη. Ἡ πρωτη των πυλων μολιβδου, ἡ δευτερα κασσιτερου, ἡ τριτη χαλκου, ἡ τεταρτη σιδηρου, ἡ πεμπτη καραστου νομισματος, ἡ ἑκτη αργυρου, χρυσου δ' ἡ ἑβδομη. Primum assignant Saturno tarditatem illius sideris plumbo indicantes: alteram Veneri, quam referunt, ut ipsi quidem putant, stanni splendor et mollities; tertiam Jovi, aheneam illam quidem et solidam: quartam Mercurio, quia Mercurius et ferrum, uterque operum omnium tolerantes, ad mercaturam utiles, laborum patientissimi. Marti quintam, inæquálem illam et variam propter mixturam. Sextam, quæ argentea est, lunæ; septimam auream soli tribuunt, quia solis et lunæ colores hæc duo metalla re-

metallurgic astrology, as Borrichius calls it, or of the astronomical or mythological nomination of metals, though it differs from that used at present. According to this arrangement, tin belongs to Jupiter, copper to Venus, iron to Mars, and the mixed metal to Mercury. The conjecture of Borrichius, that the transcribers of Origen have, either through ignorance or design, transposed the names of the gods, is highly probable: for if we reflect that in this nomination men, at first, differed as much as in the nomination of the planets, and that the names given them were only confirmed in the course of time, of which I shall soon produce proofs, it must be allowed that the causes assigned by Origen for his nomination do not well agree with the present reading, and that they appear much juster when the names are disposed in the same manner as that in which we now use them.*

ferunt. *Contra Celsum*, lib. vi. 22, p. 161.—I expected to have received some explanation of these words from the editors of Origen, and in those authors who have treated expressly on the religious worship of the Persians; but I find that they are quoted neither by Hyde; Philip a Turre, whose *Monumenta veteris Antii* is printed in *Thesaurus Antiquitat. et histor. Italiæ*, viii. 4to; nor by Banier in his Mythology.

* Borrichius arranges the words in the following manner: Secundam portam faciunt Jovis, comparantes ei stanni splendorem et mollitiem; tertiam Veneris æratam et solidam; quartam Martis, est enim laborum patiens, æque ac ferrum, celebratus hominibus; quintam Mercurii propter misturam inæqualem ac variam, et quia negotiator est; sextam Lunæ argenteam; septimam Solis auream.

This astrological nomination of metals appears to have been conveyed to the Brachmans in India; for we are informed that a Brachman sent to Apollonius seven rings, distinguished by the names of the seven stars or planets, one of which he was to wear daily on his finger, according to the day of the week.* This can be no otherwise explained than by supposing that he was to wear the gold ring on Sunday; the silver one on Monday; the iron one on Tuesday, and so of the rest. Allusion to this nomination of the metals after the gods occurs here and there in the ancients. Dy-

Ol. Borrichius de ortu et progressu chemiæ. Hafniæ 1668, 4to. p. 29. Professor Eichhorn reminded me, as allusive to this subject, of the seven walls of Ecbatana, the capital of Media, the outermost of which was the lowest, and each of the rest progressively higher, so that they all overtopped each other. Each was of a particular colour. The outermost was white; the second black; the third purple; the fourth blue; the fifth red, or rather of an orange colour; and the summit of the sixth was covered with silver, and that of the seventh or innermost, with gold. Such is the account given by Herodotus, i. 98; and it appears to me not improbable that they may have had a relation to the seven planets, though nothing is hinted on that subject by the historian.

* Φησι δε ὁ Δαμις και δακτυλιους ἑπτα τον Ιαρχαν τῳ Απολλωνιῳ δουναι, των ἑπτα επωνυμους αστερων ὁυς φορειν τον Απολλωνιον κατα ἑνα προς τα ονοματα των ἡμερων. Scribit præterea Damis, Iarcham septem annulos Apollonio dedisse, stellarum septem nominibus insignitos, quos singulos gestaverit Apollonius, unum post alium, ut dierum nomina id ferrent. *Philostrat. Vita Apollonii*, iii. 41. p. 130. How was the ring for Wednesday made? Perhaps it was hollow, and filled with quicksilver. Gesner, in *Commentaria Societat. Scien. Gotting.* 1753, iii. p. 78, thinks that these rings might have been made or cast under certain constellations.

dimus, in his Explanation of the Iliad, calls the planet Mars the iron star.* Those who dream of having had any thing to do with Mars are by Artemidorus threatened with a chirurgical operation, for this reason, he adds, because Mars signifies iron.† Heraclides says also in his allegories, that Mars was very properly considered as iron; and we are told by Pindar that gold is dedicated to the Sun.‡

Plato likewise, who studied in Egypt, seems to have admitted this nomination and meaning of the metals. We are at least assured so by Marsilius Ficinus;§ but I have been able to find no

* Iliad. v. Επει γαρ ὁ Αρειος αστηρ, ὁ σιδηρειος καλουμενος.

† Visus est sibi quis a Marte iniri, affectio ipsi facta est circa sedem et meatum, et cum non posset alio aliquo modo curari, sectione usus curatus est. Significabat enim Mars ferrum, quem ad modum etiam consuetudine transnominative per metonymiam appellamus. *Oneirocritica*, v. 37.

‡ Isthm. Od. ver. 1. Of the like kind are many passages in Eustathius on Homer's Iliad, b. xi. and also the following passages of Constantinus Manasses, where he describes the creation of the stars, in his *Annales*, edition of Meursius, Leyden 1616, 4to. p. 7, and p. 263: Saturnus nigricabat, colore plumbeo; Jupiter ut argentum splendebat; Mars flammeus conspiciebatur; Sol instar auri puri lucebat; (Venus uti stannum): Mercurius instar æris rubebat; Luna in morem glaciei pellucida suam et ipsa lucem emittebat, &c. Eustathius on *Dionys. Perieges.* v. 288, says: το μεταλλον του χρυσου τῳ Ηλιῳ ανακειται. Aurum soli dedicatum est; not *soli accumbit*, as translated by Bertrand. Olympiodorus uses the words in the same sense.

§ Commemorat et metalla, ut per septem metalla, septem planetarum influxus intelligamus, generationem omnium moderantes. Aurum quidem Soli, argentum Lunæ, plumbum Saturno, electrum

proof of it, except where he says of the island Atlantis, that the exterior walls were covered with copper and the interior with tin, and that the walls of the citadel were of gold.* It is not improbable that Plato adopted this Persian or Egyptian representation, as he assigned the planets to the demons; but perhaps it was first introduced into his system only by his disciples.† They seem, however, to

Jovi, ferrum et æs Marti, Veneri aurichalcum, Mercurio stannum, Platonici tribuunt. In his Preface to Critias. *Platonis Opera*; Francof. 1602, fol. p. 1097.

* Muri, qui exteriorem orbem claudebat, superficiem omnem ære tenui vestierunt; ejus vero qui interiorem, stanno; ejus denique qui circumdabat arcem, aurichalco, igneo fulgore corusco. Regio vero ipsa intra arcem, ita constructa: In medio sacrum et inaccessibile Clitonis Neptunique templum, aureo ambitu circumdatum. P. 1105.

† It is probable that Ficinus had in view a passage in *Olympiodori Commentar. in Meteora Arist.* which, as it is remarkable, and as that work is scarce, I have here transcribed. It may be found lib. iii. p. 59, in the edition of Venice 1551, fol. Ιστεον δε και τουτο, ὁτι Θειος Προκλος εν τοις εις Τιμαιον ὑπομνημασιν αναγει τα μεταλλα εις τους ἑπτα πλανωμενους, λεγων ανακεισθαι τον μεν μολιβδον τῳ Κρονῳ δια το βαρυ και στυγνον και ψυχρον. Το δε ηλεκτρον τῷ Διΐ δια το ευκρατον και ζωογονον του αστερος, ὁμοιως, δε και μιγμα τιμιωτερον εστι χρυσου και ευκρατον. Τῳ δε Αρει τον σιδηρον, δια το τμητικον και οξυ. Ἡλιῳ δε τον χρυσον, ὡσανει πηγη φωτος ουτι. Αφροδιτη δε τον χαλκον δια το ανθηρον, και ὁτι πλησιον εστι του ἡλιου, ὡσπερ και χαλκος του χρυσου. Ἑρμῆ δε τον κασσιτερον δια το διαφανες και στιλπνον, ἁμα δε και δια το πλησιον ειναι της σεληνης, ὡσπερ ὁ κασσιτερος του αργυριου. Τῃ δε Σεληνῃ τον αργυρον, επειδη και ὁ αργυρος παρα χρυσῳ τιθεμενος δοκει καταλαμπεσθαι ὑπο του χρυσου και φωτεινοτερος γινεσθαι, ὡσπερ ἡ σεληνη ὑπο ἡλιου καταλαμπεται. Illud quoque sciendum, quemadmodum divinus Proclus in suis in Timæum commentariis ad septem planetas metalla omnia revocat; cum dicit plumbum quidem Saturno dicatum propter vim gravem et tristem et frigidam. Electrum autem Jovi propter naturam sideris temperatam et vitæ largientem. Simili

have varied from the nomination used at present; as they dedicated to Venus copper, or brass, the principal component part of which is indeed copper; to Mercury tin; and to Jupiter electrum. The last-mentioned metal was a mixture of gold and silver; and on this account was probably considered to be a distinct metal, because in early periods mankind were unacquainted with the art of separating these noble metals.*

The characters by which the planets and metals are generally expressed when one does not choose to write their names, afford a striking example how readily the mind may be induced to suppose a connexion between things which in reality have

autem modo et migma; migma vero majori æstimatione dignum est, magisque temperatum quam sit aurum. Marti vero ferrum consacrat propter acutum roboris et vim cædendi. Soli autem aurum ipsum, tanquam qui universi luminis fons existat. Vult æs deinde Veneri dicatum propter floridum fulgorem, et quia sole non omnino diversam habet naturam, sicut æs quoque ad auri speciem propius accedit. Mercurio vero stannum proprium dicat propter translucidum et fulgidum nitorem; simulque quia lunæ proximus adjacet, sicut stannum prope argenti naturam est. Lunæ autem sacrum argentum est, quoniam argentum auro in proximo adjacens lucem ab ipso auro accipere videtur, et splendidus effici, more lunæ quæ luce solis undique collustratur —According to the translation of Camotius, printed by itself, at Venice 1567, fol. p. 203.

* This distribution, which is ascribed to the Platonists, may be found also in the scholiasts on Pindar, at the beginning of the fifth Isthmian Ode, p. 459: Εκαστω δε των αστερων, ὑλη τις αναγεται. Ἡλιῳ μεν ὁ χρυσος. Σεληνῃ δε, ὁ αργυρος. Αρεϊ, σιδηρος. Κρονῳ, μολιβδος. Διϊ ηλεκτρος. Ερμῃ, κασσιτερος. Αφροδιτῃ, χαλκος. This confirms what I have before said, that mankind at first were not unanimous in this division of the metals among the gods.

no affinity or relation to each other. Antiquaries and astrologers, according to whose opinion the planets were first distinguished by these characters, consider them as the attributes of the deities of the same name. The circle in the earliest periods among the Egyptians was the symbol of divinity and perfection; and seems, with great propriety, to have been chosen by them as the character of the sun, especially as, when surrounded by small strokes projecting from its circumference, it may form some representation of the emission of rays. The semicircle is, in like manner, the image of the moon, the only one of the heavenly bodies that appears under that form to the naked eye.* The character ♄ is supposed to represent the sithe of Saturn; ♃ the thunderbolts of Jupiter; ♂ the lance of Mars, together with his shield; ♀ the looking-glass of Venus; and ☿ the caduceus or wand of Mercury.†

The expression by characters adopted among the chemists agrees with this mythological signification only in the character assigned to gold.—Gold, according to the chemists, was the most perfect of metals, to which all others seemed to be inferior in different degrees. Silver approached

* Clemens, in his *Stromata*, lib. iv. p. 556, speaking of the Egyptian hieroglyphics, says: Qui solem volunt scribere, faciunt circulum; lunam autem, figuram lunæ cornuum formam præ se ferentem, convenienter ei formæ, quæ proprie dicitur.

† Riccioli Almagest. novum, vii. 1. vol. i. p. 480.

nearest to it; but was distinguished only by a semicircle, which, for the more perspicuity, was drawn double, and thence had a greater resemblance to the most remarkable appearance of the moon; the name of which this metal had already obtained. All the other metals, as they seemed to have a greater or less affinity to gold or silver, were distinguished by characters composed of the characters assigned to these precious metals.* In the character ☿ the adepts discover gold with a silver colour. The cross placed at the bottom, which among the Egyptian hieroglyphics had a mysterious signification,† expresses, in their opinion, something I know not what, without which quicksilver would be silver or gold. This something is combined also with copper, the possible change of which into gold is expressed by the character ♀. The character ♂ declares the like honourable affinity also; though the half-cross

* Willi. Christoph. Kriegsmann, Taaut, oder Auslegung der chymischen zeichen, damit die metallen und andere sachen von alters her bemerkt werden. Frankfurt 1665, six sheets octavo. This work contains nothing but chemical reveries. In researches of this kind I consider it as my duty to mention those books, the titles of which may seem to promise information on the subject, while at the same time they contain nothing worth notice. It is proper that my readers should know there are such works, and that they may save themselves the trouble of consulting them.

† Jablonski, Pantheon Ægypt. i. p. 282, 283, 287; and ii. p. 131. This author makes it the representation of something which cannot be well named. *Kircheri Œdipus Ægypt.* t. ii. pars ii. p. 399, Romæ 1653. fol.

is applied in a more concealed manner; for, according to the properest mode of writing, the point is wanting at the top, or the upright line ought only to touch the horizontal, and not to intersect it. Philosophical gold is concealed in steel; and on this account it produces such valuable medicines. Of tin one half is silver, and the other consists of the something unknown: for this reason the cross with the half moon appears in ♃. In lead this something is predominant, and a similitude is observed in it to silver. Hence in its character ♄ the cross stands at the top, and the silver character is only suspended on the right hand behind it.*

The mythological signification of these characters cannot be older than the Grecian mythology; but the chemical may be traced to a much earlier period. Some, who consider them as remains of the Egyptian hieroglyphics,† pretend that they may be discovered on the table of Isis, and employ them as a proof of the high antiquity, if not of the art of making gold, at least of chemistry. We are told also that they correspond with many other characters which the adepts have left us as emblems of their wisdom.

* Boerhaave, Elementa chemiæ. Lugd. Bat. 1732, 4to. i. p. 32. See also Kircher ut supra, p. 171.

† Goguet, ii. p. 370, 371, considers them as remains of the original hieroglyphics; but he is of opinion that we received them in their present form from the Arabians.

If we are desirous of deciding without prejudice respecting both these explanations, it will be found necessary to make ourselves acquainted with the oldest form of the characters, which, in all probability, like those used in writing, were subjected to many changes before they acquired that form which they have at present. I can, however, mention only three learned men, Saumaise,* Du Cange, † and Huet, ‡ who took the trouble to collect these characters. As I am afraid that my readers might be disgusted were I here to insert them, I shall give a short abstract of the conclusion which they form from them; but I must first observe that the oldest manuscripts differ very much in their representation of these characters, either because they were not fully established at the periods when they were written, or because many supposed adepts endeavoured to render their information more enigmatical by wilfully confounding the characters; and it is probable also that many mistakes may have been committed by transcribers.

The character of Mars, according to the oldest mode of representing it, is evidently an abbrevia-

* Plinianæ Exercitat. in Solinum, p. 874.

† Glossarium ad scriptores med. et infimæ Græcitatis. Lugduni 1688. fol. At the end of the Appendix, p. 5 and 6.

‡ In his Annotations on *Manilii Astronomicon*, added to the edition by Michael Fayus *in usum Delphini*. Parisiis 1679, 4to. p. 80.

tion of the word Θουρος, under which the Greek mathematicians understood that deity;* or, in other words, the first letter Θ, with the last letter ς placed above it. The character of Jupiter was originally the initial letter of Ζευς; and in the oldest manuscripts of the mathematical and astrological works of Julius Firmicus the capital Z only is used, to which the last letter ς was afterwards added at the bottom, to render the abbreviation more distinct. The supposed looking-glass of Venus is nothing else than the initial letter, a little distorted, of the word Φωσφορος, which was the name of that goddess. The imaginary sithe of Saturn has been gradually formed from the two first letters of his name Κρονος, which transcribers, for the sake of dispatch, made always more convenient for use, but at the same time less perceptible. To discover in the pretended caduceus of Mercury the initial letter of his Greek name Στιλβων, one needs only look at the abbreviations in the oldest manuscripts, where they will find that the Σ was once written as C; they will remark also that transcribers, to distinguish this abbreviation still more from the rest, placed the C thus, ↄ, and added under it the next letter τ. If those to whom this deduction appears improbable, will only take the trouble to look at other Greek abbreviations, they will find many that dif-

* This is proved by Saumaise, p. 872.

fer still further from the original letters they express than the present character ☿ from the C and ♃ united. It is possible also that later transcribers, to whom the origin of this abbreviation was not known, may have endeavoured to give it a greater resemblance to the caduceus of Mercury. In short, it cannot be denied that many other astronomical characters are real symbols, or a kind of proper hieroglyphics, that represent certain attributes or circumstances, like the characters of Aries, Leo, and others quoted by Saumaise.

But how old is the present form of these characters? According to Scaliger,* they are of great antiquity, because they are to be found on very old gems and rings. If the ring number 104 in Goræus be old and accurately delineated, this must indeed be true; for some of these characters may be very plainly distinguished on the beazel.† We are told by Wallerius,‡ that they were cer-

* In his Annotations on *Manilii Astronomicon.* Strasburgh 1665, 4to. p. 460. Quam vetusti sint characteres planetarum, argumento sunt vetustissimæ gemmæ, et palæ annulorum, in quibus eæ incisæ visuntur.

† In *Gori, Thesaurus Gemmarum antiquarum astriferarum,* Florentiæ 1750, 3 vol. fol., I found nothing on this subject. Characters of the moon and of the signs in the zodiac often occur; but no others are to be seen, except in tab. 33, where there is a ring, which has on it the present characters of Mars and Venus. In general the planets are represented by seven small asterisks, or by six and the character of the moon. Besides, the antiquity of this gem caunot be ascertained.

‡ Physische chemie, i. p. 48.

tainly used by the ancient Egyptians, because Democritus, who resided five years in Egypt, speaks of them in the plainest terms. I do not know whence Wallerius derived this information, but it proves nothing. He undoubtedly alludes to the laughing philosopher of Abdera, who lived about four hundred and fifty years before our æra, but no authentic writings of his are now extant. Fabricius* says that we have a Latin translation of a work of his *De arte sacra*, Patavii 1572, which, however, is certainly a production of much later times. I have it now before me from the library of our university; and I find that it is not

* It appears that he never saw the book; for in vol. i. p. 809, he misquotes both the title and the date. The whole title is, *Democritus Abderita de arte magna, sive de rebus naturalibus. Nec non Synesii et Pelagii, et Stephani Alexandrini, et Michaelis Pselli, in eundem commentaria.* Dominico Pizimentio Vibonensi interprete. Patavii 1573, nine sheets small octavo. The editor, however, says in the preface: Democriti Abderitæ libellum de arte magna, et Synesium ejusdem interpretem, ereptum a Corcyræo quodam, qui Venetiis Romam se contulerat, in Latinum converti. In p. 5 stands: Ex rebus naturalibus V mysticis Democriti, and in p. 11 follows: Dioscoro sacerdoti magni Serapidis in Alexandria, Deo favente, Sinesius philosophus s. p. d. and also a letter, p. 18: Pelagii Philosophi de eadem magna arte. P. 23 Steph. Alexandrini, œcumenici philosophi et magistri magnæ hujus artis, auri conficiendi actio prima. D. Pizimentio interprete. There are nine *actiones*. At the end stands: Michaelis Pselli Epistola ad Xiphilinum patriarcham, de auri conficiendi ratione. D. Pizim. Vibon. interprete. Conring says in his *Hermetica medicina*, p. 29, that this book was printed four years after at Cologne, with *Mizaldi Mirabilia*. Salmasius, in his Annotations on Tertullian *De pallio*, p. 188, 189, gives two receipts from the Greek original.

the whole book, but only an abstract, and written in so extravagant a manner, that the deception is not easily discovered. It contains chemical processes, but nothing of the characters of metals; which is the case also with the letters of Democritus, published by Lubbinus.*

ZINC.

Zinc is one of those metals which were not known to the Greeks, Romans, or Arabians. This we have reason to conjecture, because it has not been distinguished by a chemical character like the rest; but it is fully proved, by our not finding in the works of the ancients, any information that appears even to allude to it. I know also but of one instance where it is supposed to have been found among remains of antiquity. Grignon pretends that something like it was discovered in the ruins of the ancient Roman city in Champagne.† Such an unexpected discovery deserved to have been examined with the utmost minuteness; but it seems to have been examined only in a very superficial manner; and as that was the case, it

* See the collection of Greek letters of *Eilh. Lubbinus*. Ex officina Commelina, 1601, 8vo.

† Bulletin des fouilles d'une ville Romaine, p. 11.

is impossible to guess what kind of a metal or metallic mixture this author considered as zinc.

It is not surprising that this metal should have remained so long unknown, for it has never yet been found pure.* Its principal component part is often and in a great degree mixed with ores; and when these are melted, it becomes sublimated in a metallic form, and is found adhering above to the cool sides of the furnace; but a particular apparatus is necessary, else the reduced metal partly evaporates, and is partly calcined, by which means it appears like an earthy crust, and exhibits to the eye no traces of metal.

That mixture of zinc and copper called at present brass, tomback, pinchbeck, princes-metal, &c. and which was first discovered by ores, abundant in zinc, yielding when melted not pure copper, but brass, was certainly known to the ancients. Mines that contained ores, from which this gold-coloured metal was produced, were held in the highest estimation; when exhausted, the loss of them was regretted; and it was supposed that the metal would never be again found. In the course of time it was remarked, no one knows by what accident, that an earth, which must have been calamine, when added to copper, while melting, gave it a yellow colour. This earth was there-

* See Gmelins Grundrisse der Mineralogie. Gottingen 1790, 8vo. p. 440.

fore used, though it was not known to what metal it belonged, in the same manner as calx of cobalt was employed in colouring glass before mineralogists were acquainted with that metal itself. Aristotle and Stabo speak of an earth of that kind, the use of which in making brass has been retained through every century. Ambrosius, bishop of Milan, in the fourth century; Primasius, bishop of Adrumetum in Africa, in the sixth; and Isidore, bishop of Seville, in the seventh, mention an addition by which copper acquired a gold colour, and which undoubtedly must have been calamine.* When, in the course of time, more calamine was discovered, the ancient method of procuring brass from copper-ore that contained zinc was abandoned; and it was found more convenient first to extract from it pure copper, and then to convert it into brass by the addition of calamine.

Those desirous of inquiring further into the knowledge which the ancients had of this metal

* The first says, in his Exposition of the book of Revelation, chap. 1: Æs namque in fornace, quibusdam medicaminibus admixtis, tamdiu conflatur, usque dum colorem auri accipiat, et dicitur aurichalcum. The second says, on the same passage: Aurichalcum ex ære fit, cum igne multo, et medicamine adhibito, perducitur ad aureum colorem.----*Isidor. in Origin.* Aurichalcum dictum quod et splendorem auri et duritiam æris possideat: fit autem ex ære et igne multo, ac medicaminibus perducitur ad aureum colorem. ---Have these bishops copied each other? I should here give the history of brass (*aurichalcum*), had I not said a great deal on that subject in the annotations to *Aristot. Auscult. mirab.* and were I not afraid that it might be considered as a repetition.

must examine the meaning of the word *cadmia* which seems to have had various significations. This task I have ventured to undertake; and though I cannot clear up every thing that occurs respecting it, I shall lay before my readers what information I have been able to obtain on the subject, because perhaps it may amount to somewhat more than is to be found in the works of old commentators. *Cadmia*, signified then, in the first place, a mineral abounding in zinc, as well as any ore combined with it, and also that zinc-earth which we call calamine. Those who should understand under it only the latter, would not be able to explain the greater part of the passages in the ancients where it is mentioned. It is probable that ore containing zinc acquired this name, because it first produced brass.* When it was afterwards remarked, that calamine gave to copper a yellow colour, the same name was conferred on it also. It appears, however, that it was seldom found by the ancients;† and we must consider *cadmia*, in general, as signifying ore that contained zinc. Gold-coloured copper, or brass, was long

* Plin. lib. xxxiv. sect. 22: Ipse lapis, e quo fit æs, cadmia vocatur.

† Zinc-earth, besides being mentioned by Aristotle and Strabo, is mentioned also by Galen *De Simplic. medicam. facultatibus*, lib. ix. p. 142. As he found no furnace-calamine (*ofenbruch*) when he resided in Cyprus, he procured from the overseer of the mines some raw *cadmia*, which had been found in the mountains and rivulets, and which certainly must have been calamine.

preferred to pure or common copper, and thought to be more beautiful the nearer it approached to the best *aurichalcum*. Brass therefore was supposed to be a more valuable kind of copper; and on this account Pliny says, that *cadmia* was necessary for procuring copper, that is brass. Copper, as well as brass, was for a great length of time called *æs*, and it was not till a late period that mineralogists, in order to distinguish them, gave the name of *cuprum* to the former.* Pliny says, that it was good when a large quantity of *cadmia* had been added to it, because it not only rendered

* At first it was called *æs cyprium*, but in the course of time only *cyprium*; from which was at length formed *cuprum*. It cannot however be ascertained at what periods these appellations were common. The epithet *cupreus* occurs in manuscripts of Pliny and Palladius; but one cannot say whether later transcribers may not have changed *cyprius* into *cupreus*, with which they were perhaps better acquainted. The oldest writer who uses the word *cuprum* is Spartian; who says, in the life of Caracalla, *cancelli ex ære vel cupro*. But may not the last word have been added to the text as a gloss? Pliny, book xxxvi. 26, says: Addito *cyprio et nitro*; which Isidore, xvi. 15. p. 393, expresses by the words *adjecto cupro et nitro*. The superiority of the Cyprian copper gave occasion to this appellation; as the best iron or steel was called *chalybs*, from the *Chalybes* (a people of Galatia) who prepared the finest, and carried on the greatest trade with it. But in what did the superiority of this Cyprian copper consist? In its purity, or in its colour, which approached near to that of gold? That island produced a great deal of ore which contained zinc, and abounded also with calamine. Pliny says, *in Cypro prima fuit æris inventio*. Red copper however had been known there from the earliest periods, so that the honour of its invention must be allowed to that island without any contradiction; and Pliny must undoubtedly allude in the above passage to some particular kind.

the colour more beautiful, but increased the weight. In the like manner, a quintal of copper in Hungary produces an hundred and fifty pounds of brass. The same author remarks also, that the *cadmia* (*fossilis*) was not used in medicine: this however is to be understood only of the raw ore, for some physicians prepared zinc-earth from ore that contained zinc, as he afterwards tells us; and Galen extols the calamine found in Cyprus on account of its superior effects, because, perhaps, the earth could be obtained from it much purer.

In the second place, *cadmia*, among the ancients, was what we call (*ofenbruch*) furnace-calamine, or what in melting ore that contains zinc, or in making brass, falls to the bottom of the furnace, and which consists of more or less calcined zinc.* As this furnace-calamine assumes various appearances, according to the manner of melting, and according to many other circumstances that in part cannot be defined; and as the ancients comprehend all its varieties under the general name of *cadmia*, and give to each variety, according to its form, consistence, and colour, a particular name also, a confusion of names has hence arisen which

* Pliny says, p. 659: Fit sine dubio cadmia et in argenti fornacibus, sed nequaquam comparanda æreariæ. Dioscorides says the same. Some suppose that the author means litharge; but he speaks of silver-ore mixed with zinc, which certainly will produce (*ofenbruch*) furnace-calamine.

cannot now be cleared up, especially as it is not thought worth while to distinguish all its incidental variations. Our physicians esteem only the pure zinc-earth; and as they know how to obtain it, they are not under the necessity of using impure furnace-calamine. In our melting-houses it is employed, without much nicety in the choice, for making zinc or brass.*

* I shall embrace this opportunity of presenting to those fond of critical remarks, a few observations on Dioscorides. In book. v. c. 84, he first mentions some sorts of *cadmia*, βοτρυιτις, πλακωτη and οστρακιτις. These, according to Galen and Pliny, are undoubtedly certain kinds of (*ofenbruch*) furnace-calamine; but Saumaise in his book *De homonymis*, p. 230, and Sarracen in his Annotations, p. 113, are of opinion that Dioscorides considered them as native kinds of *cadmia*, or minerals abundant in zinc. First, because he says: τοιαυται δε εισιν αι εκ των παλαιων μεταλλων ορυσσομεναι, tales sunt quæ e fodinis veteribus eruuntur; and secondly, because he begins afterwards to speak for the first time of factitious *cadmia*, or furnace-calamine, where he says: γενναται δε ἡ καδμεια εκ του χαλκου καμινευομενου. I cannot however allow myself to believe that Dioscorides, who was so careful, and who immediately after describes the artificial preparation of *cadmia* clearly and properly, should have thus erred. Besides, every kind of *ofenbruch* (furnace-calamine) must have discovered its origin from fire to such a good judge of minerals as Dioscorides. I am convinced that he, as well as Galen and Pliny, considered the above kinds as furnace-calamine. The words τοιαυται δε εισιν αι εκ των π. μ. ο. were not written by him, and are only an annotation made by some person on the passage, and inserted afterwards in the text by an inattentive transcriber. Such insertions, in my opinion, are more frequent in Dioscorides than in any other author. His works were a kind of manual to physicians, in which each made such observations as he thought proper. The words γενναται δε ἡ καδμεια εκ τ. χ. κ. by no means form a transition to the artificial kinds of *cadmia*. The author only begins there to give an account

What here appears to me most singular is, that the ancients should have given the same names to furnace-calamine (*ofenbruch*) as they gave to ores that contained zinc. The affinity of these substances they could conjecture only from their effects, or perhaps they were induced to do so from observing that furnace-calamine was not produced but when the different kinds of *cadmia*, as they were called, were melted; that is, when yellow and not red copper was obtained. *Ofenbruch* got the name of furnace-calamine at Ram-

how the before-described kinds of *cadmia* were produced or prepared. The translation: Gignitur porro et cadmia quædam e fuligine, quæ, dum excoquitur æs, lateribus camerisque fornacum applicatur, is entirely wrong. It ought to be: Fit autem cadmia. --- The former has arisen from the reading γενναται δε τις καδμεια, found in some manuscripts; and those transcribers have been considered to be right, who, on account of the preceding words, εκ των παλαιων μεταλλων, seemed to be convinced that Dioscorides had hitherto spoken of native calamine.

Pompholyx was the name of the white flowers of zinc which Dioscorides, v. 85, p. 352, compares to wool, and which by chemists were formerly called *lana philosophica*. That author says: εριων τολυπαις αφομοιουται, lanarum carptarum flocculos imitatur. The ancients collected these flowers when produced by the melting of zinc-ore; but they obtained them also by an apparatus which is fully described by Dioscorides and Galen, and which approaches near to that used for collecting arsenic in the poison melting-houses as they are usually called.—That these flowers are named also *nicht*, and furnace-*nicht*, is well known. Frisch conjectures that this name was derived from *onychites*, which signified a kind of furnace-dross. After this derivation was forgotten, the word was translated *nihil* and *nihilum*; and in the same manner from glass-gall has arisen *fel vitri*.

melsberg, when it was observed that it could be employed instead of native calamine for making brass.* Were the ancients then in any measure acquainted with this use of it? Galen and Dioscorides speak only of its use in medicine, and say nothing of its being employed in the preparation of brass. The Arabian writers, particularly the translators of the Greek physician, speak in a much clearer manner of the preparation of brass; but the appellations which they employ are so indeterminate in their signification, that an answer to the above question cannot be deduced from them. *Climia*, which some pronounce *calimia*, and from which the modern Greeks made *kelimia*, and the Latins *lapis calaminaris*, seems to have entirely the same meaning as *cadmia*. *Tutia*, which occurs first in the eleventh century, in Avicenna, and which the Greeks write *toutia*, or perhaps more properly *thoûthia*, signifies sometimes *pompholyx;* but, in common, it seems to express also minerals that contain zinc, and likewise furnace-calamine.† Could it be proved that the

* This however I will not with certainty affirm. As *calmey* and *galmey* have probably taken their rise from *cadmia* or *calimia*, and as both these words signified proper calamine, as well as *ofenbruch*, the latter, perhaps, may at an earlier period have signified furnace-calamine.

† Proofs respecting this subject may be found in *Salmasius de homonymis*. I shall quote only one passage from Serapion, p. 277: Ex tutia est quædam quæ invenitur in mineris, et ex ea est quæ fit in fornacibus, in quibus citrinatur æs, et colligitur et reponitur,

tutia of the Arabs and latter Greeks was furnace-calamine, or the *tutia* of our druggists, the oldest account with which I am acquainted of furnace-calamine, employed in making brass, would occur in Zosimus, who, according to every appearance, lived in the fifth century.* This author tells us, that, in order to make brass, Cyprus copper must be melted, and pounded *tutia* must be strewed over it. Saumaise suspects that Zosimus here means only calamine: but however this may be, his receipt has been retained till the present time in books on the arts; for these recommend not calamine but *tutia*. Notwithstanding this, we are still ignorant where and how the substance is prepared which is sold under that name; but it evidently appears to the eye, that it is a mixture of calciform zinc and burnt earth. †

sicut climia. Cementation of copper was called *citrinatio æris*; by the Greeks ποιησις χαλκου ξανθου, or ξανθωσις χαλκου.

* It is not certainly known when this Zosimus Panoplitanus lived. His works, which must contain abundance of information respecting the history of chemistry, have never yet been printed. The greater part of them were preserved in the King's library at Paris. The receipt to which I allude has been inserted by Saumaise, p. 237.

† Neumann's Chemie; von Kessel, iv. 2. p. 657. *Fallopius de metal.* p. 307, says, it is made at Venice, which appears to me most probable, though it occurs also in the bills of lading of East India ships. We read in *Observations sur la physique*, vi. p. 255, that for many years *tutia* has been collected and sold in the bishoprick of Liege. Lehmann endeavours to show that it was made by the Jews in Poland. *Novi commentarii Academ. Petropolit.* xii.

We can with more certainty affirm, that this use of furnace-calamine, in making brass, was known to Albertus Magnus in the thirteenth century; for he says, first, that yellow copper was made by the addition of calamine, which he calls *lapis calaminaris*. He tells us afterwards, that Hermes taught how to give a gold colour to copper by throwing pounded *tutia* into the melted metal. *Tutia*, says he, which is used in the transmutation of metals, is not a native mineral, but an artificial mixture, produced in the furnace when copper-ore is melted; and he advises glass-gall to be strewed over the ore, otherwise calamine and *tutia* will lose their force in the fire.* It would appear that the last-mentioned name, in the thirteenth century, signified only furnace-calamine, and that its use for making brass was at that period known.

For many centuries however, the *ofenbruch*, furnace-calamine, with which, as we are told, the furnaces at Rammelsberg overflowed, was thrown aside as useless, till at length, in the middle of the

p. 381. As the use of tutia has been almost abandoned, because physicians prefer pure flowers of zinc, and because those who make pinchbeck employ purified zinc; it is probable that this substance will soon be entirely neglected.

* Ligatur autem per oleum vitri; tolluntur enim fragmenta vitri, et convertuntur in pulverem, et spargitur in testam super æs postquam immissa est calaminaris, et tunc vitrum projectum enatat super æs, et non sinit evaporare lapidem et lapidis virtutem, sed reflectit vaporem lapidis in æs. *De mineralibus.* Coloniæ 1569, 12mo. p. 350. lib. iv. cap. 5; and lib. v. cap. 7. p. 388.

sixteenth century, Erasmus Ebener first showed that it might be used instead of native calamine for making brass. This Ebener, descended from the noble family of that name at Nuremberg, was a man of great learning, and an able statesman. He was employed by his native city, and by foreign princes, on occasions of the highest importance. In 1569, he was privy-counsellor to Julius duke of Brunswick, and died in 1577, at Helmstadt, where he was buried.* I regret much that I can give no farther account of this important discovery than what I have inserted in my introduction to Technology. The time even when it was made, is not known with certainty. Lœhneyss says, that it was sixty years before the period when he wrote. But at what period did he write? The oldest edition, with which I am acquainted, of his treatise on mines is of the year 1617, so that this discovery would fall about the year 1557.† Calvör caused to be printed an old account of the Rammelsberg mines, which was said to have been published in 1565. According to that work, Erasmus Ebern (for so was the name there improperly written) made the above-mentioned observation at Nuremberg, about seven-

* Doppelmayrs Nachricht von Nürnbergischen Künstlern, p. 77.

† The other edition was printed at Stockholm and Hamburgh, by Liebezeit, and is the same as that mentioned by H. Gatterer, in *Anleitung den Harz zu bereisen*, i. p. 313, and ii. p. 13.

teen years before, that is, about the year 1548.* Schluter† assigns as the period, about 1550, and Honemann‡ about 1559. We may therefore very safely place it in the middle of the sixteenth century, and probably the discovery happened in 1553, at which time Ebener was sent to duke Henry, with whom he continued a long time, as we are expressly told by Doppelmayr. This use of calamine refuse induced the managers of the profitable brass-works in the Harz forest to pick up carefully that which before had been thrown aside. Duke Julius, who endeavoured to improve every branch of manufacture, and particularly what related to metallurgy, and who, agreeably to the then prevailing and apparently returning mode of princes, suffered himself to be duped with the hopes of making gold, improved the brass-works at Buntheim, below Harzburg, and by these means brought a great revenue to the electoral treasury.§

Another production of zinc, artificial white vitriol, was also long prepared, used, and employed in commerce before it was known that it

* Historische nachricht von den Unter- und Ober-Harzischen bergwerken. Braunschw. 1765, fol. p. 208.

† Von hüttenwerken, p. 235.

‡ Die Alterthümer des Harzes. Clausthal 1754, 4to. ii. p. 119 and 124.

§ Rehtmeiers Braunschweig-Luneburgische Chronik. Braunschweig 1722, fol. p. 1063.

was procured from this semi-metal. That it was not known before the middle of the sixteenth century, and that it was first made at Rammelsberg, may with confidence be affirmed. Schluter ascribes the invention of it to duke Julius, and places it in the year 1570:* but it must be somewhat older than the above-quoted account of Rammelsberg; for the author, who wrote about 1565,† relates, that in his time one citizen only, whom he calls Henni Balder, boiled white vitriol; and it appears that this person kept the process a secret. That the invention however was not then new, is evident from his adding, that what its effects might be in medicine had not been examined; but that its use in making eye-water had been known almost as early as the time when it was discovered. This agrees with another account, according to which the method of boiling white vitriol was found out

* Von hüttenwerken, p. 597.

† White vitriol also is made at Goslar, but by one citizen only, named Henni Balder. It is not procured by the evaporation of copper like other vitriol; but when large quantities of ore are roasted in the furnaces, a red substance is from time to time collected on the refuse of the ore, and found in some places half an ell thick. This substance, which is saltish, is formed into a lye, and boiled in small leaden pans. The rest of the process I do not know, but I observed that it crystallises like saltpetre, but it is stronger and whiter. It is also cast into small cakes about the thickness of one's hand. This vitriol is employed by the leather-dressers, and may be used for many things instead of alum; but it cannot be used in dressing white skins, because it makes them yellowish. *Historische nachricht*, p. 212.

at the time when Christopher Sander whose service to the Harz is well known, was tithe-gatherer.* Honemann says, that Sander was tithe-gatherer at the mines of the Upper Harz before the year 1564, but that in this year he was principal tithe-gatherer and director of the mines and melting-houses at Goslar.† Sander himself, in a paper dated August 3, 1575, seems to ascribe the invention of white vitriol to duke Julius.‡

At first this salt was called *erzalaun*, a name occasioned by its likeness to alum, but afterwards it was more frequently known by those of *gallitzenstein*, *golitzenstein*, and *calitzenstein*.§ The latter names however appear to be older than white vitriol itself; as we find that green vitriol, even before the year 1565, was called green *gallitzenstein*. May not the word be derived from *gallæ*; because it is probable that vitriol and galls were for a long time the principal articles used for making ink and in dyeing? I am of opinion that the white vitriol, which is produced in the mines of Rammelsberg in the form of icicles, gave rise to the invention of this salt. The former, so early as the year 1565, was called white native vitriol, or white *gogkelgut*, and was packed up in casks,

* Bruckmann, Magnalia Dei, ii. p. 459.

† Honemann, ii. p. 101. *Calvors Historische nachricht*, p. 161 and 225.

‡ Bruckmann, ii. p. 446.

§ In the like manner we find *calmey* instead of *galmey*.

and in that manner transported for sale.* I shall not here enter into the old conjectures respecting the origin and component parts of this vitriol; but it deserves to be remarked, that Henkel† and Neumann‡ observed in it a mixture of zinc, by which Mr. Brandt, a member of the Swedish council of mines, was led to prove, that, when pure, it consists of the vitriolic acid and zinc earth; and this was afterwards confirmed by Hellot.§

I come now, in the last place, to the history of this semi-metal, which, when furnace-calamine was used, could not remain long unobserved, as it is sometimes found amongst it uncalcined in metallic drops. It is worthy of remark that Albertus Magnus, who first described the use of fur-

* Calvor, Historische nachricht, p. 199 and 200. Properly it is written and pronounced *jöckel*. It is very remarkable that in Iceland this word at present signifies icicles. I imagined that I had been the first person who made this remark when I found the word often in *Olafsen und Povelsen's Reise durch Island*, i. p. 46; but I observe that the same remark is made and explained by Anderson, in *Nachrichten von Island*, Hamburg 1746, 8vo. p. 4.

† Kieshistorie, p. 904.

‡ Chemie, von Kessel, iv. 2, p. 832, where may be found the old opinions on this subject.

§ Brandt, in Acta Upsaliens. 1735. *Hellot in Memoires de l'Acad. des sciences à Paris*, 1735, p. 29. Of the latest state of white vitriol works I have given an account in *Beytragen zur œkonomie, technolog.* iv. p. 59. It deserves to be remarked, that since the year 1730 the demand for this article has increased every ten years, though one cannot say why it is more used at present than formerly.

nace-calamine in making brass, is the oldest author in whose works mention is made of zinc.* He calls it *marchasita aurea.* This was properly a stone, the metallic particles of which were so entirely sublimated by fire, that nothing but useless ashes remained behind. It contained fixed quicksilver, communicated a colour to metals, on which

* I shall here give the author's whole account, that the reader may compare it with my extract; for I am not so fully acquainted with the nomenclature of the ancient chemists as to flatter myself that I understand the whole of it.

De mineral. ii. cap. 11: Marchasita, sive marchasida ut quidam dicunt, est lapis in substantia, et habet multas species, quare colorem accipit cujuslibet metalli, et sic dicitur marchasita argentea et aurea, et sic dicitur aliis. Metallum tamen quod colorat eum non distillat ab ipso, sed evaporat in ignem, et sic relinquitur cinis inutilis, et hic lapis notus est apud alchimicos, et in multis locis veniuntur.

Lib. iii. cap. 10: Æs autem invenitur in venis lapidis, et quod est apud locum qui dicitur Goselaria est purissimum et optimum, et toti substantiæ lapidis incorporatum, ita quod totus lapis est sicut marchasita aurea, et profundatum est melius ex eo quod purius.

Lib. v. cap. 5: Dicimus igitur quod marchasita duplicem habet in sui creatione substantiam, argenti vivi scilicet mortificati, et ad fixionem approximantis, et sulphuris adurentis. Ipsum habere sulphureitatem comperimus manifesta experientia. Nam cum sublimatur, ex illa emanat substantia sulphurea manifesta comburens. Et sine sublimatione similiter perpenditur illius sulphureitas.

Nam si ponatur ad ignitionem, non suscipit illam priusquam inflammatione sulphuris inflammetur, et ardeat. Ipsam vero argenti vivi substantiam manifestatur habere sensibiliter. Nam albedinem præstat Veneri meri argenti, quemadmodum et ipsum argentum vivum, et colorem in ipsius sublimatione cæleſtium præstare, et luciditatem manifestam metallicam habere videmus, quæ certum reddunt artificem Alchimiæ, illam has substantias continere in radice sua.

account it was well known to the alchemists, burned in the fire, and was at length entirely consumed. It was found in various parts, but that at Goslar was the best because the copper it contained seemed to have in it a mixture of gold. To give this copper however a still greater resemblance to gold, some tin was added to it, by which means it became more brittle. This marchasita also rendered copper white as silver. Thus far Albertus. It obtained without doubt the name of *marchasita aurea* because zinc communicates a yellow colour to copper; and for the same reason the Greeks and the Arabians called *cadmia* golden or *aurea*.* But how could Albertus say that marchasite made copper white? Did he commit a mistake, and mean tin? To me this appears not probable, as at one time he seems to call it *argentea*. I imagine that he knew that copper, when mixed with as much zinc as possible, that is, according to Scheffer,† eighty-nine pounds to a hundred, became white; and it appears that by this he wished to establish its affinity with quicksilver.

The next author who gives an intelligible account of this metal, is Theophrastus Paracelsus, who died in 1541. I do not however imagine that it was forgotten in this long interval, at least

* Salmasius de homonymis, p. 203.

† Chemische vorlesungen, p. 604.

by those who were called alchemists. I am rather of opinion, that on account of the great hopes which it gave them by the colouring of copper, they described it purposely in an obscure manner, and concealed it under other names, so that it was not discovered in their works. There are few who would have patience to wade through these, and the few who could do so, turn their attention to objects of greater importance than those which occupy mine. Gold and silver excepted, there is no metal which has had formerly so many and so wonderful names as zinc.* For this reason, chemists long believed that zinc was not a distinct semi-metal, but only a variety of tin or bismuth; and with these perhaps it may hence have been often confounded.

The name zinc occurs first in Paracelsus. He expressly calls it a distinct metal, the nature of which was not sufficiently known; which could be cast, but was not malleable, and which was produced only in Carinthia. Was he then unacquainted with the zinc of Goslar, which was known at an earlier period to Albertus Magnus?† George

* A great many may be found collected in *Fuchs, Geschichte des zinks im verhalten gegen andere körper.* Erfurt 1778, 8vo.

† Paracelsi Opera, durch Brisgoium in truck gegeben. Strasburg 1616, fol. *Chronica des landes Karnten,* p. 251. *Von berg-krankheiten,* p. 656. *De separatione elementorum,* p. 793. *Philosophiæ* lib. iv. p. 56: Zinc for the most part is a bastard kind of copper. *Primum manuale,* p. 685 and 686. *De mineralibus tractatus,* i. p. 137. Because this is the principal passage, I shall here transcribe

Agricola, who wrote about the year 1550, speaks however of the Goslar zinc, but he calls it *liquor candidus*, and in German *conterfey*.* Mathesius, who published his Sermons in 1562, says, "at Freyberg there is red and white zinc."† Perhaps he did not mean the metal, but minerals that contained zinc. George Fabricius, who died in 1571, conjectures that *stibium* is what the miners call *cincum*, which can be melted, but not hammered.‡

One sees by these imperfect accounts that this semi-metal must have been scarce, even in the middle of the sixteenth century, and that it was not in the collection of Agricola, which was considerable for that period. Libavius, who died in

it as it is to be found in the following edition: *Etliche Tractat. Theophr. Paracelsi.*—iv. *von Mineralien*, Strasburg 1582, 8vo. p. 425: Of zinc. There is another metal, zinc, which is in general unknown. It is a distinct metal of a different origin, though adulterated with many other metals. It can be melted, for it consists of three fluid principles, but it is not malleable. In its colour it is unlike all others, and does not grow in the same manner; but with its *ultima materia* I am as yet unacquainted, for it is almost as strange in its properties as *argentum vivum*. It admits of no mixture, will not bear the *fabricationes* of other metals, but keeps itself entirely to itself. In *Basilii Valentini Triumph-wagen des antimonii*, Hamburg 1717, 8vo. p. 347, zinc is mentioned together with cobolt, marchasite, and bismuth.

* De re metallica, lib. ix. p. 329, and in the first index. Liquor candidus primo e fornace defluens cum Goselariæ excoquitur pyrites, *kobelt*, quem parietes fornacis exudant, *conterfey*.

† In the third Sermon, p. 122.

‡ De metallicis rebus, in Gesner's work *De omni rerum fossilium genere*, p. 27.

1616, mentions it several times, but he regrets, in one of his letters, that he had not been able to procure any of it.* Was this owing to the prohibition of duke Julius, by which it was forbidden to be sold? This prohibition is quoted by Pott† from *Jungii Mineralogia*, with which I am unacquainted; but as Pott has already, by his unintelligible quotations, made me spend many hours to no purpose, I shall not waste more in searching for it. The prohibition alluded to is mentioned neither by Rehtmeier nor by any other author. The foolish taste for alchemy, which prevailed then at the Duke's court, makes it not altogether improbable that one was issued;‡ and if that was really the case, it was occasioned not so much by any dread of this semi-metal being misused, as Pott thinks, but by the high hopes which were entertained of its utility in making gold. The first accurate and certain account of the method of procuring zinc at Goslar, is, as far as I know, given by Lœhneyss, in 1617, though he considers

* This letter may be found in J. Hornung's *Cista medica*. Lipsiæ 1661, iv.

† De zinco, p. 21.

‡ How much duke Julius, who in other respects did great service to his country, suffered himself to be duped by the art of making gold, appears from an anecdote given by Rehtmeier, p. 1016. Of this anecdote I received from Mr. Ribbentrop an old account in manuscript, which one cannot read without astonishment. There is still shown, at the castle of Wolfenbuttle, an iron stool, on which the impostor, Anna Maria Zieglerinn, named *Schluter Ilsche*, was burnt, February 5, 1575.

it to be the same as bismuth.* Joh. Schrœder of Westphalia, who died in 1664, calls it *marcasita pallida.*†

The first person who purposely procured this semi-metal from calamine, by the addition of some inflammable substance, was undoubtedly Henkel, who gave an account of his success in the year 1741, though he concealed the whole process.‡ After him, Dr. Isaac Lawson, a Scotsman, seems to have made experiments which proved the possibility of obtaining zinc, in this manner, on a large scale; and in 1737 Henkel heard that it was then manufactured in England with great advantage. Of this Lawson I know nothing more than what is related by Dr. Watson.§

* Page 83: When the people at the melting-houses are employed in melting, there is formed under the furnace, in the crevices of the wall, among the stones where it is not well plastered, a metal which is called zinc or *conterfeht;* and when the wall is scraped, the metal falls down into a trough placed to receive it. This metal has a great resemblance to tin, but it is harder and less malleable, and rings like a small bell. It could be made also, if people would give themselves the trouble; but it is not much valued, and the servants and workmen only collect it when they are promised drink-money. They, however, scrape off more of it at one time than at another; for sometimes they collect two pounds, but at others not above two ounces. This metal, by itself, is of no use, as, like bismuth, it is not malleable; but when mixed with tin, it renders it harder and more beautiful, like the English tin. This zinc or bismuth is in great request among the alchemists.

† Thesaurus pharmacolog. Ulmæ 1662, 4to. p. 458.

‡ Kieshistorie, p. 571, and particularly p. 721.

§ Pott refers to Lawson's *Dissert. de nihilo,* and quotes some words from it; but I cannot find it; nor am I surprised at this, as

Anthony von Swab, member of the Swedish council of mines, procured this semi-metal afterwards from calamine by distillation, in 1742; as did Marggraf in 1746, who appears, however, not to have been acquainted with the Swedish experiment. In the year 1743, one Champion established tin-works at Bristol, which were continued by his successor James Emerson, who established works of the like kind at Henham, in the neighbourhood. The manner in which the metal was procured has been described by Dr. Watson, in his Chemical Essays.

The greater part of this semi-metal, used in Europe, is undoubtedly brought from the East Indies. The Commercial Company in the Netherlands, between the years 1775 and 1779, caused to be sold on their account, above 943,081 pounds of it.* In the year 1780, the chamber of Rotterdam alone sold 28,000 pounds; and I find, by printed catalogues, that the other chambers, at that period, had not any of it in their

it was not known to Dr. Watson. See *Chemical Essays*; Cambridge 1786. 12mo. iv. p. 34. Pryce, in *Mineral. Cornub.* p. 49, says: "The late Dr. J. Lawson, observing that the flowers of lapis calaminaris were the same as those of zinc, and that its effects on copper were also the same with that semi-metal, never remitted his endeavours till he found the method of separating pure zinc from that ore." The same account is given in the supplement to Chambers's Dictionary, 1753, art. *calam.* and *zinc*; and in *Campbell's Political Survey of Britain*, ii. p. 35. The latter, however, adds, that Lawson died too early to derive any benefit from his discovery.

* Ricards Handbuch der kaufleute, i. p. 57.

possession. If the account given by Raynal be true, the Dutch East India Company, purchase annually at Palimbang, a million and a half of pounds.* In 1781, the Danish Company at Copenhagen, purchased 153,953 pounds of tutenage, which had been carried thither in two vessels, at the rate of from four and one-eighth to four and a quarter schillings Lubec per pound. It is probable that the English and Swedes import this article also. It would be of some consequence, if one could learn in what part of India, when, and in what manner, this semi-metal was first procured, and in what year it was first carried thence to Europe. According to the scanty information which we have on the subject, it comes from China,† Bengal, ‡ Malacca,§ and the Malabar coast, from which copper and tin are also imported.‖ In the oldest bills of lading of ships belonging to the Netherlands I find no mention of zinc; but it is

* Geschichte der besitzungen in Indien, i. p. 241. The author says that the Company give for it at the rate of twenty-eight florins three-quarters per hundred weight, and that this price is moderate. At Amsterdam, however, the price commonly is from seventeen to eighteen florins banco. According to a catalogue which I have in my possession, the price, on the 9th of May 1788, was seventeen florins, and, on the 22d of January 1781, it was only sixteen.

† Meisters Orient. lustgärtner, p. 276.

‡ Ibid. p. 268.

§ Linschoten's Reise, b. ii. c. 17. The author calls it *calaem*, the name used in the country. It is a kind of tin. *Bruckmann, Magnal. Dei*, p. 1038.

‖ Baldæus, Beschreibung der küste Malabar, Amsterd. 1672, fol. p. 98.

possible that it may be comprehended under the name of Indian tin; for so it was at first called. Savot, who died about the year 1640, relates on the authority of a cotemporary writer,* that some years before† the Dutch had taken from the Portuguese a ship laden with this metal, which was sold under the name of *speautre*. It is probable, therefore, that it was brought to Europe so early as the beginning of the seventeenth century. Indian tin is mentioned by Mr. Boyle.‡

It is probable that this semi-metal was discovered in India before any thing of the European zinc had been known in that country; but we are still less acquainted with the cause of the discovery than with the method of procuring the metal. We are told that an Englishman, who, in the above century, went to India, in order to discover the process used there, returned with an account that it was obtained by distillation *per descensum*.§

Respecting the origin of the different names of this semi-metal, I can offer very little. *Conterfey* signified formerly every kind of metal made in

* De nummis antiquis; in Thesaurus antiquitat. Roman. xi. p. 1195.

† In the latest edition of Essays de Jean Rey, published, with notes, by Gobet, Paris 1777, viii. p. 178. It is there said that this happened in the year 1620.

‡ Experimenta de flammæ ponderabilitate. Londini 1673, 12mo. p. 15. exp. 12.

§ Bergmann, Opuscula, ii. p. 321. *Abhandlungen der Schwed. Akad.* xxxvii, p. 85.

imitation of gold.* Frisch says it was called *zink*, from which was formed first *zinetum*, and afterwards *zincum*, because the furnace-calamine assumes the figure of (*zinken* or *zacken*) nails or spikes; but it is to be remarked, that these names do not occur before the discovery of this semi-metal, though *ofenbruch* was known long before. Fulda speaks of the Anglo-Saxon *sin*, *zink*, which he translates *obryzum*.† *Spiauter*, *speauter*, and *spialter*, from which Boyle made *speltrum*, and also *tutaneg* or *tuttanego*, came to us from India with the commodity. Under the last-mentioned name is sometimes comprehended a mixture of tin and bismuth. *Calaem* is also an Indian appellation given to this semi-metal, and has a considerable likeness to calamine; but I am of opinion with Saumaise, that the latter is not derived from the former, as *lapis calaminaris* occurs in the thirteenth century, and *calaem* was first brought to us by the Portuguese from India.

* Matthesius, Pred. v. p. 250. "*Conterfeil* is a metal of little value, formed by additions and colouring substances, so that it resembles gold or silver, as an image, or any thing counterfeited, does its archetype. Thus copper is coloured by calamine and other mixtures, in such a manner that it appears to be pure gold." In the police ordinance issued at Strasburgh in 1628, young women are forbidden to wear gold or silver, or any *conterfaite*, and every thing that might have the appearance of gold or silver.

† Sammlung Germanischer würzelwörter. Halle 1776, 4to. p. 285.

BOOK-CENSORS.

"On account of the great ease," says Mr. Putter, "with which, after the invention of printing, copies of books could be multiplied and dispersed, it was necessary that some means should be devised to prevent a bad use from being made of this art, and to guard against its being employed to the prejudice of either religion or good morals, or to the injury of states. For this reason it was every where laid down as a general maxim, that no one should be allowed to establish a printing office at pleasure, but by the permission and under the inspection of government; and that no work should be suffered to go to press until it had been examined by a censor appointed for that purpose, or declared by a particular order to be of a harmless nature."*

Many centuries, however, before the invention of printing, books were forbidden by different governments, and even condemned to the flames. A variety of proofs can be produced that this was the case among both the ancient Greeks and Romans. At Athens the works of Protagoras were prohibited; and all the copies of them which could be collected were burnt by the public

* Der büchernachdruck nach ächten grundsätzen des rechts geprüft. 1774, 4to. It was by reading the above passage I was induced to make this inquiry into the antiquity of book-censors.

crier.* At Rome, the writings of Numa, which had been found in his grave, were, by order of the Senate condemned to the fire, because they were contrary to the religion which he had introduced.† As the populace at Rome were, in times of public calamity, more addicted to superstition than seemed proper to the government, an order was issued that all superstitious and astrological books should be delivered into the hands of the prætor.‡ This order was often repeated;§ and the emperor Augustus caused more than two thousand of these books to be burnt at one time.‖ Under the same emperor the satirical works of Labienus were condemned to the fire, which was the first instance of this nature; and it is related as something singular, that, a few years after, the writings of the person who had been the cause of the order for that purpose shared the like fate, and were also publicly burnt.¶ In a manner somewhat similar

* Diogenes Laert. lib. ix. 52. *Cicero De nat. deor.* lib. i. cap. 23. *Lactantius De ira,* ix. 2. *Eusebius De præparatione evang.* xiv. p. 19. *Minucius Felix,* viii. 13.

† Livius, lib. xl. c. 29. *Plin.* xiii. 13. *Plutarchus in Vita Numæ. Lactantius De falsa relig.* i. 25, 5. *Valer. Max.* i. cap. 1, 12.

‡ Livius, lib. xxv. cap. 1.

§ Liv. xxxix. 16. *Tacit. Annal.* vi. 12.

‖ Sueton. lib. ii. cap. 31.

¶ The whole circumstance is related by Seneca the rhetorician, in the introduction to the fifth, or, as others reckon, the tenth book of his *Controversiæ,* or that which stands before *Controvers.* xxx. Every one, perhaps, may not be aware that these *Controversiæ* are

the works of Ben. Arias Montanus, who assisted to make the first catalogue of prohibited books in the Netherlands, were afterwards inserted in a catalogue of the same kind. The burning of these works having induced Cassius Severus to say, in a sneering manner, that it would be necessary to burn him alive, as he had got by heart the writings of his friend Labienus, this expression gave rise to a law of Augustus against abusive writings.* When Cremutius Cordus, in his History, called C. Cassius the last of the Romans, the Senate, in order to flatter Tiberius, caused the book to be burnt; but a number of copies were saved by being concealed.† Antiochus Epiphanes caused

not to be found in all the editions of the works of that philosopher. In *Senecæ rhetoris Suasoriæ, controversiæ, declamationumque excerpta,* Parisiis 1613, fol. an edition valuable on account of the annotations, the passage occurs in page 197 :—In hunc (Labienum) primum excogitata est nova pœna ; effectum est enim per inimicos, ut omnes ejus libri incenderentur. Res nova et insueta, supplicia de studiis sumi. Bono hercule publico, ista in pœnas ingeniosa crudelitas post Ciceronem inventa est. Quid enim futurum fuit, si ingenium Ciceronis triumviris libuisset proscribere? - - - - - Ejus, qui hanc in scripta Labieni sententiam dixerat, postea viventis adhuc scripta combusta sunt; jam non malo exemplo quia suo - - - - Cassii Severi, hominis Labieno junctissimi, belle dicta res ferebatur. Illo tempore quo libri Labieni ex S. C. urebantur: Nunc me, inquit, vivum uri oportet, qui illos edidici.

* Taciti Annal. lib. i. c. 72. Bayle, in his Dictionary, has endeavoured to clear up some doubts respecting the history of Cassius and Labienus. See the article Cassius.

† Libros per ædiles cremandos censuere patres, sed manserunt occulti et editi. Quo magis socordiam eorum inridere libet, qui

the books of the Jews to be burnt;* and in the first centuries of our æra the books of the Christians were treated with equal severity, of which Arnobius bitterly complains.† We are told by Eusebius, that Diocletian caused the sacred Scriptures to be burnt.‡ After the spreading of the Christian religion, the clergy exercised against books that were either unfavourable or disagreeable to them, the same severity which they had censured in the heathens as foolish and prejudicial to their own cause. Thus were the writings of Arius condemned to the flames at the council of Nice; and Constantine threatened with the punishment of death those who should conceal them.§ The clergy assembled at the council of Ephesus requested the Emperor Theodosius II, to cause the works of Nestorius to be burnt; and

præsenti potentia credunt extingui posse etiam sequentis ævi memoriam. Nam contra, punitis ingeniis gliscit auctoritas: neque aliud externi reges, aut qui eadem sævitia usi sunt, nisi dedecus sibi, atque illis gloriam peperere. *Tacit. Annal.* lib. iv. cap. 35.

* Maccab. ii.

† Alios audio mussitare indignanter et dicere: oportere statui per senatum, aboleantur ut hæc scripta, quibus Christiana religio comprobetur, et vetustatis opprimatur auctoritas - - - Nam intercipere scripta, et publicatam velle submergere lectionem, non est deos defendere, sed veritatis testificationem timere. *Arnobius adversus gentes*, lib. iii. Lugduni Bat. 1651, 4to. p. 104. He repeats the same thing at the end of the fourth book, p. 152.

‡ Eusebius, Histor. eccles. lib. viii. cap. 2. Suidas says the same.

§ Socrates, lib. i. cap. 6.

this desire was complied with.* The writings of Eutyches shared the like fate at the council of Chalcedon; and it would not be difficult to collect examples of the same kind from each of the following centuries.

We have instances also that, many centuries prior to the invention of printing, authors submitted their works, before they were published, to the judgment of their superiors. This was done principally by the clergy; partly to secure themselves from censure or punishment, and partly to show their respect to the Pope or to bishops. It, however, does not appear that this was a duty, but a voluntary act. In the year 768 Ambrosius Autpert, a Benedictine monk, sent his Exposition of the book of Revelation to Pope Stephen III, and begged that he would publish the work and make it known. On this occasion he says expressly, that he is the first writer who ever requested such a favour; that liberty to write belongs to every one who does not wish to depart from the doctrine of the fathers of the

* Ulpianus: Tantundem debebit judex facere in libris improbatæ lectionis, magicis forte, vel his similibus; hæc enim omnia protinus corrumpenda sunt. *Digestor.* lib. x. tit. 2, 4, 1.---Nec vero impios libros nefandi et sacrilegi Nestorii adversus venerabilem orthodoxorum sectam, decretaque sanctissimi cœtus antistitum Ephesi habiti, scriptos, habere aut legere, aut describere quisquam audeat, quos diligenti studio requiri, ac publice comburi decernimus ---*Cod.* lib. i. tit. 5, 6.

church; and he hopes that this freedom will not be lessened on account of his voluntary submission.*

Soon after the invention of printing, laws began to be made for subjecting books to examination; a regulation proposed even by Plato; and which has been wished for by many since.† It is very probable that the fear under which the clergy were, lest publications should get abroad prejudicial to religion, and consequently to their power, contributed not a little to hasten the establishment of book-censors. The earliest instance of a book printed with a permission from government, is commonly supposed to occur in the year 1480; and Dom Liron, a Benedictine monk, is, perhaps, the first person who made that remark. He is the author of a work called *Singularités historiques et*

* Sed non ideo libertas succubuit, quia humilitas semetipsam libere prostravit. *Baillet, Jugemens des Sçavans.* Paris 1722, 4to. vol. i. p. 26.

† In the year 1480 Hermolaus Barbarus wrote to George Merula as follows: Plato, in Institutione de legibus, inter prima commemorat, in omni republica præscribi curarive oportere, ne cui liceat, quæ composuerit, aut privatim ostendere, aut in usum publicum edere, antequam ea constituti super id judices viderint, nec damnarint. Utinam hodieque haberetur hæc lex; neque enim tam multi scriberent, neque tam pauci bonas litteras discerent. Nam et copia malorum librorum offundimur, et omissis eminentissimis auctoribus, plebeios et minutulos consectamur. Et quod calamitosissimum est, periti juxta imperitique de studiis impune ac promiscue judicant.—This letter may be found in *Angeli Politiani Opera.* Lugduni 1533, 8vo. p. 441.

*litteraires ;** in the last part of which, where he speaks of the Heidelberg edition of the book *Nosce te ipsum*, in 1480, he says, "This is the first pub-" lication I found accompanied with several solemn " approbations and attestations in its favour." The same thing is said by J. N. Weislinger, one of the most illiberal defenders of the Catholic church, in whose work, entitled *Armamentarium Catholicum,*† there is an account of that book. He there tells us in Latin, without mentioning Liron : *Hic primus liber est, quem ego vidi, theologorum examini subjectum, lectum et approbatum ;* and, in the opinion of Mercier, it really is the oldest. It has four approbations ; the first and last of which I shall here insert, as they will serve to show the foolish pride of the clergy at that period :— " Ego Philippus Rota, juris utriusque doctor, *licet omnium minimus,* hoc ipsum opusculum *Nosce te* instructius perlegi ac diligentius perscrutatus sum. Et quoniam ipsum non modo sancte catholiceque compositum reperi, verum etiam mira utilitate refertissimum, in hujusce rei testimonium me subscribere non dubitavi. ----- Nos Mapheus Girardo, *miseratione divina* patriarcha Venetiarum, Dalmatiaeque primas, ex inspectione suprascriptorum do-

* Singularités historiques et litteraires. Paris 1738—1740, 4to. vol. viii.

† Armamentarium catholicum bibliothecæ quæ asservatur Argentorati in commenda St. Johannis Hierosolymitani. Argentinæ 1749, fol.

minorum, qui fidem faciunt de suprascripto opere, et ex tali sua conclusione et fide conjuncti, idem testificamur esse opus orthodoxum et devòtum."* There were, therefore, censors at this early period who gave their opinion of books without reading them.

I should have considered these instances as the oldest information respecting book-censors, had I not been induced by Mr. Eccard, the learned amanuensis belonging to our library, to look into the *Literary Weekly Journal of Cologne*, for the year 1778. In that work I found an ingenious account, by an anonymous author, of the early state of printing in that city, and of two books printed almost a year sooner than 1479, with the approbation of the public censor. The first is *Wilhelmi episcopi Lugdunensis Summa de virtutibus;* at the end of which are the following words:— " Benedictus sit dominus virtutum, qui hoc opus earundem felici consummatione terminari dedit in laudabili civitate Coloniensi, temptatum, *admissumque et approbatum ab alma universitate studii*

* I Philip Rota, doctor of laws, *though the least of all,* have read over carefully, and diligently examined, this small work, *Nosce te*; and as I have found it not only composed devoutly and catholically, but abounding also with matter of wonderful utility, I do not hesitate, in testimony of the above, to subscribe my name---- I Mapheus Girardo, by the divine mercy patriarch of Venice and primate of Dalmatia, confiding in the fidelity of the above gentlemen, who have examined and approved the above-mentioned book, do testify that it is a devout and orthodox work.

civitatis praedictae, *de consensu et voluntate* spectabilis et egregii viri pro tempore rectoris ejusdem, impressum per Henr. Quental." The other book is a Bible, with the following conclusion:— "Anno incarnationis dominice millesimo quadringentesimo LXXIX ipsa vigilia Matthaei apostoli. Quando insigne veteris novique testamenti opus cum canonibus evangelistarum et eorum concordantiis in laudem et gloriam sancte et individue trinitatis intemerateque virginis Marie impressum in Civitate Coloniensi per Conradum de Homborch, *admissum, approbatum* ab alma universitate Coloniensi."

The oldest mandate for appointing a book-censor is, as far as I know at present, that issued by Berthold, archbishop of Mentz, in the year 1486, and which may be found in the fourth volume of Guden's *Codex diplomaticus.** As this curious work is not common, some readers, perhaps, will not be displeased to see this order at full length, with the instructions given to the censors.

* Codex diplomaticus. Francof. et Lips. 1758, 4to. vol. iv. p. 460. An account of the establishment of a book-censor at Mentz may be found also in *Georg. Christ. Johannis Rerum Moguntiacarum*, vol. i. fol. p. 798.

Mandatum poen. de codicibus Græcis, Latinis &c. in linguam vulgarem sine praevia doctorum approbatione non vertendis &c. 1486.

Bertoldus d. g. sancte Moguntine Sedis Archiepiscopus s. r. i. per Germaniam Archicancellarius, princeps Elector. Etsi ad mortalem eruditionem comparandam, divina quadam imprimendi arte ad singularum scientiarum codices abunde facilique perveniri possit, compertum tamen habemus, quosdam homines, inanis glorie aut pecunie cupiditate ductos, hac arte abuti, et quod ad vite hominum institutionem datum est, ad perniciem et calumpniam deduci.

Vidimus enim libros de divinis officiis et apicibus Religionis nostre e latina in germanicam linguam traductos, non sine religionis dedecore versari per manus vulgi; Quid denique de sacrorum Canonum legumque preceptis? Que, etsi a iure consultis, viris utrique prudentissimis atque eloquentissimis, aptissime limatissimeque scripta sint, tantam tamen Scientia ipsa habet nodositatem, ut etiam eloquentissimi sapientissimique hominis extrema vix sufficiat etas.

Huius artis volumina stulti quidam, temerarii atque indocti, in vulgarem linguam traducere audent, quorum traductione, multi etiam docti Viri videntes confessi sunt, se propter maximam

verborum impropriationem et abusum minus intellexisse. Quid denique dicendum de reliquarum scientiarum operibus, quibus etiam nonunquam falsa commiscent, aut falsis Titulis inscribunt, tribuuntque Authoribus egregiis eorum figmenta, quo magis emptores inveniant?

Dicant translatores tales, si verum colunt, bono etiam sive malo id faciant animo, anne lingua Germanica capax sit eorum, que tum Greci, tum Latini egregii Scriptores de summis speculationibus Religionis Xpiane et rerum scientia accuratissime argutissimeque scripserunt? Fateri oportet, ydiomatis nostri inopiam minime sufficere, necesseque fore, eos ex suis cervicibus nomina rebus fingere incognita; aut, si veteribus quibusdam utantur, veritatis sensum corrumpere, quod propter magnitudinem periculi in litteris sacris magis veremur. Quis enim dabit rudibus atque indoctis hominibus, et femineo sexui, in quorum manibus Codices sacrarum litterarum inciderint, veros excerpere intellectus? Videatur sacri Ewangelii, aut Epistolarum Pauli textus, nemo sane prudens negabit, multa suppletione et subauditione aliarum scripturarum opus esse.

Occurrerunt hec, quia vulgatissima sunt. Quid putabimus de his, que inter scriptores in ecclesia Catholica sub accerrima pendent dispositione? Multa afferre possemus, de quibus tamen ad propositum paucula ostendisse sufficiat.

Verum, cum initium huius artis in hac aurea

nostra Moguntia, ut vera ejus appellatione utamur, divinitus emerserit, hodieque in ea politissima atque emendatissima perseveret; Iustissime eius artis decus a nobis defensabitur; Nostra enim intersit, divinarum litterarum puritatem immaculatam servari; Vnde prefatis erroribus, et hominum impudentium aut sceleratorum ausibus, prout possumus, auctore Domino cuius res agitur, occurrere, frenoque cohibere volentes, omnibus et singulis ecclesiasticis et secularibus personis nostre ditioni subjectis, aut infra eius terminos negotiantibus, cuiuscunque gradus, ordinis, professionis, dignitatis aut conditionis existant, tenore presentium districte precipiendo mandamus, ne aliqua opera, cuiuscunque scientie, artis vel notitie, e Greco, Latino, vel alio sermone, in vulgare Germanicum traducant, aut traducta, quovis commutationis genere vel titulos distrahant, vel comparent, publice vel occulte, directe vel indirecte, nisi ante impressionem, et impressa ante distractionem, per clarissimos honorabilesque, nobis dilectos, Doctores et Magistros universitatis studii in civitate nostra Moguntina Iohannem Bertram de Nuenburg in Theologia, Alexandrum Diethrich in iure, Theodericum de Meschede in medicina, et Alexandrum Eler in artibus, Magistros et Doctores Vniversitatis studii in opido nostro Erfordie ad hoc deputatos, patenti testimonio, ad imprimendum vel distrahendum admissa vel, si in opido Franckfordie—libri venales ex-

positi, per honorabilem, devotum nobis dilectum loci plebanum in Theologia magistrum, ac unum vel duos Doctores et Licentiatos, per Consulatum dicti Opidi, annali stipendio conductos, visi et approbati fuerint.

Si quis vero huius nostre provisionis contemptor fuerit, aut contra huiusmodi mandatum nostrum consilium auxilium vel favorem quovis modo, directe vel indirecte, prestiterit, Sententiam excommunicationis ipso facto, et preterea amissionem librorum expositorum, ac etiam Centum florenorum auri penam, Camere nostre applicandam, se noverit incurrisse; a qua sententia nemini, citra auctoritatem specificam, liceat absolvere.

Datum apud Arcem S. Martini in civitate nostra Moguntina, nostro sub Sigillo.

Die quarta mensis Ianuarii Anno MCCCCLXXXVI.

EIUSDEM CUM PRIORI MANDATO ARGUMENTI QUOAD EXACTAM LIBRORUM CENSURAM. 1486.

BERTOLDUS (&c.) Honorabilibus, Doctissimis nobis in Xpo dilectis, Io. Bertram in Theologia, AL. Dietherich in Iure, TH. de Meschede in Medicina, Doctoribus, et AND. Eler in Artibus Magistro—Salutem, et ad infra scripta diligentiam.

Experti scandala et fraudes, per quosdam Litterarum translatores ac impressores librorum commissas hisque obviare, et viam ut possumus occlu-

dere cupientes; mandamus ne quis sub diocesi et ditione nostra quos libros in germanicam linguam transferat, imprimat, vel impressos distrahat, nisi prius in Civitate nostra Moguntina talia Opera sive libri per vos visi, et quantum ad materiam ipsam, ad transferendum et distrahendum probati fuerint, iuxta formam mandati desuper publicati.

Vobis igitur, de quorum prudentia et circumspectione plurimum confidimus, tenore presentium committimus, ut si quando transferenda, imprimenda vel distrahenda Opera sive libri ad vos delati fuerint, eorum materiam ponderetis, et si forte ad rectum sensum non facile traduci poterunt, aut errores et scandala magis pariunt, aut pudicitiam ledunt, eos reiiciatis; quos vero admittendos statueritis, manibus vestris propriis, saltem duo ex vobis in fine signetis, quo magis appareat, qui libri per vos visi et probati fuerint. Deo nostro ac rei publice munus gratum utileque exhibituri.

Data apud Arcem S. Martini—Sub secreto nostro. X Ianuarii Anno MCCCCLXXXVI.

In the year 1501, pope Alexander VI published a bull, the first part of which may form an excellent companion to the above mandate of the archbishop of Mentz.* After some complaints against the devil, who sows tares among the wheat, his

* The whole bull may be seen in *Annales ecclesiastici ab anno quo desinit Baronius usque ad an.* 1534, *auctore Odorico Raynaldo,* tom. xix. Coloniæ Agrip. 1691, fol. p. 514. ad an. 1501. § 36.

holiness proceeds thus: "Having been informed, that by means of the said art many books and treatises containing various errors and pernicious doctrines, even hostile to the holy Christian religion, have been printed, and are still printed in various parts of the world, particularly in the provinces of Cologne, Mentz, Triers, and Magdeburg; and being desirous, without further delay, to put a stop to this detestable evil - - - - - - we, by these presents, and by authority of the Apostolic chamber, strictly forbid all printers, their servants, and those exercising the art of printing under them, in any manner whatsoever, in the abovesaid provinces, under pain of excommunication, and a pecuniary fine, to be imposed and exacted by our venerable brethren the archbishops of Cologne, Mentz, Triers, and Magdeburg, and their vicars general or official in spirituals, according to the pleasure of each in his own province, to print hereafter any books, treatises, or writings, until they have consulted on this subject the archbishops, vicars, or officials above mentioned, and obtained their special and express licence, to be granted free of all expense, whose consciences we charge, that before they grant any licence of this kind, they will carefully examine, or cause to be examined, by able and catholic persons, the works to be printed; and that they will take the utmost care that nothing may be printed wicked and scandalous, or contrary to the orthodox faith." - - - The

rest of the bull contains regulations to prevent works already printed from doing mischief. All catalogues and books printed before that period were to be examined, and those which contained any thing prejudicial to the Catholic religion were to be burned.

In the beginning of the sixteenth century, it was ordered by the well-known council of the Lateran, held at Rome in the year 1515, that in future no books should be printed but such as had been inspected by ecclesiastical censors. The following are the words of the decree: Sacro approbante concilio statuimus et ordinamus, quod de caetero nullus librum aliquem, sive aliam quamcunque scripturam tam in urbe nostra quam in aliis civitatibus et diocesibus imprimere seu imprimi facere praesumat, nisi prius in urbe per vicarium nostrum et sacri palatii magistrum, in aliis vero diocesibus per episcopum vel alium ab episcopo ad id deputandum et inquisitorem haereticae pravitatis illius dioecesis in quibus librorum impressio eiusmodi fieret, diligenter examinetur, et per horum manu propria subscriptionem *gratis et sine dilatione* imponendam approbetur. Qui autem secus praesumpserit, ultra librorum amissionem, et illorum publicam combustionem, excommunicationis sententia innodatus existat.*

In France, the faculty of Theology usurped, as

* Summa conciliorum, a Bartholemeo Caranza collecta, et Francisci Sylvii additionibus aucta. Duaci 1659, 8vo. p. 670.

some say, the right of censuring books; but in the year 1650, when public censors, whom the faculty opposed, were appointed without their consent, they stated the antiquity of their right to be two hundred years. For they said, "It is above two "hundred years since the doctors of Paris have "had a right to approve books without being "subjected but to their own faculty, to which "they assert they are alone responsible for their "decisions."*

EXCLUSIVE PRIVILEGE FOR PRINTING BOOKS.

I DO not mean in this article to give a complete catalogue of all the books printed under a privilege in the fifteenth and sixteenth centuries, for such a list would be attended with very little utility. All I wish is to contribute something towards answering the question, What are the oldest privileges granted to books?

The oldest known at present, is that granted in the year 1490, by Henry bishop of Bamberg, to the following book: *Liber missalis secundum ordinem ecclesiæ Bambergensis*—Anno incarnationis dominice MCCCCXC. nono vero kal. April.—In civitate Babenbergn. per magistrum Johannem

* Baillet, Jugemens des sçavans, i. p. 19.

Sensenschmidt, prefate civitatis incolam, et Heinr. Petzensteiner. This privilege was first noticed by Mr. Panzer, in his History of the Nuremberg editions of the Bible,* and afterwards by Mr. Am Ende, in Meusel's Collection for enlarging historical knowledge.† The latter says: "One may readily believe that this bishop was not the inventor of such privileges, and that they are consequently of much greater antiquity than has hitherto been supposed." Mr. Am Ende mentions also a privilege of the year 1491, to a work called *Hortus sanitatis*, typis Iacobi Meydenbach. - - - - - Impressum autem est hoc ipsum in incl. civ. Moguntina - - - sub Archipraesulatu rever. et benigniss. principis et D. D. Bertholdi, archiep. Moguntinensis ac princ. elector. cujus felicissimo auspicio graditur, recipitur et auctorisatur. This, says Mr. Am Ende, may allude to a privilege, and perhaps not. For my part, I conjecture that it refers only to a permission to print, granted in consequence of the institution of book-censors by the archbishop Berthold, in the year 1486.

The oldest Venetian privilege at present known, is of the year 1491, found by Mr. Putter to the following work: *Foenix Magistri Petri memoriae Ravennatis.* At the end stands, Bernardinus de

* Geschichte der Nürnbergischen ausgaben der Bibel. Nürnberg 1778, 4to. p. 31.

† Meusel, Beytragen zur erweiterung der geschichtkunde, part ii. p. 105.

Choris de Cremona impressor delectus impressit. Venetias die X Ianuarii MCCCCXCI. The book is in quarto, and has the privilege on both the last pages. There is a Venetian privilege also of the year 1492, to *Tragedie Senece cum commento* - - - - Cum privilegio ne quis audeat hoc opus cum hoc commento imprimere, sub pena in eo contenta, Venetiis per Lazarum Issarda de Saliviano 1492, die XII Decembris.

The oldest Papal privilege hitherto known, is of the year 1505, to *Hervei Britonis in* IV *Petri Lombardi sententiarum volumina scripta subtilissima.*

The following list of a few of the oldest privileges is collected from Putter* and Hoffmann.†

1494. A Venetian, to *Vincentii Bellovacensis Speculum historiale.*

1495. A Milanese, by duke Louis Sforza, to Michael Ferner and Eustachius Silber for *I. A. Campani Opera.*

1497. A Venetian, for an edition of Terence.

1501. *Privilegium sodalitatis Celticæ a senatu Romani imperii impetratum,* to Conrade Celtes' edition of the works of Hroswitha.

* Der büchernachdruck nach ächten grundsätzen des rechts geprüft, *ut supra.*

† Von denen ältesten kayserlichen und landesherrlichen bücherdruck-oder verlag-privilegien, 1777, 8vo.

1506. A papal, of pope Julius II, to Evangelista Tosino the bookseller, for *Ptolomaei Geographia.*

1507. A French, of Louis XII to Antoine Verard.

1507. A Venetian, for *Epytoma sapientie.*

1510. The first Imperial, to *Lectura aurea semper Domini abbatis antiqui.**

1512. An Imperial, to Jacob Spiegel's Exposition of *Aurelii Prudentii Clementis Hymni.*

1512. An Imperial, to Rosslin's *Swangere frauwen rosegarten.*

1514. An Imperial, to *Kaysersbergers Predigten.*

1515 An Imperial, to *Riccardi Bartholini Lib. de bello Norico.*

1515. An Imperial, to *Germania Enee Sylvii.*

1517. A book on medicine: *impressum in emporio Antverpiano--cum gratia et privilegio.*

1519. An Imperial, to *Pontani de immanitate liber.*

1527. A privilege from the duke of Saxony to the edition of the New Testament by Emser.

In the year 1495, Aldus published the works of

* Among the oldest Imperial privileges may be reckoned that to the edition of Ptolemy of 1513. *Argentinae cum gratia et privilegio imperiali per decem annos.*

Aristotle, at the end of the first part of which we find the following notice: Concessum est eidem Aldo inventori ab illustrissimo senatu Veneto, ne quis queat imprimere neque hunc librum, neque caeteros quos is ipse impresserit; neque ejus uti invento. The last words allude to the Greek types which were employed in printing the Aldine editions of the Greek classics.*

In 1498 were printed at Venice, in quarto, *Ephemerides, sive Almanach perpetuus.* At the end stands: Expliciunt Ephemerides solis, lunae, planetarumque perpetui, impensis, opera et arte impressionis mirifica Petri Liechtenstein coloniensis explete, anno siderum conditoris 1498. Venetiis. Cum gratia et privilegio.

Mr. Hoffmann speaks in a very doubtful manner respecting a privilege of the year 1517, granted to John Scheffer for his edition of Livy, and says that he had sought for it in vain. For this reason, and because that edition, which I have now before me from the library of our university, is exceedingly scarce, and because the privilege itself contains some things worthy of notice, I shall here give it at full length. The edition however is of 1518.

MAXIMILIANUS divina favente clementia Romanorum Imperator semper Augustus, ac Germaniae, Hungariae, Dalmatiae, Croatiae, &c. Rex,

* See Hambergers Zuverlässigen nachrichten von den schriftstellern, i. p. 123, 267.

Archidux Austriae, Dux Burgundiae, Brabantiae &c. Comes Palatinus, &c. Honesto nostro, et sacri imperii fideli nobis dilecto Ioanni Scheffer Chalcographo Moguntino gratiam nostram Caesaream et omne bonum. Cum, sicut docti et moniti sumus fide dignorum testimonio, ingeniosum chalcographiae, authore auo tuo, inuentum felicibus incrementis in universum orbem permanaverit, et fere omnes chalcographi, non modo per imperii nostri ditionem sed alia etiam regna, gratia seu privilegio de non imprimendis libris ex officina eorum emanatis secundum vim obtenti cuiuslibet privilegii gaudeant, ne eorum irritus labor fiat, et sibi iacturam officio suo pariant, sicut tibi in publicatione Liviana contigisse accepimus. Proinde volentes tibi, tum ob avum tuum, omni vel ob hoc divinum inventum favore et commendatione dignum, tum pro damni tui recuperatione, quod accepisti ex praecipiti secundaria operum a te publicatorum editione, opportuno remedio succurrere, et in posterum prospicere, omnibus et singulis, cuiuscunque conditionis existant, Chalcographis et librorum impressoribus, ubilibet locorum in sacro Romano imperio, et etiam in terris nostris haereditariis, constitutis sub poena infra scripta serio inhibemus, ne Titum Livium per decennium, quem sub incude in praesentiarum habes, et Latinum et Germanicum, ac etiam auctiorem quam hactenus nunquam publicatus, edere proxime intendis, ac alia pleraque opera quacunque

in lingua, quae tu primum apud Germanos, licet apud exteros impressa fuerint, publicabis, per sexennium a dato editionis cuiuslibet talium librorum et operum imprimere, seu alibi imprimi facere, aut post diem eorundem editionis impressos adducere, quovismodo, aut quaesito colore studeant vel praesumant, aut ab aliis ista fiant authores sint, sub poena amissionis librorum sic editorum, aut vaenum expositorum, quos etiam praefatus Ioannes, aut cui ab eo agendum hoc commissum fuerit, de facto ubicunque eos compererit, accipere et in commodum suum convertere poteris et poterit, impedimento, contradictione, et impugnatione cessante quorumcunque, cuiuscunque dignitatis, praeeminentiae, status et officii fuerint. Et amplius sub poena decem marcharum auri puri, quas toties quôties contrafactum fuerit, irremissibiliter exigendas a contrafacientibus, et pro medietate fisco nostro Caesareo pro reliqua vero iniuriam passi usibus decernimus esse applicandas. Harum testimonio literarum sigilli nostri munimine roboratarum. Datum in oppido nostro Vuels die nona mensis Decembris. An. M.D.XVIII. Regnorum nostrorum, Romani XXXIII. Hungariae vero XXIX.

Ad mandatum Caesareae
majestatis proprium.

Io. Spiegel.

Anderson remarks on the year 1590, that the first exclusive patent, for printing a book in Eng-

land, which occurs in Rymer's Fœdera,* was granted in the above year by queen Elizabeth, to Richard Weight of Oxford, for a Translation of Tacitus. I am much astonished that Anderson, who was so often obliged to use Rymer's Fœdera, and who seems indeed to have consulted it with attention, should have overlooked the oldest patents which are to be found in that collection. In that laborious work, so important to those who wish to be acquainted with the history of British literature, Ames' Typographical Antiquities, there are privileges of still greater antiquity. The oldest which I observed in this work, though I may perhaps have overlooked some, are the following:

1510. The history of king Boccus - - - - printed at London by Thomas Godfry. Cum privilegio regali.

1518. Oratio Richardi Pacei - - - Impressa per Richardum Pynson, regium impressorem, cum privilegio a rege indulto, ne quis hanc orationem intra biennium in regno Angliæ imprimat aut alibi impressam et importatam in eodem regno Angliæ vendat.

Other works printed *cum gratia et privilegio* occur in 1520, 1521, 1525, 1528, 1530, &c.

In the year 1483, when the well-known act was made against foreign merchants, foreigners how-

* Vol. xvi. p. 96.

ever were permitted to import books and manuscripts, and also to print them in the kingdom; but this liberty was afterwards revoked by Henry VIII, in the year 1533, by an order which may be found in Ames.* In 1538, Henry issued an order respecting the printing of bibles; and in 1542, he gave a bookseller an exclusive privilege during four years for that purpose.

With a view of finding the oldest Spanish privilege I consulted a variety of works, and among others *Specimen bibliothecae Hispano-Majansianae*,† but I met with none older than that to the following book: *Aelii Antonii Nebrissen Introductiones in Latinam Grammaticen.* Logronii Cantabrorum Vasconum urbe nobilissima; anno salutis millesimo quingentesimo decimo. fol. That privileges to books were usual in Poland has been shown by Mr. Am Ende, in Meusel's Collections before mentioned; and Origny, in his *Dictionnaire des Origines*, says, that the first privilege to a book in France was granted by Louis XII, in 1507; but Origny is an author in whose testimony one cannot place much confidence.

* Page 494.

† Specimen bibliothecae Hispano-Majansianae; ex museo Davidis Clementis. Hanoverae 1753, 4to.

CATALOGUES OF BOOKS.

The first printers printed books at their own expense, and sold them themselves. It was necessary therefore, that they should have large capitals. Paper and all other materials, as well as labour, were in the infancy of the art exceedingly dear for those periods; and, on the other hand, the purchasers of books were few, partly because the price of them was too high, and partly because, knowledge being less widely diffused, they were not so generally read as at present. For these reasons many of the principal printers, notwithstanding their learning and ingenuity, became poor.* In this manner my countrymen Conrade Sweinheim and Arnold Pannarz, who were the first, and for a long time the only, printers at Rome, a city which on many accounts, particularly in the sixteenth century, might be called the first in Christendom, were obliged, after the number of the volumes in their warehouses amounted to 12,475, to solicit support from the Pope.† In the course of time this profession was divided, and

* Several of them were editors, printers, and proprietors of the books which they sold.

† Their lamentable petition of the year 1472 has been inserted by Fabricius in his *Bibliotheca latina*. Hamburgi 1772, 8vo. iii. p. 898. See also *Putter von Büchernachdruck*, p. 29,

there arose booksellers. It appears that the printers themselves first gave up the bookselling part of the business, and retained only that of printing; at least this is said to have been the case with that well-known bookseller John Rainmann, who was born at Oehringen, and resided at Augsburg.* He was at first a printer and letter-founder; and from him Aldus purchased his types. Books of his printing may be found from the year 1508 to 1524; and in many he is styled the celebrated German bookseller. About the same period lived the booksellers Jos. Burglin and George Diemar. Sometimes there were rich people of all conditions, particularly eminent merchants, who caused books which they sold, to be printed at their own expense. In this manner that learned man Henry Etienne was printer at Paris to Ulric Fugger at Augsburg, from whom he received a salary for printing the many manuscripts which he purchased. In some editions, from the year 1558 to 1567, he subscribes himself *Henricus Stephanus, illustris viri Hulderici Fuggeri typographus.*† In the like manner also, in the beginning of the 17th century, a society of learned and rich citizens of Augsburg, at the head of whom was Marx Welser, the city-steward, printed

* Mr. Von Stetten, Kunst-geschichte der reichs-stadt Augsburg, p. 43.

† Von Stetten, p. 68.

a great number of books, which had commonly at the end these words, *Ad insigne pinus.** Printing therefore thus gave rise to a new and important branch of trade, that of bookselling, which was established in Germany, chiefly at Franckfort on the Mayn, where, at the time of the fairs particularly, there were several large booksellers-shops in that street which still retains the name of *book-street.*

George Willer, whom some improperly call Viller, and others Walter, a bookseller at Augsburg, who kept a very large shop, and frequented the Franckfort fairs, first fell upon the plan of causing to be printed every fair a catalogue of all the new books, in which the size, and printers' names were marked. Le Mire, better known under the name of Miræus,† says, that catalogues were first printed in the year 1554; but Labbe,‡ Reimmann§ and Heumann,‖ who took their information from Le Mire, make the year perhaps erroneously to be 1564. Willer's catalogues were

* Von Stetten, p. 40.

† Le Mire, a Catholic clergyman, who was born in 1598, and died in 1640, wrote a work *De scriptoribus ecclesiasticis sæculi* xvi. which is printed in *Fabricii Bibliotheca ecclesiastica* Hamburgi 1718, fol. The passage to which I allude may be found p. 232; but perhaps 1564 has been given in Fabricius instead of 1554 by an error of the press.

‡ Labbe, Bibliotheca bibliothecarum. Lipsiæ 1682, 12mo. p. 112,

§ Einleitung in die *Historiam literariam*, i. p. 203.

‖ Conspectus reip. litter. c. vi. § 2. p. 316.

printed till the year 1592 by Nicol. Bassæus, printer at Franckfort. Other booksellers however must have soon published catalogues of the like kind, though that of Willer continued a long time to be the principal.

Among the many curious and rare articles in the library of professor Baldinger, there is a collection of old catalogues, the earliest of which are the following: *Catalogus novus nundinarum autumnalium* Francofurti ad Moenum anno 1586 celebratarum. Plerique apud Joan. Georg. Portenbachium et Th. Lutz bibliopolam Augustanum venales habentur: *A catalogue of all the new books*—printed at Franckfort by Peter Schmid.* This catalogue was published by booksellers of Augsburg; but not by Willer, of whom we have: *Catalogus novus nundinarum autumnalium* Francofurti ad Moenum anno 1587——Plerique in aedibus Georgii Willeri, bibliopolae Augustani, venales habentur. *A catalogue of almost all the books which have been published between last Easter and the present September fair.* Franckfort on the Mayn printed by Nicolas Bassæus. †

In all these catalogues, which are in quarto, and

* Verzeichnuss aller neuwer bucher—Gedruckt in Franckfort durch Peter Schmid.

† Verzeichnuss fast aller neuwer bucher welche seyther der nechstverschienen fastenmess, biss auff diese gegenwertige herbstmess, in offentlichem truck seyn aussgangen. Gedruckt zu Frankfurt a M. durch Nicolaum Bassæum.

not paged, the following order is observed. The Latin books occupy the first place, beginning with the Protestant theological works, perhaps because Willer was a Lutheran; then come the Catholic; and after these, books of jurisprudence, medicine, philosophy, poetry, and music. The second place is assigned to German books, which are arranged in the same manner.

The last Easter catalogue of Willer which I find in Professor Baldinger's library, is of the year 1597. On the title is: *Plerique libri in ædibus Eliæ et Georgii Willeri fratrum bibliopolarum Augustanorum habentur.* It is printed also by Bassæus at Franckfort. George and Elias Willer were perhaps sons of the former.

In the year 1604, the general Easter catalogue was printed with a permission from government, as appears by the following title: *Catalogus universalis pro nundinis Francof. de anno* 1604—A catalogue of all the new books, or books improved and republished, which will be exposed for sale in Book-street, Franckfort, during the Easter fair 1604. Francofurti permissu superiorum excudebat Joh. Saur. To be had at the shop of Peter Kopff. The order of the books is the same as before.

After this the Leipsic booksellers began not only to reprint the Franckfort catalogues, but to enlarge them with many books which had not been brought to the fairs in that city. I have,

from professor Baldinger's library, *Catalogus universalis pro nundinis Francofurtensibus vernalibus de anno* 1600---or, A catalogue of all the books on sale in Book-street, Franckfort, and also of the books published at Leipsic, which have not been brought to Franckfort, with the permission of his highness, the elector of Saxony, to those new works which have appeared at Leipsic. Printed at Leipsic, by Abraham Lamberg; and to be had at his shop. On the September catalogue, of the same year, it is said that it is printed from the Franckfort copy, with additions. I find an Imperial privilege, for the first time, on the Franckfort September catalogue of 1616: *cum gratia et privilegio speciali s. caes. maj. Prostat apud. J. Krugerum Augustanum.* Some Imperial permissions, however, may be of an earlier date; for I have not seen a complete series of these catalogues.

Reimmann* says that, after Willer's death, the catalogue was published by the Leipsic bookseller Henning Grosse, and by his son and grandson. The council of Franckfort caused several regulations to be issued respecting catalogues; an account of which may be seen in *D. Orth's Treatise on the Imperial Fairs at Franckfort.*† After the business of bookselling was drawn from Franckfort

* Part iii. chap. 3. p. 766.

† Abhandlung von den reichs messen in Franckfurt. Frankf. 1765, 4to. p. 500.

to Leipsic, occasioned principally by the restrictions to which it was subjected at the former by the censors, no more catalogues were printed there; and the shops in Book-street were gradually converted into taverns. *

In perusing these old catalogues one cannot help being astonished at the sudden and great increase of books; and when one reflects that a great, perhaps the greater, part of them no longer exist, this perishableness of human labours will excite the same sensations as those which arise in the mind when one reads in a church-yard the names and titles of persons long since mouldered into dust. In the sixteenth century there were few libraries; and these, which did not contain many books, were in monasteries, and consisted principally of theological, philosophical, and historical works, with a few, however, on jurisprudence and medicine; while those which treated of agriculture, manufactures, and trade, were thought unworthy of the notice of the learned, and of being preserved in large collections. The number of these works was, nevertheless, far from being inconsiderable; and, at any rate, many of them would have been of great use, as they would have served to illustrate the instructive history of the arts. Catalogues which might have given occasion to inquiries after books, that may be

* Joh. Adolph. Stock, Frankfurter Chronik, p. 77.

still somewhere preserved, have suffered the fate of tomb-stones, which, being wasted and crumbled to pieces by the destroying hand of time, become no longer legible. A complete series of them, perhaps, is no where to be found; at least, I do not remember to have ever seen one in any library.

This loss might, in some measure, be supplied by two works, were they not now exceedingly scarce. I mean those of Cless and Draudius; who, by the desire of some booksellers, collected together, as Georg at a later period, all the catalogues published at the different fairs in different years. The work of Cless has the following title: *Unius sæculi ejusque virorum litteratorum monumentis tum florentissimi, tum fertilissimi, ab anno* 1500 *ad* 1602 *nundinarum autumnalium inclusive, elenchus consummatissimus—desumtus partim ex singularum nundinarum catalogis, partim ex bibliothecis.* Auctore Joanne Clessio, Wineccensi, Hannoio, philosopho ac medico.* By the editor's preface it appears that the first edition was published in 1592. The order is almost the same as that observed by Willer in his catalogues.

The work of Draudius, which was printed, in several quarto volumes, for the first time, in 1611,

* Francofurti, ex offic. Joannis Saurii, impensis Petri Kopffii 1602, 4to. The first part contains 563 pages, and the second 292.

and afterwards in 1625, is far larger, more complete, and more methodical. * I have never seen a perfect copy of either edition; but, perhaps, the following information may afford some satisfaction to those who are fond of bibliography. One part, which I consider as the first, has the title of *Bibliotheca classica, sive Catalogus officinalis, in quo singuli singularum facultatum ac professionum libri, qui in quavis fere lingua extant—recensentur; usque ad annum* 1624 *inclusive.* Auctore M. Georgio Draudio. † It contains Latin works on theology, jurisprudence, medicine, history, geography, and politics. The copy in the library of our university ends at page 1304; which has, however a catch-word that seems to indicate a deficiency. The second part is entitled, *Bibliotheca classica, sive Catalogus officinalis, in quo philosophici artiumque adeo humaniorum, poetici etiam et musici libri usque ad annum* 1624 *continentur.*

This part, containing Latin books also, begins at page 1298, and ends with page 1654, which is followed by an index of all the authors mentioned.

* An account of both these works may be found in *Reimmanni Bibliotheca historiæ litterariæ, sive Catalogus bibliothecæ Reimmannianæ.* Hildesiæ 1738, 8vo. ii. p. 97—192. Reimmann says, that Draudius' Bibliotheca was printed three times at Franckfort, viz. in 1611, 1621, and 1644, which, however, is not perfectly correct.

† Francofurti ad M. impensis Balthasaris Ostern. 1625.

A smaller volume, of 302 pages, without an index, has for title, *Bibliotheca exotica, sive Catalogus officinalis librorum peregrinis linguis usualibus scriptorum;* and a fourth part, forming 759 pages besides an index of the authors, is called, *Bibliotheca librorum Germanicorum classica;* that is, A catalogue of all the books printed in the German language till the year 1625. By the indices, and the proper arrangement of the matter, the use of this work is much facilitated. I must, however, observe that the oldest catalogues had the same faults as those of the present time,* and that these have been copied by Draudius. Many books are mentioned which were never printed, and many titles, names, and dates, are given incorrectly; but Draudius, nevertheless, is well worth the attention of any one who may be inclined to employ his time and ingenuity on the history of literature; and his work certainly was of use to Haller when he composed his bibliotheca.

* I shall refer those who may be desirous of seeing a humorous comparison of the catalogues of 1619 with those of 1780, and of the state of literature at that period, with what it is at present, to Frommichen's Essay in the *Teutsche Museum* for September 1780, p. 176.

AURUM FULMINANS.

If gold be dissolved in aqua-regia, and precipitated by volatile lixivious salt, or by fixed lixivious salt, when the aqua-regia has been prepared with sal ammoniac, a yellow powder will be obtained, which, when heated, or only bruised, explodes suddenly with a prodigious report. The force of this aurum fulminans is terrible, and, in the hands of incautious persons, has often occasioned much mischief. But, however powerful, it cannot, as some have imagined, be employed instead of gunpowder, even were not this impossible on account of the high value of the metal from which it is made; for explosion does not take place when the powder is confined. Phænomena of this kind are always of importance, and afford subject of speculation to the philosopher, though no immediate use can be made of them. Experiments, however, have rendered it probable that this powder may possess some medicinal virtues, and we are assured that it can be employed in enamel painting. *

He who attempts to trace out the invention of aurum fulminans is, like a person bewildered in

* An account of the principal writers who have treated of aurum fulminans may be found in *Weigel's Chemie*, i. p. 225. See also *Lewis, Zusammenhang der künste.* Zurich 1764, 8vo. i. p. 172.

a morass, in danger every moment of being lost. I allude here to the immense wilderness of the ancient alchemists, or makers of gold; to wade through which my patience, though pretty much accustomed to such labour, is not sufficiently adequate. Those who know how to appretiate their time will not sacrifice it in endeavouring to discover the meaning of books which the authors themselves did not, in part, understand, or to comprehend passages in which the writer tells us nothing, or, at any rate, nothing of importance. I have, however, made my way through this labyrinth from Spielmann to the works which are ascribed to one Basilius Valentin.*

The period when this powder was invented is as uncertain as the accounts given of its composition. It is, however, probable that the discoverer was a German Benedictine monk, who lived about the year 1413;† and there is reason to think that he may have made many useful observations, of which we are yet as ignorant as of the meaning of the Egyptian hieroglyphics; for both are almost equally unintelligible, though some, who possess more imagination and credulity than judgment, think they understand and can explain them. The Egyptian hieroglyphics are indeed totally

* Spielmann, Institut. chem. p. 288. Hanc calcem Bas. Valent. inter primos clare describit.

† See the preface of Bened. Nic. Petræus to the Works of Valentin, printed at Hamburg 1717, in octavo.

incomprehensible, but those of Valentin only in part; for when new observations have been made respecting gold, they have been found afterwards in the works of Valentin, in a passage which no one before could understand. In this case these writings are of no more utility than the answers of the ancient oracles, which were comprehended when a knowledge of them was no longer necessary, and which misled those who supposed that they comprehended them sooner. But the account of aurum fulminans in Valentin is so uncommonly intelligible, that it almost seems he either wrote in an explicit manner without perceiving it, or that the words escaped from him contrary to his intention. As the work in which it may be found, is scarce, I shall transcribe the prescription.*

"Take a pound of aqua-regia made with sal ammoniac; that is, take a pound of good strong aquafortis, and dissolve in it four ounces of sal ammoniac, and you will thus obtain a strong aqua-regia, which must be repeatedly distilled and rectified until no more feces remain at the bottom, and until it become quite clear and transparent. Take fine thin gold-leaf, in the preparation of which antimony has been used; put it into an alembic; pour aqua-regia over it; and let as much of the gold as possible be dissolved. After the

* Fr. Basilii Valentini, Benedictiner ordens, Letztes testament; von Georg Philips Nenter. Med. Doct. Strasburg 1712, 8vo. p. 223.

gold is all dissolved, add to it some *oleum tartari*, or *sal tartari* dissolved in a litte spring-water, and it will begin to effervesce. When the effervescence has ceased, pour some more oil into it; and do this so often till the dissolved gold fall to the bottom, and until no more precipitate is formed, and the aqua-regia remains pure and clear. You must then pour the aqua-regia from the gold calx, and wash it well with water eight or ten times. When the gold calx is settled, pour off the water, and dry the calx in the open air when the sun shines, but not over the fire; for as soon as this powder becomes a little heated or warm, it explodes, and does much mischief, as it is so powerful and violent, that no man can withstand it. When the powder has been thus prepared take strong distilled vinegar and pour over it; keep it continually over the fire for twenty-four hours, without stirring it, so that nothing may fall to the bottom, and it will be again deprived of its power of exploding; but take great care that no accident happen by carelessness. Pour off the vinegar, and, having washed the powder, expose it to dry."

The latter part of the receipt shows that Valentin had made experiments in order to discover how aurum fulminans might be deprived of its power of exploding, and he found that this could be done by vinegar. It appears from his writings, that he

had discovered also that the same thing could be effected by sulphur.*

After the time of Valentin, Crollius, who lived in the last half of the sixteenth century, seems to have been best acquainted with this powder, and to have principally made it known :† at any rate his works are referred to by most of the modern writers. He calls it *aurum volatile*, and speaks of its being useful in medicine. The name *aurum fulminans* was, as far as I know, first used by Beguin.‡ The method of preparing it is described by Kircher, who considers it as a thing uncommon, and who calls it *pulvis pyrius aureus*.§

* See Bergmann's Treatise on Pulvis fulminans, translated from the Latin, in *Baldingers Magazin für Aerzte* 1777, part vii. p. 600. This treatise may be found also, but revised and enlarged, in *T. Bergmanni Opuscula physica et chemica*, 1780, 8vo. vol. ii. p. 133. On the effect of vinegar Bergmann says, p. 151 : Ad siccum distillando acetum adfusum, fulminandi vis domata reperitur, quod tamen intelligendum est de residuo vel non edulcorato, vel etiam ope caloris reducto.

† Osualdi Crollii Basilica chymica. Francofurti (1609) 4to. p. 211.

‡ J. Beguini Tyrocinium chymicum was printed for the first time at Paris, in 1608, 12mo. In the French translation, *Les élemens de chymie de maistre Jean Beguin ; reveus, expliquez et augmentez par Jean Lucas de Roy* ; troisième edition, Paris 1626, 8vo ; the receipt for making *or fulminant* may be found p. 314.

§ Kircheri Magnes. Coloniæ 1643, 4to. p. 548. The author says, that he found the receipt for preparing it in *Liber insignis de incendio Vesuvii*. That I might know whether this work contained any thing respecting the history of aurum fulminans, I inquired after

CARP.

So obscure is the ichthyology of the ancients, or so little care has been taken to explain it, that the question whether our carp were known to Aristotle, Pliny, and their cotemporaries, cannot with any great degree of probability be determined. Besides, that subject is attended with much greater difficulties than the natural history of quadrupedes. Among four-footed animals there is a greater variety in their bodily conformation, which at any rate strikes the eye more, and can be more easily described than that of fishes, which in general are so like in shape, that an experienced systematic naturalist finds it sometimes difficult to determine the characterising marks of the genera and species. It is not surprising therefore that the simple descriptions of the ancients, or rather the short accounts which they give us of fish, do not afford information sufficient to enable us to distinguish with accuracy the different kinds. Quadrupedes may terrify us by their ferocity, or endeavour to avoid us by shyness and craft; but it is still possible to observe their sexes, their age, and their

it. Kircher undoubtedly meant *Incendio del monte Vesuvio, di Pietro Castelli*; in Roma 1632, 4to: but the directions given there, p. 46, for making *oro fulminante*, are taken from Crollius. Nothing farther is to be found in Kircher's *Mundus subterraneus*. Amstel. 1678, fol. i. p. 229.

habits, and to remark many things that are common to one or only a few species. Fishes, on the other hand, live in an element in which we cannot approach them, and which for the most part conceals them from our observation. The chase, since the earliest periods, and in modern times more than formerly, has been the employment of idle persons, who bestow upon it greater attention the fewer those objects are which can attract their curiosity or employ their minds: but fishing has almost always been the laborious occupation of poor people, who have no time to make observations, as they are obliged to follow it in order to find a subsistence; and mankind in general seldom see fish except on their tables or in collections of natural history. On this account those properties of fish by which their species could be determined, are less known. The descriptions of four-footed animals which have been handed down to us from the time of the Greek and Roman writers give us, at any rate, some information; but from those of fishes, which are more uncommon, we can scarcely derive any; unless one were as acute or easy of belief as many collectors of petrifactions, who imagine that they can distinguish each species of fish in the impression which they see in stones. More however might be done towards elucidating the ichthyology of the ancients than has hitherto been attempted. It would be necessaryonly to make a beginning by collecting the species and

names which can with certainty be determined, together with the authorities, and separating them from the rest; and an abstract should be formed of what is said in the ancients respecting the unknown species, or whatever may in any measure serve to make us acquainted with them; but mere conjectures ought never to be given as proofs, nor ought the opinions of commentators, or the explanations of dictionaries to be adopted without sufficient grounds. If these are to be believed without further examination, the names *cyprini* and *lepidoti* must be considered as those of carp; and the proposed question would be soon answered: but that opinion has scarcely probability in its favour when one searches after proofs.

I shall not here lay before the reader every thing completely that the ancients have said respecting the *cyprini*, and which is in part so corrupted by transcribers, that no certain meaning can be drawn from it. Were I to treat of the ichthyology of the ancients, it might be necessary; but as that is not the case, I shall only quote such parts of it as have been employed by Rondelet and others to prove that they were our carp. Their principal grounds seem to be, that among all the fish of the ancients no others occur which can with any probability be considered as carp. If the *cyprini* therefore were not carp, these must not have been named by the ancients; and that undoubtedly will not readily be admitted. It is well known what a

high value the ancients, particularly the Orientals, set upon fish, of which they had a great variety; and it appears that they preferred them to all dishes prepared from four-footed animals or fowls.* Fish seem to have been the choicest delicacies of voluptuaries, and in that respect they are oftener mentioned by historians than fowls. Physicians also, to whom the most sumptuous tables have in all ages been of the greatest benefit, speak of fish oftener in their writings than of dishes made of the flesh of other animals. In the ancient cookery, the number of dishes prepared from fish is indeed great in comparison of those dressed from fowls. *Turdi* and *attagines* are much praised; but had pheasants, snipes, partridges, and others, been as much esteemed then as they are at present, these would not have been forgotten, or would have occurred oftener. Fish, at present, form the principal food in Greece, as well as at Constantinople, and a great abundance and variety of them may be found there in the markets; but fowl which have been caught or shot are seldom exposed for sale. When the Egyptian and Greek monks wished to distinguish themselves by abstinence and temperance, they denied themselves all kinds of fish, as the richest delicacies, in the same

* οψον properly signified fish, but in the course of time it was used for every dainty, and οψοφαγια and φιλοψια had the same signification as the French words *gourmandise, friandise*. See *Plutarch. Sympos.* iv. 3. p. 667. and *Vossius De idololat.* iv. 23. p. 1371.

manner as pretended devotees among the Europeans deny themselves flesh. But though all this may be true, it does not prove that our carp must occur in the writings of the ancients. The Roman voluptuaries, indeed, left very little untried that was likely to gratify their appetite; but it was impossible for them to make a trial of every thing. There may have been particular reasons also which prevented them from meeting with carp; and who will venture to affirm, that all the knowledge of the ancients must be contained in those few of their writings which have been preserved to us by accidents?

If one, freed from these prejudices, should now ask why the *cyprinus* must be our carp, the answer will be, because what we read of the tongue and scales of the *cyprini* cannot be applied with so much propriety to any species of fish as to the *cyprinus carpio* of Linnæus. Aristotle informs us that the *cyprini* had properly no tongue, but that their soft fleshy palate might very readily be taken for one.* Athenæus affirms that they had a tongue, but that it lay in the upper part of the mouth or palate; and in confirmation of this, he refers to Aristotle.† This assertion of Athenæus

* Histor. Animal. lib. iv. cap. 8. p. 477. I follow the reading of the best edition, or that of Sylburgius: μη σκοπουμενος, which is adopted by Vossius and H. Schneider in *Artedi Synonymia piscium.* Lipsiæ 1789, 4to. p. 8. Camus reads with Scaliger μεν instead of μη,

† Lib. vii. p. 309.

however is very dubious; for these words are not to be found in the works of Aristotle which have been preserved, though the same meaning might be indeed forced, in case of necessity, from the passage first quoted. It is possible that Athenæus, as Casaubon* has already conjectured, may here, as well as in other parts, allude to some book of Aristotle not now extant. Besides, he calls the fish of which he speaks, not *cyprinus*, but *cyprianus*; and a question therefore arises, whether he may not have meant some other kind. This much at any rate appears certain from the passage of Aristotle, that the *cyprinus* had a thick fleshy palate; and that indeed is the case with our carp, so that the head, on account of the delicacy and agreeable taste of the palate, is reckoned the most relishing part. By that circumstance however nothing is proved; as it is not peculiar to carp alone, but common to every species of the same genus, such as the bream, tench, &c. Fish of this kind, says Mr. Bloch, have properly no tongue; that which appears to be one is merely a cartilaginous substance which projects through those band-like parts that enclose it on each side.† This proof would have more weight, did we find

* Animadvers. vii. 17. p. 540.

† Fische Teutschlands, i. p. 26. *Blasii Anatome animalium*, p. 263 and p. 472. fig. 4. Quod lingua vulgo dicitur, proprie non est lingua; nam in superiori palato hæret, ita ut cibus sub ea transeat, sed est glandulosa quædam substantia alba, mollis, humida, et quæ puncta aut alio modo læsa se miro modo commovet.

it related, that in the time of Aristotle, the tongue was considered as an exquisite morsel: but that is not mentioned; and H. Krunitz* is mistaken, when he says that Heliogabalus, to satisfy his luxurious appetite, was induced to try a fricassee of the tongues of carp: it consisted only of the tongues of peacocks and nightingales.† Had the ancients really used carp on their tables, we must have ascribed to them the discovery of these delicious fish.

The other proof which is brought from the scales consists in what is said by Dorion, in Athenæus, ‡ that the *cyprianus* was called also by some *lepidotus*, or scaly. As all fish have scales, the scales of this species must have been extremely large, as they got that name by way of eminence;§ and it must be indeed allowed, that the above epithet would suit our carp exceedingly well, as their scales, as is known, are very large. But this circumstance alone proves nothing, as the *mullus* and *mugil* have still larger scales; and to the first genus belonged one of the fish most esteemed by the ancients.‖ Strabo mentions the

* Œkonomische Encyclopedie, xxxv. p. 138.

† Ælii Lampridii Vita Heliogab. c. 20. p. 484.

‡ Lib. vii. p. 309.

§ Orpheus, in his Poem on Stones, ix. 6. p. 317, ascribes to the *lepidotus* bright silver-coloured scales.

‖ This fish was a first-rate article of luxury among the Romans, and was purchased at a dear rate. Juvenal says: Mullum sex millibus emit, æquantem sane paribus sestertia libris. See *Plin.* lib. ix.

lepidotus among the sacred fish of the Nile; but whether it be the same as that of which Dorion speaks, cannot be determined. It is however certain that the Nile contains carp still; for Norden saw them caught at the waterfall near Essuane, which is the ancient Syene.* Did we know that the modern Greeks at present call carp *cyprini*, this would prove more; for it is an undoubted fact, that the ancient names have for the most part been retained in Greece. We are assured by Massarius,† that the Greeks still use the name *cyprinus;* but Gyllius says, that it is employed only by a few: and this is confirmed by Bellon, who mentions all the names of carp which he heard in Greece, and which are entirely different from the ancient;‡ but he adds, that carp in Ætolia are still called *cyprini*. Both the before-mentioned circumstances respecting the *cy-*

c. 17. The Italians have a proverb: *La triglia non mangia chi la piglia*, which implies, that he who catches a mullet is a fool if he eats it and does not sell it. When this fish is dying, it changes its colours in a very singular manner till it is entirely lifeless. This spectacle was so gratifying to the Romans, that they used to show the fish dying in a glass vessel to their guests before dinner. Oculos antequam gulam pavit. *Seneca.* TRANS.

* Nordens Reise durch Ægypten. Bresl. und Leipz. 1779, 8vo. p. 376.

† Franc. Massarii Veneti in nonum Plinii de Nat. Hist. librum castigationes et annotationes. Basiliæ 1537, 4to.

‡ A great service would be rendered to the natural history of the ancients, if some able systematic naturalist would collect all the Greek names used at present. Tournefort and others made a beginning.

prini agree extremely well with our carp; but as they will suit other kinds equally well, they afford no complete proof, but only a probability which amounts to this, that among the large-scaled fish, carp in particular have a fleshy palate; and it is readily admitted that the ancients were acquainted with all kinds, and chose names for them with more foundation than is done at present.

In opposition to this probability, it may be said, that Oppian * and Pliny † reckon the *cyprini* among the sea-fish, to which kind our carp do not belong. This reply, however, which some have indeed made, is not of great weight. In the first place, both these writers seem to have been in an error; for what Pliny says of the *cyprini* is evidently taken from Aristotle, and the latter does not tell us that these fish live in the sea, but rather the contrary. The Roman author, as Dalechamp remarks, added the words *in mari*, if they were not added by some transcriber. Oppian, as a poet, does not always adhere strictly to truth; and he makes more of the fresh-water fish of Aristotle to be inhabitants of the sea. In the second place, I consider the distinction made between sea-fish, fresh-water fish, and those kept in ponds, to be not always very certain or well founded. Who knows whether the greater part of the last may not have

* Halieut. i. 101 and 592.

† Lib. ix. cap. 16. p. 509.

been originally sea-fish? This is the more probable in regard to carp, as professor Foster says, that carp are sometimes caught in the harbour at Dantzic.*

In order to answer the question here proposed, another point may be considered. As all nations at present give these fish the same name, it is probable that it was brought with them from that country where they were first found, and from which they were procured. Cassiodorus, who lived in the sixth century, is the oldest author as yet known in whom that name has been observed.† In a passage where he speaks of the most delicate and costly fish, which at that time were sent to the tables of princes, he says, Among these is the *carpa*, which is produced in the Danube. In the earliest Latin translation of Aristotle, the word *cyprinus*, as Camus says, is expressed by *carpra*. In the thirteenth century this fish was called by Vincentius de Beauvais‡ *carpera*, and by Cæsarius *carpo*;§ and it is highly pro-

* Philosophical Transact. vol. lxi. 1771, part i. p. 310.

† Privati est, habere quod locus continet; in principali convivio hoc profecto decet exquiri, quo visum debeat admirari. Destinet carpam Danubius. *Variarum* lib. xii. 4to. p. 389. Edition of Geneva, 4to. 1650.

‡ Carpera piscis est quasi squamis aureis, in lacis vel fluviis, sic dicta, quasi quæ carpens pavit, &c. *Speculum naturale*, xvii. 40. p. 1274. According to the edition of the Benedictines, Duaci 1624, fol.

§ Post hæc frater Simon vidit dæmonem loricatum et galeatum, habentem squamas, tanquam piscis qui vocatur carpo. *Dialogi*

bable that both these names allude to our carp. By the above passage of Cassiodorus, the opinion that these fish were the *cyprini* of the ancients obtains a new, but at the same time a very feeble, proof; for the *cyprinus* was found also in the Danube, as we learn from Ælian*, who, among the fish of the Ister, mentions black *cyprini;* and these, according to the conjecture of professor Schneider, were the black fish of the Danube which Pliny considers as unhealthful or poisonous, and like which there were some in Armenia. Our carp indeed are not poisonous, but Pliny alludes to a particular variety, and what he says was only report, to which however something must have given rise, as also to the idea of carp with a death's head, and the head of a pug-dog, as some have been represented by writers of the sixteenth century. The *carpo* of Cæsarius appears to have been our carp, because its scales had a very great resemblance to those of the latter; for we are told in the work already quoted, that the devil, once indulging in a frolic, appeared in a coat of mail, and had scales like the fish *carpo.* The *carpera* of Vincent de Beauvais is still less doubtful, as the same craft in avoiding rakes and nets is ascribed to that fish as is known to be employed

miraculorum, distinct. ii. cap. 29. This book forms the second part of the *Bibliotheca patrum Cisterciensium.* Bono-Fonte 1662, fol.

* De nat. animal. xiv. 23. Plin. xxxi. sect. 19. p. 550. Antigonus Caryst. cap. 181. p. 222.

by our carp. Sometimes they thrust their heads into the mud, and suffer the net to pass over them; and sometimes they join the head and tail together, and separating them suddenly, throw themselves towards the surface of the water, and, springing often four or five feet above the net, make their escape.

But whence did this name arise? The origin assigned by Vincentius, or the anonymous author of the lost books *De natura rerum*, like another mentioned in ridicule by Gesner, is too silly to be repeated. More learned at any rate is the derivation of Menage, who traces it from *cyprinus*, which was afterwards transformed into *cuprinus*, *cuprius*, *cuprus*, *cupra*, *curpa*, and lastly into *carpa*. For my part, I am more inclined to derive it from a dialect which was spoken on the banks of the Danube, and to believe that it was brought with the fish from the southern part of Europe; but I am too little acquainted with that dialect to be able to render my conjecture very probable; and the etymologists I consulted, such as Wachter, Ihre, Johnson, &c. afforded me no assistance. Fulda gave me some hopes, as he allows the word to be of German extraction;* but I must however confess, that his derivation is too far-fetched, and, like the chemistry of the adepts, to me not perfectly intelligible.

* Germanische Würzelwörter, p. 71.

It may perhaps not be superfluous here to observe that one must not confound *carpa* and *carpo*, or our carp, with *carpio*. The latter belongs to the genus of the salmon and trout; and in the Linnæan system is called *salmo carpio*. It is found chiefly in the Lago di Garda, the ancient Lacus Benacus, on the confines of Tyrol.* The oldest account of this fish is to be found in works of the sixteenth century, such as the poems of Pierius Valerianus,† and in *Jovius de Piscibus*.‡ According to Linnæus, it is found in the rivers of England; but that is false. This celebrated naturalist suffered himself to be misled by Artedi, who gives the char or chare, mentioned by Cambden in his description of Lancashire,§ as the *salmo carpio*. Pennant however, by whom it is not mentioned among the English fish, says expressly, that the char is not the carpio of the Lago di Garda, but rather a variety of the *salmo alpinus*.‖

That our carp were first found in the southern parts of Europe, and conveyed thence to other countries, is undoubtedly certain. Even at pre-

* Büschings Geographie, v. p. 585, where these fish are mentioned under the name of *carpioni*.

† The poem here alluded to is printed in Gesner, p. 219.

‡ Jovius de Piscibus, cap. 35. p. 122. *Benacinus carpio*. He calls our carp, chap. 38, p. 131, *carpenæ*.

§ Cambdeni Britannia in epitomen redacta a Ziricæo. Amsterd. 1639, 12mo. p. 347.

‖ British Zoology, vol. iii. p. 259.

sent they do not thrive in the northern regions, and the further north they are carried they become the smaller.* Some accounts of their transportation are still to be found. If it be true that the Latin poem on the expedition of Attila is as old as the fifth or sixth century, and if the fish which Walther gave to the boatmen who ferried him over the Rhine, and which the latter carried to the kitchen of Gunther king of the Franks, were carp, this circumstance is a proof that these fish had not been before known in that part of France which bordered on the Rhine.† The examination of this conjecture I shall however leave to others. D'Aussy quotes a book never printed, of the thirteenth century, entitled, *Proverbes*, and in which is given an account of the best articles produced at that time by the different parts of the kingdom, and assures us that a great many

* Pontoppidan, Natürliche historie von Norwegen, ii. p. 236.

† Illic pro naulo pisces dedit antea captos,
Et mox transpositus graditur properanter anhelus.
— — — — — — —
Portitor exsurgens præfatam venit in urbem,
Regalique coco, reliquorum quippe magistro,
Detulerat pisces, quos vir dedit ille viator.
Hos cum pigmentis condisset et apposuisset
Regi Gunthario, miratus fertur ab alto:
Istiuscemodi nunquam mihi Francia pisces
Ostendit, reor externis a finibus illos.
De prima expeditione Attilæ regis Hunnorum in Gallias, carmen edit. a F. C. J. Fischer. Lipsiæ 1780, 4to. x. 432.
Fischer, Sitten und gebräuche der Europäer im 5 und 6ten jahrhunderte. Frankf. 1784, 8vo. p. 121.

kinds of fish were mentioned in it, but no carp, though at present they are common all over France.*

It appears also that there were no carp in England in the eleventh century; at least they do not occur in the Anglo-Saxon Dictionary of Aelfric, who, in 1051, died archbishop of York.† We are assured likewise, that they were first brought into the kingdom in the fifth year of the reign of Henry VIII, or in 1514, by Leonard Mascal of Plumsted in Sussex.‡ What we read in the Linnæan

* Histoire de la vie privée des Français, p. i. 2. p. 59.

† It may be found at the end of *Gul Somneri Dictionarium Saxonico-Latino-Anglicum.* Oxonii 1659, fol. p. 55.

‡ This information I found in *Anderson's History of Commerce,* and in *Pennant's British Zoology,* vol. iii. p. 300. Both these authors refer to *Fuller's British Worthies.* Fuller composed a large work on the lives of celebrated Englishmen, who had rendered essential service to their country, which, as far as I know, was never printed. We are told in the *Biographia Britannica,* vol. iii. p. 2059, that an abridgement of it was printed in quarto, under the fictitious title of *Abel redivivus.* Another abridgement, however, mentioned by Anderson, under the title of *English Worthies in Church and State,* must have been printed in octavo in 1684. As I have seen none of these works of Fuller, I can give no further account of this worthy Mascal. I nevertheless flatter myself that I can rectify an error which has become very common. *Klein,* in *Historia piscium,* v. p. 58, says: Leonard. Mascal, libro de piscat. primum se cyprinos, *carp.* in Angliam intulisse scribit. The same account has been repeated by Richter in his *Ichthyologie,* Leipzig 1754, 8vo. p. 792; by Krunitz in his *Encyclopedie,* xxxv. p. 11, and also by others. It appears to me highly probable, or rather certain, that a book by Nicolaus Marschalk or Mareschalcus, but who cannot be the Mascal of Sussex, is alluded to in the above pas-

System, that these fish were first brought to England about the year 1600, is certainly erroneous. Where that celebrated naturalist, under whom I had the pleasure of studying, acquired this information, I do not know.

Denmark is indebted for these fish to that

sage. The former was a native of Thuringia, and died professor of law and history at Rostock in 1525. He wrote many historical works, which were much esteemed, and of which a good account may be found in various books, such as the *Hamburgisches Biblioth. historica*, cent. ii. p. 261; *Von Westphalen Monumenta edita*, tom. i. in the preface, and p. 459; and in *Fabricii Biblioth. medii ævi*, vi. p. 749. They are all very scarce, as the author printed only a few copies in his own printing-office, which was one of the first at Rostock. See *Vogt, Catal. lib. rar.* p. 444, and *Freytag, Analecta litter. de lib. rar.* p. 572. The scarcest however is the work mentioned by Klein, and which I never saw. The best account of it is in *Conr. Gesneri Hist piscium*, where the author enumerates all the writers on the subject of fishes. It is as follows: Nicolai Mareschalci, Thurii, Historia aquatilium, impressa est Rostochii in ædibus ipsius an. 1520, in fol. cum picturis, sed fictis et absurdis, iisdem aut simillimis, quales in libris Bartholomæi Anglici et hujus farinæ scriptorum de rerum natura habentur. Sunt autem collectanea tantum ex auctoribus ordine alphabeti congesta; proprium nihil, neque observatio ulla, neque nomen Germanicum ullum; quod hercle miror, cum de longinquis navigationibus suis per maria glorietur. Promittit et zoographiam et therion historiam, et ornithographiam, quæ ipsum præstitisse non puto. As I knew that Schöttgen had given some account of the life of Marschalk, I procured his work, which is entitled, *C. Schöttgenii Commentat. de vita N. Mareschalci, quam ob raritatem recudi curavit* J. P. Schmidius, Rostochii 1752, 4to. but I found in it nothing more concerning the above book than what is said by Gesner. It is certain that the similarity of the names Mascal and Marschalk has occasioned them to be confounded, though the christian name of the one was Leonard, and that of the other Nicholas.

celebrated statesman Peter Oxe, who introduced them into the kingdom as well as cray-fish, and other objects for the table. He died in the year 1575.*

We are told that these fish were brought from Italy to Prussia, where they are at present very abundant, by a nobleman whose name is not mentioned. This service however may be ascribed with more probability to the upper burggrave, Caspar von Nostiz, who died in 1588, and who in the middle of the sixteenth century first sent carp to Prussia from his estate in Silesia, and caused them to be put into the large pond at Arensberg not far from Creuzburg. As a memorial of this circumstance the figure of a carp, cut in stone, was shown formerly over a door at the castle of Arensberg. This colony must have been very numerous in the year 1535, for at that period carp were sent from Konigsberg to Wilda, where the archduke Albert then resided.† At present a great many carp are transported from Dantzic and Konigsberg to Russia, Sweden, and Denmark. It appears to me probable, that these fish after that period became every where known and esteemed, as eating fish in Lent and on Fast-days was among Christians considered to be a religious duty, and that on this account they endeavoured to have

* Algem. Welthistorie, xxxiii. p. 204. *Pontoppidan's Naturgeschichte von Danemark.* Copenhagen 1765, 4to. p. 190.

† F. S. Bock, Naturgeschichte von Preussen. Dessau 1784, 8vo. iv. p. 642.

ponds stocked with them in every country, because no species can be so easily bred in these reservoirs.

I shall observe in the last place, that the *spiegel-karpen*, mirror-carp, distinguished by yellow scales, which are much larger, though fewer in number, and which do not cover the whole body, are not mentioned but by modern writers. Mr. Bloch says that they were first described by Johnston under the name of royal-carp. The passage where he does so I cannot find; but in plate xxix, there is a bad engraving, with the title *spiegel-karpen*, which however have scales all over their bodies, and cannot be the kind alluded to. On the other hand, the *spiegel-karpen* are mentioned by Gesner, who, as appears, never saw them.* In my opinion, Balbin, who wrote in the middle of the sixteenth century, was the first person who gave a true and complete description of them; and, according to his account, they seem to have come originally from Bohemia.† The first correct figure of them is to be found in Marsigli.‡

* *Spiegel-karpen*, cyprini quidam sunt e Franconia, sic dicti a maculis, p. 370.

† Carpiones regii, quod genus vix extra Bohemiam (in Moravia tamen aliquando, sed a nobis advectum) inveneris. Duos habent ordines squamarum, quæ a capite ad caudam usque trahuntur, cætera nudi sunt; squamæ in aureum colorem desinunt; jucundissimo quodam carnis sapore præstant cæteris. Sed ob teneritudinem diu non vivit, cum lorica illa squamęa adversus injurias minime defendantur. *Miscellan. Bohem.* p. 126.

‡ Danub. vol. iv. p. 59. tab. 20.

CAMP-MILLS.

UNDER this appellation are understood portable or moveable mills, which can be used, particularly in the time of war, when there are neither wind- nor water-mills in the neighbourhood, and which on that account formerly accompanied armies in the same manner as camp-ovens, and camp-forges. Some of these mills have stones for grinding the corn, and others are constructed with a notched roller like those of our coffee-mills. Some of them also are so contrived, that the machinery is put in motion by the revolution of the wheels of the carriage on which they are placed; and others, and perhaps the greater part of those used, are driven by horses or men, after the wheels of the carriage are sunk in the ground, or fastened in some other manner.

To the latter kind belongs that mill of which Zonca* has given a coarse engraving, but without

* Novo teatro di machine ed edificii per varie et sicure operationi, con le loro figure tagliate in rame, con la dichiaratione e dimostratione di ciascuno - - - di Vittorio Zonca, architetto della magnifica communita di Padoua. In Padoua appresso Franc. Bertelli, 1656, fol. This scarce book consists of 115 pages, and contains forty two plates, besides the title-page. The greater part of the machines delineated are engines for raising heavy bodies; but many of them are used in various trades and manufactures, and may serve in some measure to illustrate the history of them. The figures are coarse

any description. He says it was invented by Pompeo Targone, engineer to the well-known marquis Ambrose Spinola; and he seems to place the time of the invention about the end of the sixteenth century.* This mill is the same as that described by Beyer in his *Theatrum machinarum molarium*, and represented in the twenty-seventh plate of that work.† Beyer remarks that it was employed by Spinola.

The inventor, as his name shows, was an Italian, who made himself known, in particular, at the celebrated siege of Rochelle, under Louis XIII, at which he was chosen to assist, because in the year 1603, when with Spinola, who was consulted respecting the operations at Rochelle, he had helped by means of a mole to shut the harbour

and defective, and the descriptions, which are not altogether intelligible, contain only, for the most part, an account of the common construction of each machine. By the preface it appears that the book was printed once before, in 1621.

* The figure of the mill has the following title: Nova inventione de' molini per macinare et condurre in guerra, inventati dal Sig. *Pompeo Targone*, ingegniero dell' eccellentissimo Sign. *Ambrosio Spinola*, generale per la maestà cattolica in Fiandra, dietro, il numero ottantaotto. This figure is the only one in the work not particularly described.

† J. M. Beyer, Theatrum machinarum molarium, oder Schauplatz der Mühlen-Bau-kunst. Leipzig 1735, fol. This work was reprinted at Dresden in 1767, but without any additions, though promised in the title. Like figures also may be found in *Harsdorfers Philosophischen und mathematischen erquickstunden, dritter theil.* Nurnberg 1692, 4to. p. 437 and 658.

of Ostend during the tedious siege of that place.* He was likewise in the French service, as *intendant des machines du roi;* but his numerous and expensive undertakings did not succeed according to his expectations.† He invented also a particular kind of gun-carriages, and a variety of warlike machines.‡

Another old figure of such a mill was shown to me by professor Meister, in *Recueil de plusieurs machines militaires,*§ printed in 1620. This machine was driven by the wheels of the carriage; but whether it was ever used, the author does not inform us.

Lancellotti‖ ascribes this invention to the Germans, about the year 1633.

* Toze, Geschichte der Vereinigten Niederlande. Halle 1771, 2 theile, 4to. 1. p. 496.

† All those authors who have written expressly on the fate of the Huguenots, the history of Richelieu, Louis XIII, and the siege of Rochelle, make mention of Targone. See *Histoire de Louis* XIII, *par Dupleix.* Paris 1643, fol. p. 235 and 323. This work forms the fourth part of *Histoire générale de France, par Dupleix. Histoire de Louis* XIII, *par Le Vassor.* Amsterdam 1757, 4to. ii. p. 505. iii. p. 159.

‡ Histoire de la milice Françoise, par Daniel. Amsterdam 1724, 2 vol. 4to. i. p. 332.

§ Recueil de plusieurs machines militaires et feux artificiels pour la guerre et recreation; avec l'Alphabet de Tritemius - - - de la deligence de Franç. Thybourel et de Jean Appier. Au Pont-a-Mousson 1620, 4to. Livre troisième, p. 22.

‖ L'Hoggidi, overo gl'ingegni non inferiori a' passati; dell' abbate D. Secondo Lancellotti da Perugia, parte seconda, in Venetia

Carriages for transporting camp-forges and mill-machinery are mentioned by Leonard Fronsperger,* but he does not say whether complete mills were affixed to them.

MIRRORS.†

It is highly probable that a limpid brook was the first mirror,‡ but we have reason to think that

1636, 8vo, p. 457: Questo anno (1633) s'intende de Germania una nuova inventione di molino sopra un carro tirato da quatri cavalli, facile ad essere condotto per monti e valli, che caminando macina col giro delle ruote, e stando fermo macina come un molino a vento.

* Kriegsbuch, ander theil; von wagenburgk umb die veldleger. Frankfurt 1596, fol. p. 9.

† The works in which this subject has been already treated are the following:

Eberhartus de Weihe de speculi origine, usu et abusu. A compilation formed without taste, of which I gave some account in the Article on Chimneys.

Spanhemii Observationes in Callimachi hymnum in lavacrum Palladis, p. 615.

Meursii Exercitationes criticæ, ii. 2. 6. In his Works, vol. v. p. 614. Contains only some passages from ancient authors.

Histoire de l'Académie des Inscriptions, tome xxiii. p. 140. *Recherches sur les Miroirs des anciens, par Ménard.* A short paper, barren of information.

‡ Passages of the poets, where female deities and shepherdesses are represented as contemplating themselves in water instead of a mirror, may be found collected by Gudius, Rigaltius, and others, in the notes to *Phædri Fab.* i. 4, in the edition of Burmann, Amstelodami 1698, 8vo. p. 19, 215, 408.

artificial mirrors were made as soon as mankind began to exercise their art and ingenuity on metals and stones. Every solid body, capable of receiving a fine polish, would be sufficient for this purpose; and indeed, the oldest mirrors mentioned in history were of metal. Those which occur in Job* are praised on account of their hardness and solidity; and Moses relates,† that the brazen laver, or washing-bason, was made from the mir-

Saggi di Dissertazioni Accademiche lette nella nob. Accademia Etrusca dell' città di Cortona, 4to. tomo vii. p. 19: *Sopra gli specchi degli antichi*, del Sig. Cari. A translation from the French, with the figures of some ancient mirrors. It contains an explanation of some passages in Pliny, where he seems to speak of a mirror formed of a ruby, and some conjectures respecting the mirror of Nero. An anonymous member of the academy, in an appendix, confirms the former, and considers the latter very properly as improbable.

Recueil d'Antiquités (par Caylus), tome iii. p. 331, and tome v. p. 173. A description and figures of ancient mirrors, with some chemical experiments on their composition.

Amusemens Philosophiques sur diverses parties des sciences, et principalement de la physique et des mathematiques. Par le pere Bonaventure Abat. Amsterdam 1763, 8vo. p. 433: *Sur l'antiquité des mirroirs de verre.* A dissertation worthy of being read on account of the author's acquaintance with the ancient writers, and his knowledge of technology; but he roves beyond all proof, and employs much verbosity to decorate his conjectures, which by their ornaments, however, acquire very little probability.

* Hast thou with him spread out the sky, which is strong and as a molten looking-glass? Job, chap. xxxvii. ver. 18.

† And he made the laver of brass, and the foot of it of brass, of the looking-glasses of the women assembling, which assembled at the door of the tabernacle of the congregation. Exodus, chap. xxxviii. ver. 8.

rors of the women who had assembled at the door of the tabernacle to present them, and which he caused them to deliver up. As the women appeared in full dress at divine worship, it was necessary for them to have looking-glasses after the Egyptian manner. With these the washing-basons, according to the conjecture of most interpretators, were only ornamented, covered, or perhaps hung round; and Michaelis * himself was once of this

* Historia vitri apud Judæos, which may be found in *Commentar. Societat. scient. Gotting.* iv. p. 330. Having requested professor Tychsen's opinion on this subject, I received the following answer: "You have conjectured very properly that the mirrors of the Israelitish women, mentioned Exod. xxxviii. 8, were not employed for ornamenting or covering the washing-basons, in order that the priests might behold themselves in them; but that they were melted, and basons cast of them. The former was a conceit first advanced, if I am not mistaken, by Nicol. de Lyra, in the fourteenth century, and which Michaelis himself adopted in the year 1754; but he afterwards retracted his opinion when he made his translation of the Old Testament at a riper age. In the Hebrew expression there is no ground for it; and mirrors could hardly be placed very conveniently in a bason employed for washing the feet. I must at the same time confess that the word (מראת) which is here supposed to signify a mirror, occurs no where else in that sense. Another explanation therefore has been given, by which both the women and mirrors disappear from the passage. It is by a learned Fleming, Hermann Gid. Clement, and may be found in his *Dissertatio de labro aeneo*, Groning. 1732, and also in *Ugolini Thesaurus*, tom. xix. p. 1505, where it is quoted. He translates the passage thus: Fecit labrum aeneum et operculum ejus aeneum cum *figuris ornantibus*, quæ ornabant ostium tabernaculi. This explanation however is attended with very great difficulties; and as all the old translators and Jewish commentators have here understood mirrors; and as the common

opinion. But why should we not rather believe that the mirrors were melted and formed into washing-basons? As soon as mankind began to endeavour to make good mirrors of metal, they must have remarked, that every kind of metal was not equally proper for that use, and that the best could be obtained from a mixture of different metals. In the mirrors, however, which were collected by Moses, the artists had a sufficient stock of speculum metal, and were not under the necessity of making it themselves; and for this reason they could much more easily give to the whole bason a polished surface, in which the priests, when they washed, might survey themselves at full length. At any rate such a bason would not be the only one employed instead of a mirror. Artemidorus * says, that he who dreams of viewing himself in a bason, will have a son born to him by his maid. Dreams indeed are generally as groundless as this interpretation; but one can hardly conjecture that Artemidorus would have thought of such a dream, had it not been very common for people to contemplate themselves in a bason. There were formerly a kind of fortune-

translation is perfectly agreeable to the language and circumstances, we ought to believe that Moses, not having copper, melted down the mirrors of his countrywomen, and converted them into washing-basons for the priests."

* Oneirocrit. lib. iii. cap. 30. p. 176: Λεκανη εγκατοπτριζεσθαι τεκνωσαι απο θεραπαινης σημαινει; pelvi vice speculi uti, ex famula filios procreare significat.

tellers, who pretended to show in polished basons to the simple and ignorant, what they wished to know.* The ancients also had drinking-vessels, the inside of which was cut into mirrors, so disposed, that the image of the person who drank from them was seen multiplied.† Vopiscus mentions, among the valuable presents of Valerian to the emperor Probus, when a tribune, a silver cup of great weight, which was covered in the inside with mirrors of this sort.‡

* Specularios vocant, qui in corporibus lævigatis et tersis, ut sunt lucidi enses, pelves, cyathi, speculorumque diversa genera, divinantes curiosis consultationibus satisfaciunt. *Joh. Sarisberiensis*, i. cap. 12.

† Quinetiam pocula ita figurantur, exsculptis intus crebris ceu speculis, ut vel uno intuente populus totidem imaginum fiat. *Plin.* lib. xxxiii. cap. 9. p. 627. Seneca, speaking of such mirrors, uses also the expression *populus*. See his *Quæst. nat.* i. cap. 5.

‡ Vita Probi, cap. iv. p. 926: Patinam argenteam librarum decem specillatam. Saumaise chooses rather to read *specellatam*. I am inclined to think that this word ought to be read in Suetonius instead of *speculatum*, where he speaks of an apartment which Horace seems to have been fond of. That historian, in his Life of Horace, says: Ad res venereas intemperantior traditur. Nam *speculato* cubiculo scorta dicitur habuisse disposita, ut quocunque respexisset, ibi ei imago coitus referretur. Lessing, who in his Miscellanies (*Vermischten Schriften*, Berlin 1784, 12mo. iii. p. 205.) endeavours to vindicate the poet from this aspersion, considers the expression *speculatum cubiculum*, if translated *an apartment lined with mirrors*, as contrary to the Latin idiom, and thinks therefore that the whole passage is a forgery. Baxter also before said, that this anecdote had been inserted by some malicious impostor. This I will not venture to contradict, but I am of opinion that *specillatum* or *specellatum cubiculum* is at any rate as much agreeable to the Roman idiom as *patina specillata*. This expression Saumaise and Casaubon have

Menard and others conjecture, that mirrors in the time of Homer were not much used, because he mentions them on no occasion, not even where he describes in so circumstantial a manner the toilet of Juno.* In answer to this, however, I have two things to observe. In the first place, it is not to be expected that Homer should have mentioned every article with which he was acquainted; and, secondly, we are assured by Callimachus, where he evidently has imitated the before quoted passage of Homer, † that neither Juno nor Pallas employed a mirror when they dressed. Mythology therefore did not allow the

justified by similar phrases, such as *opera filicata, tesselata, hederata,* &c. The chamber in which Claudian makes Venus ornament herself, and be overcome by the persuasion of Cupid, was also covered over with mirrors, so that whichever way her eyes turned, she could see her own image. *Hymn. in nupt. Honor. et Mariæ,* 117.

— — — — Speculi nec vultus egebat
Judicio; similis tecto monstratur in omni
Et rapitur quocunque videt.

Did Claudian imagine that this goddess knew how to employ such an apartment, not only for dressing, but even after she was undressed, as well as Horace? I have seen at a certain court, a bed entirely covered in the inside with mirrors.

* Iliad. lib. xiv. ver. 166.

† Hymnus in lavacrum Palladis, v. 15, 21. It was however customary to ascribe a mirror to Juno, as Spanheim on this passage proves; and Athanasius, in *Orat. contra gentes,* cap. xviii. p. 18, says that she was considered as the inventress of dress and all ornaments. Should not therefore the mirror, the principal instrument of dress, belong to her? May it not have been denied to her by Callimachus, because he did not find it mentioned in the description which Homer has given of her dressing-room?

poet to introduce a mirror upon the toilet of that deity. Polydore Vergilius, Boccace, Menard, and others, have all fallen into the error of making Æsculapius the inventor of mirrors, though Cicero* seems to say the same thing; but the best commentators have long since observed very justly, that the Roman philosopher alludes not to a mirror but to a probe, the invention of which we may allow to the father of medicine, who was at first only a surgeon.

When one reflects upon the use made of metal mirrors, particularly at Rome, to add to magnificence and for other purposes; and how many artists, during many successive centuries, were employed in constructing them, and vied to excel each other in their art, one cannot help conjecturing that this branch of business must at those periods have been carried to a high degree of perfection. It is therefore to be regretted, that they have not been particularly described by any writer, and that on this account the art was entirely lost after the invention of glass-mirrors, which are much more convenient. No one at that time entertained the least suspicion, that circumstances would afterwards occur which would render these metal-mirrors again necessary, as has been the case in our days by the invention of the telescope.

* Æsculapiorum primus - - - - qui specillum invenisse et primus vulnus obligasse dicitur. *De natur. Deorum*, iii. 22. Compare *Lescoloverii Humanitas theolog.* p. 642.

Our artists then were obliged to make new experiments in order to discover the best mixture for mirrors of metal; and this should be a warning to mankind, never to suffer arts which have been once invented and useful, to become again unknown. A circumstantial description of them should at any rate be preserved for the use of posterity, in libraries, the archives of human knowledge.

When we compare metals in regard to their fitness for mirrors, we shall soon perceive that the hardest of a white colour possess in the highest degree the necessary lustre. For this reason platina is preferable to all others, as is proved from the experiments made by the count von Sickingen. Steel approaches nearest to this new metal, and silver follows steel; but gold, copper, tin, and lead are much less endowed with the requisite property. I have however observed among the ancients no traces of steel-mirrors; and it is probable they did not make any of that metal, as it is so liable to become tarnished, or to contract rust. An ancient steel-mirror is indeed said to have been once found, but as some marks of silvering were perceived on it, a question arises whether the silvered side was not properly the face of the mirror.* Besides, every person knows that a

* Speculum chalybeum, cujus diameter quinque pollices æquat; pars aversa leviter concava deargentata varia parerga habet. *Fortun. Licet. de lucernis antiq.* lib. vi. cap. 92. p. 1086. As this mirror

steel mirror would not retain its lustre many centuries amidst ruins and rubbish.

The greater part of the ancient mirrors were made of silver, not on account of costliness and magnificence, as many think, but because silver, as has been said, was the fittest and the most durable of all the then known unmixed metals for that use. In the Roman code of laws, when silver plate is mentioned, under the heads of heirship and succession by propinquity, silver mirrors are rarely omitted; * and Pliny, † Seneca, ‡ and other writers, who inveigh against luxury, tell us, ridiculing the extravagance of the age, that every

was found near Nimeguen, I expected to see a better account of it in *Antiquitates Neomagenses, sive Notitia rerum antiquarum quas comparavit Joh. Smetius*; Noviomagi 1678, 4to.: but I met with only the following passage, p. 149: Speculum chalybeum integrum, rotundum, convexum, cujus diameter pollicum quinque. Ad hæc innumera speculorum chalybeorum, et in iis quorundam deauratorum fragmenta.

* Digest. lib. xxxiii. tit. 6, 3. In the Greek translation, or Ecloga s. Synopsis των βασιλικων, lib. xliv. tit. 9. cap. 3. p. 389, stands τα σπετλα του οικου; where, as Leunclavius has already remarked, p. 91, we ought to read σπεκλα. This word can have no allusion to windows, as these were not then in use. *Digesta*, lib. xxxiv. tit. 2, 19, 8: Nec speculum (argenteum) vel parieti affixum, vel etiam quod mulier mundi caussa habuit; si non in argenti numero habita sint. We find there also, lex. xxv. 10, and in Synopsis βασιλικων, lib. xliv. tit. 15. το αργυρουν εσοπτρον.

† Plin. lib. xxxiv. cap. 17. p. 669: Argenteis speculis uti cœpere et ancillæ.

‡ Jam libertinorum virgunculis in unum speculum non sufficit illa dos, quam dedit senatus pro Scipione. *Quæst. nat.* at the end of the first book.

young woman in their time must have a silver mirror. These polished silver plates may however have been very slight, for all the ancient mirrors, preserved in collections, which I have ever seen, are only covered with a thin coat of that expensive metal: and, in the like manner, our artists have at length learned a method of making the cases of gold and silver watches so thin and light, that every footman and soldier can wear one. At first, the finest silver only was employed for these mirrors, because it was imagined that they could not be made of that which was standard; but afterwards metal was used of an inferior quality. Pliny tells us so expressly,* and I form the same conclusion from a passage of Plautus.† Philematium having taken up a mirror, the prudent Scapha gives her a towel, and desires her to wipe her fingers, lest her lover should suspect by the smell, that she had been receiving money. Fine silver however communicates as little smell to the fingers as gold; but it is to be remembered that the ancients under-

* Laminas duci et specula fieri non nisi ex optimo argento posse creditum fuerat. Id quoque jam fraude corrumpitur. Lib. xxxiii. c. 9. p. 626.

† Sc. Cape igitur speculum - - - -
Linteum cape, atque exterge tibi manus.
Phi. Quid ita, obsecro?
Sc. Ut speculum tenuisti, metuo ne oleant argentum manus;
Ne usquam argentum te suscepisse suspicetur Philolaches.
Mostell. act. i. sc. 4. v. 101.

stood much better than the moderns how to discover the fineness of the noble metals by the smell, as many modes of proof which we use to find out the alloy, were to them unknown. Money-changers therefore employed their smell when they were desirous of trying the purity of coin.* The witty thought of Vespasian, who, when reproached on account of his tax upon urine, desired those who did so to smell the money it produced, and to tell him whether it had any smell of the article which was the object of it, alludes to this circumstance. In the like manner, many savage nations, at present, can by their smell determine the purity of gold.†

* Arrianus in Epictet. i. cap. 20. p. 79. Ὁ αργυρογνωμων προσχρηται κατα δοκιμασιαν του νομισματος τῃ ὀψει, τῃ ἁφῃ, τῃ οσφρασιᾳ. Argentarius ad explorationem numismatis utitur visu, tactu, olfactu. - - - -

† I have already quoted proofs in my annotations on *Aristot. Auscult. mirab.* p. 100; and *Antigoni Caryst. Hist. mirab.* p. 234. The remaining passages of the ancients with which I am acquainted, where mention is made of silver mirrors, are the following: *Apuleius, in Apologia*, p. 424: Cur existimes imaginem suam cuique visendam potius in lapide, quam in argento? *that is* speculo argenteo. The same author mentions in his *Floralia*, p. 790, among the valuables of Juno in the island of Samos: Plurima auri et argenti ratio in lanceibus, speculis, poculis, et hujusmodi utensilibus. Κατοπτρον αργυρουν occurs among the rich articles consecrated to Juno, in Philostratus, *Icon.* i. 6. p. 773. Chrysostome, *Serm.* xvii. p. 224, drawing a picture of the extravagance of the women, says: "The maid-servants must be continually importuning the silversmith to know whether their lady's mirror be yet ready:" τοις αργυροκοποις συνεχως ερωτωντες, ει το κατοπτρον κατεσκευασθαι της κυριας. The best mirrors therefore were made by the silversmiths. It appears however that the mirror-makers at Rome formed a particular company; at

We are informed by Pliny,* that Praxiteles, in the time of Pompey the Great, made the first silver mirror, and that mirrors of that metal were preferred to all others. Silver mirrors however were known long before that period, as is proved by the passage of Plautus above quoted. To reconcile this contradiction, Meursius remarks that Pliny speaks only of his countrymen, and not of the Greeks, who had such articles much earlier, and the scene in Plautus is at Athens. This therefore seems to justify the account of Pliny, but of what he says afterwards I can find no explanation. Hardouin is of opinion that mirrors, according to the newest invention, at that period, were covered behind with a plate of gold, as our mirrors are with an amalgam of metal. But as the ancient plates of silver were not transparent, how could the gold at the back part of them produce any effect in regard to the image? May not the meaning be, that a thin plate of gold was placed at some distance before the mirror in order to throw more light upon its sur-

least Muratori, in *Thesaur. inscript. clas.* vii. p. 529, has made known an inscription in which *collegium specularіorum* is mentioned. They occur also in *Codex Theodos.* xiii. tit. 4, 2. p. 57, where Ritter has quoted more passages in which they may be found. But perhaps the same name was given to those who covered walls with polished stones and in latter times to glaziers. In Greek they were called σπεκλοποιοι.

* Prælata sunt argentea. Primus fecit Praxiteles, Magni Pompeii ætate. Nuper credi cœptum, certiorem imaginem reddi auro opposito aversis. *Lib.* xxxiii. cap. 9. p. 627.

face? But whatever may have been the case, Pliny himself seems not to have had much confidence in the invention.

Mirrors of copper, brass,* and gold,† I have found mentioned only by the poets, who perhaps employed the names of these metals because they best suited their measure, or because they wished to use uncommon expressions, and thought a golden mirror the noblest. By the brass ones perhaps are to be understood only such as were made of mixed copper. Did golden mirrors occur oftener, I should be inclined to refer the epi-

* Callimach. in lavacrum Palladis, v. 21, calls the mirror of Venus διαυγεα χαλκον, nitidum æs. Two lines before he mentions also ορειχαλκον. Æschylus, in *Stobæi Sermon. ethic.* xviii. p. 164, says, Brass is the mirror of the countenance, and wine the mirror of the mind: κατοπτρον ειδους χαλκος. Nonnus, *Dionys.* v. p. 174, calls a mirror χαλκον διαυγεα, æs splendidum; and he repeats the same thing xlii. p. 1082.

† We find by Euripides, that Helen carried with her from Ilium the golden mirror, χρυσεα ενοπτρα, παρθενων χαριτας, aurea specula, virginum delicias. Hecuba, ver. 925. Seneca, *Quæst. nat.* i. at the end, says: Postea, rerum jam potiente luxuria, specula totis paria corporibus auro argentoque celata sunt, denique gemmis adornata; et pluris unum ex his feminæ constitit, quam antiquarum dos fuit illa, quæ publice dabatur imperatorum pauperum filiabus. An tu existimas, ex auro nitidum habuisse Scipionis filias speculum, cum illis dos fuisset æs grave? Several manuscripts however have *auro inditum*; and mirrors with golden frames are undoubtedly here meant. I know still of another passage where mention is made of a gold mirror. It occurs in Ælian's *Var. hist.* lib. xii. cap. 58; but the words are so corrupted and unintelligible, that most commentators wish they were cleared up. Besides, in other writers, who relate the same circumstance, there is no mention of a mirror. The author perhaps alluded to a painting.

thet rather to the frame or ornaments than to the mirror itself; for at present we say a gold watch, though the cases only may be of that metal.

Mirrors seem for a long time to have been made of a mixture of copper and tin,* as is expressly said by Pliny,† who adds, that the best were constructed at Brundisium. This mixture, which was known to Aristotle,‡ produces a white metal, which, on account of its colour, may have been extremely proper for the purpose, and even at present, the same mixture, according to the careful experiments made by Mr. Mudge, an Englishman,§ produces the best metal for specula. It appears however that the ancients had not determined the proportion very accurately; for Pliny assures us twice, that in his time mirrors of silver were preferred. It is indeed not easy to ascertain the quantity of each metal that ought to be taken, and the most advantageous degree of heat; upon

* Provided *stannum* always signifies tin, of which I have however some doubt. To determine this point, a research would be necessary which I have not yet been able to make. The *stannum* of the ancients is certainly sometimes what the people at the German melting-houses call *werk*, as I have proved in a note to *Aristot. Auscult. mirabil.* p. 102.

† Optima specula apud majores fuernnt Brundisina, stanno et ære mixtis. Prælata sunt argentea. *Lib.* xxxiii. c. 9. p. 627. Specula quoque ex stanno laudatissima, ut diximus, Brundisii temperabantur, donec argenteis uti cœpere et ancillæ. *Lib.* xxxiv. c. 17. p. 669.

‡ Auscultat. mirabil. cap. lxiii. p. 131.

§ Philosophical Transactions, vol. lxvii. p. 296.

which a great deal depends. One of the principal difficulties is to cast the metal without blisters or air-holes, and without reducing any part of the tin to a calx, which occasions knots and cracks, and prevents it from receiving a fine polish. A passage of Lucian,* which no one as yet has been able to clear up, alludes certainly, in my opinion, to these faults. A mixture of copper and tin is so brittle, that it is very liable to crack; and a mirror formed of it, if not preserved with great care, soon becomes so dim, that it cannot be used till it has been previously cleaned and polished. For this reason a sponge with pounded pumice-stone was generally suspended from the ancient mirrors, †

* Quomodo historia sit conscrib. cap. 51. Edition of Deux-Ponts, iv. p. 210, 535: Μαλιστα δε κατοπτρῳ εοικυιαν παρασχεσθῳ την γνωμην, αθολῳ και στιλπνῳ, και ακριβει το κεντρον. Maxime vero speculo similem præbeat animum, nihil turbido, et splendido, et centri exacti; qualesque acceperit operum species, tales etiam illas ostendat; perversum vero, aut alieni coloris, aut figuræ diversæ, nihil. Commentators have found no other way to explain κεντρον than by the word *centre*, to which, according to their own account, there can be here no allusion. In my opinion κεντρον signifies those faulty places which are not capable of a complete polish on account of the knots or cracks which are found in them. Lucian therefore speaks of a faultless mirror which represents the image perfect, as he afterwards informs us. This meaning of the term *centrum* I have proved already in a note to the article on Ultramarine. See *Salmasii Exercitat. Plin.* p. 756.

† The passages which serve to prove this circumstance have been quoted by Vossius in his Annotations on Catullus, p. 97, and after him by Spanheim on Callimachus p. 622. Plato in *Timæus*, according to the edition of Stephanus, t. iii. p. 72, says: Tanquam spongia parata et prompta detergendo, cui apposita est, speculo. In

and they were kept likewise in a case or box, as may be seen by the greater part of those still extant. Mirrors of silver were less subject to this inconvenience, and I am inclined to think that the latter on this account made the former be disused, as we are informed by Pliny..

As ancient mirrors of metal are still to be found in collections of antiquities, it might be of some importance to the arts, if chemical experiments were made on their composition.. Those who have hitherto given us any account of them have contented themselves with describing their external figure and shape. Count Caylus* is the only per-

Tertullian *De pallio*, Omphale rubs the blood from an arrow with the pumice-stone which was used for cleaning a mirror. Hesychius explains νεοσμηκτον εσοπτρον by το νεωστι καθαρθεν κατοπτρον, a mirror newly cleaned.

* As the account of these experiments is given in an expensive work, which may not often fall into the hands of those who are best able to examine it, I flatter myself that I shall receive thanks for inserting it here. "The ancient mirror, which I examined, was a metallic mixture, very tender and brittle, and of a whitish colour inclining to gray. When put into the fire, it remained a long time in a state of ignition before it melted. It was neither inflammable nor emitted any smell like garlic, which would have been the case had it contained arsenic. It did not either produce those flowers which are generally produced by all mixtures in which there is zinc. Besides, the basis of this mixture being copper, it would have been of a yellow colour had that semi-metal formed a part of it. I took two drams of it and dissolved them in the nitrous acid. A solution was speedily formed, which assumed the same colour as solutions of copper. It precipitated a white powder, which I carefully edulcorated and dried. Having put it into a crucible with a reductive flux, I obtained lead very soft and malleable.

son, as far as I know, who caused any chemical experiments to be undertaken on this subject. They were made on a mirror found near Naples, by Mr. Roux, who asserts that the composition was a mixture of copper and regulus of antimony, with a little lead. Antimony however was not known to the ancients. If that metal was really a component part, the mirror must have been the

" Having filtered the solution, I took a part of it, upon which I poured an infusion of gall-nuts, but it produced no change. A solution of gold, which I poured upon another part, made it assume a beautiful green colour; but no precipitate was formed: which is sufficient to prove that there was neither iron nor tin in the mixture.

" On the remaining part of the solution I poured a sufficient quantity of the volatile alkali to dissolve all the copper that might be contained in it. The solution became of a beautiful sapphire-blue colour, and a white precipitate was formed. Having decanted the liquor, and carefully edulcorated the precipitate, I endeavoured to reduce it; but whether it was owing to the quantity being too small, or to my not giving it sufficient heat, I could not succeed. I had recourse therefore to another method.

" I took the weight of two drams of the mixture, which I brought to a high state of ignition in a cuppel. When it was of a whitish-red colour, I threw upon it gradually four drams of sulphur, and when the flame ceased, I strengthened the fire in order to bring it to complete fusion. By these means I obtained a tender brittle regulus whiter than the mixture, in which I observed a few small needles. Being apprehensive that some copper might still remain, I sulphurated it a second time, and then obtained a small regulus which was almost pure antimony.

" It results from these experiments, that the metal of which the ancients made their mirrors was a composition of copper, regulus of antimony, and lead. Copper was the predominant, and lead the smallest part of the mixture; but it is very difficult, as is well known, to determine with any certainty the exact proportion of the substances contained in such compositions."

work of more modern times, or it must be allowed that the artist had metal combined with antimony without knowing it; but the latter is not probable. The experiments however made by Roux do not seem to me to have proved in a satisfactory manner the presence of regulus of antimony; and for this reason I requested the opinion of Mr. Gmelin, which with his permission I here insert.

"According to the account given of the expe-
"riments, which were however incomplete, I think
"it probable that the metal of the mirror con-
"tained antimony; but it is much to be wished
"that the author had not confined himself merely
"to relate that he obtained a white tender brittle
"regulus, with a few metallic needles; and that
"he had carried his proofs further, and shown
"that it could be nothing else than metallic par-
"ticles of antimony. This regulus, at any rate,
"cannot have been tin, which is not brittle, and
"which readily becomes yellow by sulphur; nor
"iron, which would have become darker, and
"which in general unites sooner with sulphur
"than copper; nor could it have been manganese,
"which sometimes cannot be easily melted by such
"a fire, even with the addition of sulphur, and
"which sometimes will not dissolve in the vitriolic
"acid.

"In short, I am not convinced that the mixture
"contained no tin. As it dissolved very speedily,
"it appears to me highly probable, that the white

" calx, which was in the mean time precipitated, " was, in part, and perhaps principally, calx of " zinc; and that the pretended lead was, for the " greater part, tin. A portion of the tin may, " indeed, have been dissolved in the acid; for, " though a purple calx was not precipitated by " the solution of gold, that proves nothing. Ac- " cording to every appearance the acid was far " from being saturated, and with a solution of tin " so little saturated a solution of gold will no more " produce a distinguishable purple, than an infu- " sion of gall-nuts will a precipitate."

No certain information can be derived from these experiments, for the antiquity of the mirror was not ascertained; nor was it known whether it ought to be reckoned amongst the best or the worst of the period when it was made.

Those mirrors, which were so large that one could see one's self in them at full length, must, in all probability, have consisted of polished plates of silver; for, to cast plates of such a size of copper and tin would have required more art than we can allow to those periods; and I do not know whether our artists even would succeed in them.*

We read in various authors that, besides metals,

* Of such large mirrors Seneca speaks in his *Quæst. nat.* lib. i. Of the like kind was the mirror of Demosthenes mentioned by Plutarch, Lucian, and Quintilian. *Institut. orat.* xi. 3, 68. p. 572: Grande quoddam intuens speculum, componere actionem solebat.

the ancients formed stones into mirrors, which were likewise in use. It is undoubtedly certain that many stones, particularly of the vitreous kind, which are opake and of a dark colour, would answer exceedingly well for that purpose; but let the choice have been ever so good, they would not, in this respect, have been nearly equal to metals. These of all mineral bodies have the most perfect opacity; and for that reason the greatest lustre: both these properties are produced by their solidity; and hence they reflect more perfectly, and with more regularity, the rays of light that proceed from other bodies. Our glass mirrors, indeed, are properly metallic. Stones, on the other hand, have, at any rate, some, though often hardly perceptible, transparency; so that many of the rays of light are absorbed, or at least not reflected. Mention of stone mirrors occurs also so seldom in the ancients, that we may conclude they were made rather for ornament than real utility. In general, we find accounts only of polished plates or pannels of stone, fixed in the walls of wainscoted apartments, which were celebrated on account of their property of reflection.

Pliny* praises in this respect the obsidian stone,

* In genere vitri et obsidiana numerantur, ad similitudinem lapidis, quem in Æthiopia invenit Obsidius, nigerrimi coloris, aliquando et translucidi, crassiore visu, atque in speculis parietum pro imagine umbras reddente. *Lib.* xxxvi. c. 26. p. 758. The latter part of this passage is twice repeated by Isidore in his *Origin.* 16, 15, and 4.

or, as it is now called, the Icelandic agate. Every thing that he says of it will be perfectly intelligible to those who are acquainted with this species of stone or vitrified lava. The image reflected from a box made of it, which I have in my possession, is like a shadow or silhouette; but with this difference, that one sees not only the contour, but also the whole figure distinctly, though the colours are darkened. To form it into images and utensils, which Pliny speaks of, must have been exceedingly difficult, on account of its brittleness. I saw at Copenhagen, among other things made of it, a drinking-cup and cover, on which the artist had been employed four years.

Domitian, when he suspected that plots were formed against him, caused a gallery, in which he used to walk, to be lined with *phengites*, which by its reflection showed every thing that was done behind his back.* Under that appellation we are undoubtedly to understand a calcareous or gypseous spar, or selenite, which is indeed capable of reflecting an image; but we cannot therefore pretend to say that the ancients formed mirrors of it; nor do I explain what Pliny says,

In one of these places he says: Ponitur in speculis parietum, propter imaginum umbras reddendas.

* Tempore suspecti periculi adpropinquante, sollicitior in dies, porticuum, in quibus spatiari consueverat, parietes phengite lapide distinxit, e cujus splendore, per imagines, quidquid a tergo fieret, provideret. *Sueton. in Vita Domit.* cap. xiv. p. 334.

where he speaks of the *phengites*, as if whole buildings had been once constructed of it.* That kind of stone, for various reasons, and particularly on occount of its brittleness, is altogether unfit for such a purpose. At those periods, the windows of houses were open, and not filled up with any transparent substance, but only covered, sometimes by lattices or curtains. It is probable, therefore, that those openings of the walls of the building mentioned by Pliny, where the windows used to be, were filled up with *phengites*, which, by admitting a faint light, prevented the place from being dark even when the doors were shut; so that Pliny might say, "it appeared as if the "light did not fall into the building, but as if it "were enclosed in it."

I might be accused of omission did I not here

* In Cappadocia repertus est lapis duritia marmoris, candidus atque translucens, etiam qua parte fulvæ inciderant venæ ex argumento phengites appellatus. Hoc construxerat ædem Fortunæ, quam Seiam appellant a Servio rege sacratam, aurea domo complexus. Quare etiam foribus opertis interdiu claritas ibi diurna erat, alio quam specularium modo, tanquam inclusa luce. *Lib.* xxxvi. 22. p. 752.

Cappadociæ lapis, duritia marmoris, candidus atque translucidus, ex quo quondam templum constructum est a quodam rege, foribus aureis, quibus clausis claritas diurna erat. *Isidor. Origin.* 16, 4. Our spar is transparent, though clouds and veins occur in it, like the violet and isabella-coloured, for example, of that found at Andreasberg, Compare this explanation with what Saumaise says in *Exercitat. Plin.* p. 184.

mention also a passage of Pliny,* where he seems to speak of a mirror made of an emerald, which Nero used to assist him to see the combats of the gladiators. Cary asserts that Nero was short-sighted, and that his emerald was formed like a concave lens. The former is expressly said by Pliny,† but the latter, though by Abat considered not improbable,‡ I can scarcely allow myself to believe, because such an interpretation of Pliny's words is too forced, and because they can be explained much better in another manner. As no mention of such an excellent help to short-sighted people is to be found in any other ancient author, we must allow, if Cary's opinion be adopted, that this property of the concave emerald was casually remarked, and that no experiments were made to cut any other natural or artificial glass in the same form for the like use, because people imagined that this property was peculiar to the emerald alone, which was then commonly supposed to be

* Smaragdi plerumque et concavi, ut visum colligant. Quapropter decreto hominum iis parcitur, scalpi vetitis. Quamquam Scythicorum Ægyptiorumque duritia tanta est, ut nequeant vulnerari. Quorum vero corpus extensum est, eadem, qua specula, ratione, supini imagines rerum reddunt. Nero princeps gladiatorum pugnas spectabat smaragdo. *Lib.* xxxvii. cap. 5. p. 774.

† Neroni, nisi cum conniveret, ad prope admota hebetes (oculi.) *Lib.* xi. cap. 37. p. 617.

‡ This dissertation of Abat may be found translated in *Neuen Hamburg. Magazin.* i. p. 568.

endowed with the power of greatly strengthening the eye-sight. Much more probable to me is the explanation of an Italian, which Abat also does not entirely reject, that the emerald had a smooth polished surface, and served Nero as a mirror;* and the passage of Pliny alluded to seems to have been thus understood by Isidore† and Marbodæus. It may here be objected, that real emeralds are too small to admit of being used as mirrors; but the ancients speak of some sufficiently large for that purpose, and also of artificial ones;‡ so that we may with certainty conclude, that they classed among the emeralds sparry fluor, green vitrified lava, or the green Icelandic agate as it is called, green jasper, and also green glass. The piece of green glass in the monastery of Reichenau, which is seven inches in length, three inches in thickness, and weighs twenty-eight pounds three

* La sostanza è, che secondo il raccento di Plinio, lo specchio usato da Nerone non era nè concavo nè occhialino, ma specchio grande e lontano dall' occhio, e posto obliquamente sul terrazino, e finestra --- Dunque lo smeraldo usato da Nerone era di corpo, o male estesa, grande e piana, e collocavasi supino o sia inclinato, perchè vi si imprim essero, e riflettessero le imagini, come negli altri specchi, e perciò non si è fondamento alcuno per crederlo occhialino. Almeno Plinio dice il contrario. *Academia di Cortona*, vii. p. 34.

† Cujus corpus si extensum fuerit, sicut speculum, ita imagines reddit. Quippe Nero Cæsar gladiatorum pugnas in smaragdo spectabat. *Origin.* xvi. 7.

‡ Goguet, Ursprung der gesetze und künste, ii. p. 111. *Fabricii Bibloth. Græca*, vol. i. p. 70.

quarters;* and the large cup at Genoa, which is, however, full of flaws,† have been given out to be emeralds even to the present time.

Mirrors were made also of rubies, as we are assured by Pliny,‡ who refers to Theophrastus for his authority; but this precious stone is never found now of such a size as to render this use possible; and Cary and the anonymous Italian before mentioned have proved very properly that Pliny has committed a gross mistake, which has not been observed by Hardouin. Theophrastus, in the passage alluded to,§ does not speak of a ruby, but of the well-known black marble of Chio, though he calls both *carbunculus*,‖ a name given to the ruby on account of its likeness to a burning coal, and to the black marble on account of its likeness to a quenched coal or cinder; and

* Keyssler's Reisen, i. p. 17. *Andrea, Briefe aus der Schweiz.* Zurich 1776, 4to. p. 47, and also p. 65, where may be seen H. Von Beroldingen's opinion respecting this emerald.

† Keyssler, i. p. 441. *Mercure de France.* Août, 1757. p. 149.

‡ Nascuntur (carbunculi) et in Thracia coloris ejusdem, ignem minime sentientes. Theophrastus auctor est, et in Orchomeno Arcadiæ inveniri, et in Chio. Illos nigriores, e quibus et specula fieri. *Lib.* xxxvii. cap. 7. p. 779.

§ Αι δε δη εκ της Ελλαδος, ευτελεστεραι. οιον τα ανθρακιον το εξ Ορχομενου της Αρκαδιας. εστι δ' ουτος μελαντερος του Χιου, κατοπτρα δε εξ αυτου ποιουσι. Quæ nascuntur in Græcia, vilissimæ; uti carbunculus ex Orchomeno Arcadiæ: est autem iste nigrior Chio (marmore); specula autem ex illo fiunt. *De lapid.* § 61.

‖ Ανθραξ, Ανθρακιον.

the latter, as well as the obsidian stone, was used sometimes for mirrors.

The account how mirrors were formed by the native Americans, before they had the misfortune to become acquainted with the Europeans, is of considerable importance in the history of this art. These people had indeed mirrors which the Europeans could not help admiring. Some of them were made of black, somewhat transparent, vitrified lava, called by the Spaniards *gallinazo*, and which is of the same kind as the obsidian stone employed by the Romans for the like purpose. Of this substance the Americans had plane, concave, and convex mirrors. They had others also made of a mineral called the Inca's stone,* which, as has been already said by Bomare, Sage, Wallerius, and other mineralogists,† was a compact pyrites or marcasite, susceptible of a fine polish; and on that account often brought to Europe, and

* Anton. de Ulloa, in his Voyage, according to the German translation, which makes the ninth volume of *Der Algemeinen historie der reisen*, p. 343.

† Bomare, Mineralogie, ii. p. 15 and 159. *Sage, Mineralogie.* Leipz. 1775, 8vo. p. 230. *Wallerii Systema mineralog.* ii. p. 133. *Gmelin, Natursystem des mineralreichs, nach Linné.* Nurnberg 1778, 8vo. ii. p. 489. *Recherches sur les Americains*, par Paw, ii. p. 184. Quant à la pierre des Incas, c'est une espèce de pyrite blanche, arsenicale, luisante comme de l'étain, ou du fer recuit, dont l'analogue est inconnu dans notre continent.—The last assertion, however, is undoubtedly false.

[This stone acquired its name from its being much used in ornaments by the Incas or Princes of Peru. TRANS.]

worn formerly in rings under the name of the stone of health. Ulloa says the Inca's stone is brittle, opake, and of a somewhat blueish colour; it has often veins which cannot be polished, and where these veins are it frequently breaks. The mirrors formed of it, which he saw, were from two to three inches in diameter; but he saw one which was a foot and a half. The opinion which some have entertained, that these mirrors were cast, has no other foundation than the likeness of polished marcasite to cast brass. This mineral is very proper for reflecting images; and I am inclined to think that the Peruvians had better mirrors than the Greeks or the Romans, among whom we find no traces of marcasite being employed in that manner. It appears, however, that the Indians had mirrors also of silver, copper, and brass.*

I come now to the question in what century were invented our glass mirrors, which consist of a glass plate covered at the back with a thin leaf of metal. This question has been answered by some with so much confidence, that one might almost consider the point to be determined; but instead of real proofs, we find only conjectures or probabilities; and I must here remark, that I cannot help thinking that they are older than has hitherto been supposed, however desirous I may be to separate historical truth from conjecture.

* De la Vega, ii. 28.

When I have brought together every thing which I know on the subject, I would say, that attempts were even made at Sidon to form mirrors of glass; but that they must have been inferior to those of metal, because they did not banish the use of the latter. The first glass mirrors appear to me to have been of black-coloured glass, or an imitation of the obsidian stone; and to have been formed afterwards of a glass plate with some black foil placed behind it.* At a much later period, blown glass, while hot, was covered on the inside with lead or some metallic mixture; and still later, and, as appears, first at Murano, artists began to cover plates of glass with an amalgam of tin and quicksilver. The newest improvements are, the casting of glass-plates, and the art of making plates equally large by blowing and stretching, without the expensive and uncertain process which is required for casting.

That glass mirrors were made at the celebrated glass-houses of Sidon, is mentioned so clearly by Pliny, that it cannot be doubted.† When I read the passage, however, without prejudice, without thinking of what others have said on it already,

* Montamy in *Abhandlung von den farben zum porzellan*, Leipzig 1767, 8vo. p. 222, asserts that he saw, in a collection of antiquities, glass mirrors which were covered behind only with a black foil.

† Aliud vitrum flatu figuratur, aliud torno teritur, aliud argenti modo cælatur, Sidone, quondam iis officinis nobili, siquidem etiam specula excogitaverat. Hæc fuit antiqua ratio vitri. *Lib.* xxxvi. cap. 26, p. 758.

and compare it with what certain information the ancients, in my opinion, give on the same subject, I can understand it no otherwise than as if the author said, that the art of manufacturing glass various ways was invented, principally, at Sidon, where attempts had been made to form mirrors of it. He appears therefore to allude to experiments which had not completely succeeded; and to say that such attempts, at the time when he wrote, had been entirely abandoned and were almost forgotten. Had this circumstance formed an epoch in the art, Pliny, in another place, where he describes the various improvements of it so fully, would not have omitted it; but of those experiments he makes no further mention.* All the inventions which he speaks of, evidently relate to metal mirrors only, of which the silver, at that time were the newest. Had the Sidonian mirrors consisted of glass plates covered at the back, those of metal, the making of which was, at any rate, attended with no less trouble, which were more inconvenient for use on account of their aptness to break, their requiring to be frequently cleaned and preserved in a case, and which were more unpleasant on account of the faint, dull image which they reflected, could not possibly have continued so long in use as they

* Atque ut omnia de speculis peraguntur hoc loco, optima apud majores fuerunt Brundisina, stanno et ære mixtis. Prælata sunt argentea. *Lib.* xxxiii. cap. 9, p. 627.

really did; and circumstances and expressions relative to glass mirrors must certainly have occurred. Though glass continued long to be held in high estimation, particularly at Rome; and though many kinds of glass-ware are mentioned in ancient authors, among costly pieces of furniture, mirrors are mentioned only among articles of silver plate. I am acquainted with no certain trace of glass mirrors from the time of Pliny to the thirteenth century; but after that period, at which they are spoken of in the clearest manner, we find them often mentioned in every century; and mirrors of metal at length entirely disappear.

How the Sidonian mirrors were made, is not known; but if I may be allowed a conjecture, I am of opinion that they consisted of dark-coloured glass, which had a resemblance to the obsidian stone. Such is the usual progress of inventions. At those periods one had no other representation of glass mirrors than that afforded by natural glass or vitreous stones. When artists wished to make mirrors of glass, they would try to imitate the latter. After the invention of printing, people endeavoured to render printed books as like as possible to manuscripts; because they imagined that this invention was to be approved only so far as it enabled them to imitate these, without observing that it could far excel the art of writing. But the Sidonian glass mirrors were so much surpassed by the silver or brass ones, which per-

haps were invented about the same time, that on this account they were never brought into use. Glass mirrors, perhaps, would have been invented sooner, had mankind employed at an earlier period glass-windows, which often, when they are shut on the outside so that no light can pass through them, reflect images in a much better manner than the best mirrors of metal. This observation, which may be made daily, would then, in all probability, have been sooner turned to advantage.

No one has employed a greater profusion of words to maintain an opinion opposite to mine, than Abat; but when his proofs are divested of their ornaments, they appear so weak that one has very little inclination to agree with him. "The observation," says he, "that a plate of glass is the best mirror, when all other rays of light, except those reflected back from the glass, are prevented, by a metallic covering placed behind it, from falling on the eye, is so easy, that it must have been made immediately after the invention of glass." Who does not think here of Columbus and his egg? Instances occur in history of many having approached so near an invention, that we are astonished how they could have missed it; so that we may exclaim with a certain Emperor, *Taurum toties non ferire difficile est.**

* Fuit præterea idem ingeniosissimus: cujus ostendentia acumen pauca libet ponere. Nam cum taurum ingentem in arenam misisset, exissetque ad eum feriendum venator, neque perductum decies potu-

"The Sidonian invention," continues he, "would not have been worth mentioning, had it not produced better mirrors than those which the ancients had before of the obsidian stone. But these even are mentioned only once, in so short and abrupt a manner, and as it were out of ridicule, that one may easily perceive they were not much esteemed." "If the Sidonians," adds he, "were not the inventors, let some other inventor be mentioned;" and he assures us that he had sought information on this subject, in Neri, Kunkel, and Merret, but without success. That I believe; but Abat does not remark that by the same manner of reasoning we may ascribe to the Sidonians the invention of watches, and many other articles, the inventors of which are not to be found in books where they ought as much to be expected as the inventor of glass in Neri. The grounds on which many old commentators of the bible, Nicholas de Lyra and others, have supposed that glass mirrors were known so early as the time of Moses, are still weaker. If quoting the names of writers who entertain a like opinion be of any weight, I could produce a much greater number of learned men, who, after an express examination of the question, deny altogether that glass mirrors were used by the ancients.

isset occidere, coronam venatori misit; mussantibusque cunctis, quid rei esset, quod homo ineptissimus coronaretur, ille per curionem dici jussit, *Taurum toties non ferire difficile est.* Trebell. Pollio, Vita Galien. cap. 12.

Dr. Watson,* also, has endeavoured to support the opinion of Abat, but with less confidence and with more critical acumen. His grounds, I think, I have weakened already; but one observation here deserves not to be over-looked, because it suggests an idea that may serve to illustrate a passage of Pliny,† which, as I before remarked, has never yet been explained. If we admit, says he, that Pliny was acquainted with glass mirrors, we may thus understand what he says respecting an invention, which was then new, of applying gold behind a mirror. Instead of an amalgam of tin, some one had proposed to cover the back of the mirror with an amalgam of gold, with which the ancients were certainly acquainted, and which they employed in gilding.‡ He mentions, also, on this occasion, that a thought had once occurred to Buffon, that an amalgam of gold might be much better for mirrors than that used at present.§ This conjecture appears, at any rate, to be ingenious; but when I read the passage again, without

* Chemical Essays. Cambridge 1786, vol. iv. p. 246.

† Nuper credi cœptum, certiorem imaginem reddi auro apposito aversis. *Lib.* xxx. cap. 9, p. 627.

‡ Plin. lib. xxxiii: Æs inaurari argento vivo, aut certe hydrargyro, legitimum erat. The first name here seems to signify native quicksilver, and the second that separated from the ore by an artificial process.

§ On pourroit trouver le moyen de faire un meilleur étamage, et je crois qu'on parviendroit en employant de l'or et du vifargent. *Hist. nat. supplem.* i. p. 451.

prejudice, I can hardly believe that Pliny alludes to a plate of glass in a place where he speaks only of metalline mirrors; and the over-laying with amalgam requires too much art to allow me to ascribe it to such a period without sufficient proof. I consider it more probable that some person had tried, by means of a polished plate of gold, to collect the rays of light, and to throw them either on the mirror or the object, in order to render the image brighter.

Professor Heeren showed me a passage in the Ecloga of Stobæus, which on the first view, seems to allude to a glass mirror.* It is there said, Philolaus the Pythagorean believed that the sun was a vitreous body, which only received the rays of the ethereal fire and reflected them to us like a mirror. When we compare, however, the words of Stobæus with those by which Plutarch,† Achilles Tatius,‡ Eusebius§ and others, express the

* Φιλολαος ὁ Πυθαγορειος, ὑαλοειδη τον ἡλιον, δεχομενον μεν τον εν τῳ κοσμῳ πυρος την ανταυγειαν, διηθουντα δε προς ἡμας το τε φως και την αλεαν, ὡστε τροπον τινα διττους ἡλιους γιγνεσθαι, το, τε εν τῳ ουρανῳ πυρωδες, και το απ' αυτου πυροειδες κατα το εσοπτροειδες· ει μη τις και τριτον λεξει την απο του ενοπτρου κατ' ανακλασιν διασπειρομενην προς ἡμας αυγην. Philolaus vitreæ naturæ solem fecit, qui ut cœlestis ignis radios reciperet, ita lumen simul cum calore ad nos transfunderet; sic ut duo quodam pacto sint soles, nempe cœlestis ignis, et qui inde tanquam in speculum transfunditur; nisi quis etiam tertium velit addere, radium a speculo ad nos reflexum. *Stob. Eclog.* edit. Antverp. 1575. fol. p. 56.

† De placitis philosoph. ii. cap. 20.

‡ Isagoge in Aratum, cap. 19. § Lib. i. cap. 8.

same thing, that meaning cannot be drawn from them. It appears, at first, as if Philolaus had considered the sun to be transparent, and supposed that the rays passed through it, and came condensed to our earth, in the same manner as they are brought to a focus by a glass globe. Some commentators have explained the passage in this manner; and on account of the affinity of the Greek words have thought also of a funnel. In that case, however, the comparison of the sun with a mirror would not have been just; and if it be admitted that Philolaus considered the sun as a bright body endowed with the property of reflection, what he says of rays passing or transmitted through it, and of the pores of the sun's body, will become unintelligible. But even if we adopt the last explanation, that Philolaus imagined the sun to be a mirror, it does not follow that he had any idea of a glass one;* and, besides, he only speaks of a body capable of reflecting a strong light; and that glass, under certain circumstances, is fit for that purpose, may have been remarked as soon as it was invented, though men might not find out the art of forming it into proper mirrors by placing

* It is undoubtedly certain, that ὑαλος, which is translated *vitreous* or *glassy*, means any smooth polished body capable of reflecting rays of light. Originally it signified a watery body; and because watery bodies have a lustre, it was at length used for glass. See *Salmas. ad Solin.* p. 771. Hesychius, therefore, explains ὑαλοεις and ὑαλον by λαμπρου.

some opake substance behind it.* Empedocles also said, that the sun was a mirror, and that the light received by our earth was the reflection of the ethereal fire, which Eusebius compares to the reflection made by water.†

* More observations respecting the opinion of Philolaus may be found in the edition of Plutarch's work *De placitis philosophorum* by Ed. Corsinus, Florentiæ 1750, 4to. p. 61, and p. 23. I shall here add how it is understood by Riccioli, in his *Almagestum novum*, i. p. 93: Solem non esse omnino opacum, sed tanquam crystallum densissimum, ita diaphanum esse, ut in profunditatem corporis solaris visus noster se insinuet, et radii ad nos propagentur, non ex sola superficie, sed etiam ex centro, solis. The opinion of Empedocles is explained in *I. N. Frobesii Specimen polyhistoris heliographici.* Helmstadii 1755, 4to. p. 30.

† Professor Heeren having given me his opinion on this passage of Stobæus, I shall here insert it for the satisfaction of the learned reader. The critics, says he, will hardly be persuaded that the words και το απ' αυτου πυροειδες κατα το εσοπτροειδες are correct, as they can be translated different ways. With regard to the explanation of the matter, I build only on the plain meaning of the words. The author tells us, that Philolaus thought the sun to be a mirror; but we must conclude that he speaks of a mirror such as were then in use; a smooth plate of metal, and not a globe. In this case the first explanation of a glass globe falls to the ground. This is confirmed by Eusebius, who calls it υαλοειδης δισκος, though it is possible that the latter word may be a gloss added by some grammarian, or by Eusebius himself. If we enter further into the explanation, we must adopt the plain idea, that the rays of the sun fall upon this plate, and are reflected to us. (διηθουνται - - - κατ' ανακλασιν). I am however of opinion, that υαλος here ought to be translated *glass*, υαλοειδης *glassy* or *vitreous*; for the intention of Philolaus evidently was to define the substance of the sun's body. The result of the whole is, Philolaus considered the sun as a plain plate of glass which reflected the rays or brightness of the ethereal fire. But that he was acquainted with a proper glass mirror does not thence follow with certainty.

In the problems ascribed to Alexander of Aphrodisias, glass mirrors, covered on the back with tin, are clearly mentioned;* but this information does

* As all the Greek editions of these *Problemata* are scarce, I shall here give the whole problem in the original. Διατι τα ὑελινα κατοπτρα λαμπουσιν αγαν; Ὁτι ενδοθεν αυτα χριουσι κασσιτερῳ. πεφυκε δ' αυτου ἡ φυσις διαυγης. και τῃ ὑελῳ αναμιγνυμενη, λαμπρα ουση, πλεον διαυγαζεται και τας ιδιας ἀκτινας δια των πορων της ὑελου πκραπεμπουσα, διπλασιαζει το επιπολης και εκτος του σωματος της ὑελου· και ὁυτως γινεται σφοδρα λαμπουσα. This problem may be found also in the very scarce edition of Aristotle, by Aldus, Venice 1495; in the edition of Sylburg, printed at Mechlin, p. 292; and in the Paris edition of the *Problemata*, by Conrade Neobarius, 1541, 12mo: Αλεξανδρου Αφροδισιεως Ιατρικα απαρηματα και φυσικα προβληματα. In all these editions there is an addition, which however does not seem to belong to the problem; and which, as Sylburg says, is wanting in the oldest manuscripts. Theodore Gaza must not have found this problem in his manuscript, as it is not in his translation printed along with the problems of Aristotle, at Paris, in quarto, without any date, with a preface by Martial Campius Carhoffinus, though it contains the next problem: Quam ob causam in speculis atque aquis dilucidis nostram speciem conspicere valeamus. But it occurs, No. 132, in the edition of Politian, printed at Paris, in quarto, (*Prostant in ædibus Nicolai Beraldi*). It is inserted also in the Latin edition of *Various Problems:* Amstelod. apud Joan. Wæsbergios, 1685, 12mo. p. 219. In all these the addition is wanting; but it is inserted in the following edition: *Alex. Aphrod. Problemata—Græce et Latine*; *Joannis Dauioni studio illustrata,* Parisiis 1541, 12mo. The translation in this work I shall here transcribe:—Quare vitrea specula splendeant plurimum? Quoniam stanni natura, quo intus illinuntur, cum sit pellucida, vitro ex se perspicuo commista, magis resplendet, et radios suos per vitri exiguos meatus transmittens, ac externam illius corporis faciem duplicans, reddit magnopere lucidam. Qualitatum porro aliæ quidem vires suas in profundum nequaquam transmittunt; ut album, nigrum, fulvum et hujusmodi; aliæ penitus transfundunt per transmutationem, ut frigus, calor, siccitas, humor, quæ propterea, ad discrimen et comparationem supra dictarum, effectrices qualitates a

not lead us one step further in the history of the art; as it is proved that the above Alexander, who lived in the beginning of the third century, could not have written that work. The author, who must have been a physician, maintains the immortality of the soul, which Alexander of Aphrodisias, with Aristotle, denies. Some, therefore, have ascribed these problems to Alexander Trallianus, who practised physic in the middle of the sixth century; but this is only a conjecture which no one has as yet rendered probable, especially as there have been many physicians of the name of Alexander. The problem to which I allude is not to be found in every manuscript and edition; so that it is doubtful whether it may not be the production of a later author than that of the rest of the book, particularly as it is certain that many who had it in their possession added problems of various kinds according to their pleasure. However this may be, it is evident that the author of this problem was acquainted with mirrors covered at the back; and the expression which he uses does not merely imply that a leaf of tin was placed behind the glass plate, but that the tin in a liquid state was rubbed over it. The old French trans-

philosophis et medicis appellantur. -- A good account of the different editions of this book may be found in the edition of Aristotle printed at Deux-Ponts under the inspection of Professor Buhle, vol. i. p. 289.

lator thinks that the author speaks of windows; but that opinion is undoubtedly false.*

Of as little importance as the above passage of Alexander, is another of Isidore, often quoted in support of the antiquity of glass mirrors. On the first view it appears to be a testimony of great weight; but when closely examined it becomes reduced to very little. "Nothing," says he, "is "so fit for mirrors as glass.†" Abat and others, who have considered these words as decisive, make less hesitation to ascribe to the sixth century, in which Isidore lived, a knowledge of mirrors covered on the back with tin and quicksilver, as the same writer, in another place, observes, that quicksilver can be kept in no vessel but one of glass.‡ It is very true that a glass filled with that semi-metal will form a very good mirror; but I am of opinion that this may have been long known before people thought of making an amalgam of tin and quicksilver in order to cover the backs of

* Pourquoy reluient les fenestres de verre si fort? Pourtant que la nature de l'estain, duquel elles sont basties par dedans, fort clere, meslée avec le verre cler aussi de lui mesme reluyst d'avantage; et le quel estain outrepassant ses raïons par les petits pores du verre, et augmentant doublement la face exterieure du dit verre, la rend grandement clere. *Les problemes d'Alexandre Aphrod.—traduit de Grec en François*—par M. Herret. A Paris 1555, 8vo. p. 50. n. 131.

† Origin. lib. xvi. 15. p. 394.

‡ Servatur autem melius in vitreis vasis; nam cæteras materias perforat. Orig. xvi. 18, p. 396.

mirrors. The first passage, which is properly the one of any consequence, loses its force when it is seen that it is taken from Pliny and copied incorrectly. The latter says, that one can give to glass every kind of shape and colour, and that no substance is more ductile, or fitter to be moulded into any form.* Isidore, as is usual, says the same thing, and in the same words, except, that instead of *sequacior* he substitutes *speculis aptior;* so that the mention of a mirror is altogether unexpected, and so little suited to what goes before and what follows, that one must believe that this alteration, occasioned perhaps by the similitude of the words, or by an abreviation, was not made by Isidore, but by some transcriber.† But even if we believe that Isidore himself spoke of glass being used at that period for mirrors, we are not able to comprehend, from what he says, how glass mirrors were made in the sixth century.

I have met with no information respecting this subject in the whole period between the age of

* Fit et album et murrhinum, aut hyacinthos sapphirosque imitatum, et omnibus aliis coloribus. Nec est alia nunc materia sequacior, aut etiam picturæ accommodatior. Maximus tamen honos in candido translucentibus, quamproxima crystalli similitudine. *Lib.* xxxvi. cap. 26, p. 759.

† This reading in Isidore, however, must be old, for it is quoted by *Vincentius Bellovacensis*, lib. vi. cap. 77, p. 415. He quotes also the words of Pliny, lib. vii. cap. 77, p. 474, but with a little variation, as follows: Nec est materia sequacior vel picturæ scilicet accommodatior.

Isidore and the eleventh century. About the year 1100, at least as is supposed not without probability, Alhazen the Arabian wrote his well-known treatise on Optics,* in which I conjectured that I should find mention made of glass mirrors; but I searched that work in vain, though I must confess I did not read it through entirely. Where he begins his catoptrical lessons, he, however, often speaks of iron mirrors, by which we may understand mirrors of the best steel. In explaining a certain phænomenon, he says, that the cause of it cannot be in the darkness of the iron mirror, because, if a mirror of silver be used, the same effects will be produced.† Would he not on this occasion have introduced glass mirrors, had he been as well acquainted with them as with those already mentioned? At first, he never speaks of mirrors without adding of iron, of silver; but he mentions them afterwards without any epithet of the kind.

All these mirrors I find also in the Optics of Vitello,‡ who wrote in the middle of the thirteenth century, in Italy, a country which was at

* Opticus thesaurus Alhazeni, Arabis,—item Vitellonis Libri x. Omnes instaurati a Frederico Risnero. Basiliæ 1572, fol.

† Page 102, 103, 106. Speculum ferreum.—Sed dicet aliquis, caussam hujus rei esse nigredinem speculi ferrei, --- verum quod hoc non sit in caussa, palam ex eo est, quod, loco speculi ferrei, argenteo posito, eadem accidit probatio.

‡ Page 191, 195, 196, 197. Speculum e ferro mundo.

that time almost the only one where the arts flourished.* That author has, indeed, borrowed a great deal from Alhazen, though there are many things of his own, and he gives an account of some experiments on the refracting power of glass; but he never, as far as I have observed, mentions glass mirrors. Whether Jordanus Nemorarius, or Nemoratius, who also wrote, in the thirteenth century, a book *De speculorum natura*, makes mention of them, I do not know, because I have never had an opportunity of seeing that work. I am of opinion it was never printed.

It is in the thirteenth century however that I find the first undoubted mention of glass mirrors covered at the back with tin or lead. Johannes Peckham, or Peccam, an English Franciscan monk, who taught at Oxford, Paris, and Rome, and who died in 1292, wrote about the year 1279 a treatise of optics, which was once printed, with the title of *Johannis Pisani Perspectiva communis.*†

* Bayle, Diction. Histor. vol. iv. p. 462.

† Fabricius, in *Biblioth. medii ævi*, vol. iv. p. 331, says it was printed at Venice. Wolf, in *Unterrichten von mathematischen schriften*, quotes an edition printed at Cologne in 1624, eleven sheets quarto. By the friendship of professor Reuss, I have now before me the following scarce edition: *Perspectiva Joannis Pisani Anglici, viri religiosi, vulgo communis appellata. -- In gymnasio Lipzensi emendata atque in figuris quam diligentissime rectificata.* Thirty-eight leaves, small folio, with monkish writing, and a broad margin, on which the coarse figures are printed. At the end stands: Explicit Perspectiva Pisani communis dicta, in felici gymnasio Lipsensi emendata revisaque. Impressa arte et sollertia Baccalarii

In this work, besides mirrors made of iron, steel, and polished marble, the author not only speaks often of glass mirrors, but says also that they were covered on the back with lead, and that no image was reflected when the lead was scraped off.* Vincentius Bellovacensis† speaks in a manner still clearer, for he tells us that lead was poured over the glass plate while hot. To the same century also belongs the testimony of Raimundus Lullius,‡

Martini Herbipolensis. an. dom. 1504. Respecting this edition, and the name *Pisanus*, which seems to have been a bye-name given by some one to Peckham, compare *Einleitung zur mathematischen bücherkenntniss*, part ix. p. 280 and 284.

* Si res in speculo ostenduntur per radios reflexos, ut jam patet igitur perspicuitas, per quam species in profundum ingreditur speculi, impeditur, non expedit visionem, quoniam reflexio est a denso per primum hujus, quia densum est, propter quod specula vitrea sunt plumbo subducta. Quod si, ut quidam fabulantur, dyaphoneitas esset essentialis speculo, non fierent specula de ferro et calibe, et a dyaphoneitate remotissimis. Nec etiam de marmore polito, cujus contrarium tamen videmus. In ferro autem et hujusmodi, propter intensionem nigredinis, non est efficax speculatio. In quibusdam tamen lapidibus debilis coloris multo clarior est speculatio quam in vitris. *Propos.* 7.

In speculis vitreis plumbo abraso nihil apparere. *Propos.* 4.

† Metalla videmus esse specula, quando polita sunt et tersa, ut ferrum, argentum et talia. Idem quoque videmus de quibusdam politis lapidibus - - - Argentum bene politum inter omnia metalla melius est speculum, quia in colore magis accedit ad diaphanum. - - - At inter omnia melius est speculum ex vitro et plumbo, quia vitrum propter transparentiam melius recipit radios, plumbum non habet humidum solubile ad ipso, unde quando superfunditur plumbum vitro calido - - - efficitur in altera parte terminatum valde radiosum. *Specul. natur.* ii. 78. p. 129.

‡ In speculo vitrum existit inter plumbum et aerem et figuram sive colorem qui ei præsentatur. Ars magna, cap. lxvii. p. 517, in

Roger Bacon,* Antonius di Padua,† and Nicephorus Gregoras,‡ who died after the year 1360.§

That this invention cannot be much older, we have reason to conclude, because glass mirrors were extremely scarce in France even in the fourteenth century, while mirrors of metal were in common use; and we are told that the mirror of Anne de Bretagne, consort of Louis XII, was of the latter

Lullii Opera quæ ad inventam ab ipso artem pertinent. Argentorati 1607, 8vo.

* Imago major fit per reflexionem a speculo, quia speculum densum est, et habet plumbum ab altera sui parte, quod impedit speciei, et ideo speculum habet unde recipiat imaginem et reddat. *Opus majus, edidit S. Jebb.* Londini 1733, fol. p. 346.

† Speculum nihil aliud est quam subtilissimum vitrum. *Dominica V post Pascha,* p. 210. In *Francisci Assisiatis et Antonii Paduani Opera.* Lugduni 1653, fol.

‡ Εισι γαρ και εξ ὑελων κατοπτρα, και εκ σιδηρου, καὶ εξ αλλης ὑλης. Sunt enim ex vitro specula et ex chalybe et alia materia. *Nicephori Scholia in Synesium,* at the end of Synesii Opera, interprete Dionysio Petavio. Lutetiæ 1612, fol. p. 419.

§ In the collection of antiquities at St. Denis, an ancient mirror was shown, which was said to have belonged to Virgil. It was oval, and, before Mabillon let it fall, was fourteen inches in length, and twelve in breadth, and weighed thirty pounds. It is transparent, and of a brownish-yellow colour. According to experiments made on purpose, it was found to consist of artificial glass, mixed with a considerable portion of lead; and as it had been preserved in the above collection from the earliest periods, the practice of adding lead to glass must be very old. But whether this mirror was covered at the back, and how it was covered, though these are the most important points, I find no where mentioned. In the collection of the Grand Duke of Tuscany there is a piece of the same kind, said also to have been the mirror of Virgil. See *Le Veil, Kunst auf glas zu malen,* Nurnberg 1779, 4to. p. 23, and *Hist. de l'Acad. des sciences à Paris, année* 1787, p. 412.

kind.* Metal mirrors also were made and employed in Persia and the East, where indeed ancient usages continued longest, and glass mirrors were not known there till the commencement of the European trade with these remote regions. The former are still preferred in those countries, because they are not so liable to break, and can be preserved better in a dry hot climate than the amalgam of the latter.†

Respecting the progress of this art, I know nothing more than what follows: At first, melted lead, or perhaps tin, was poured over the glass plate while yet hot as it came from the furnace. This process agrees with that which, since very early periods, has been employed in or around Nuremberg for making convex mirrors by blowing with the pipe into the glass-bubble still hot a metallic mixture, with a little resin or salt of tartar, which prevents calcination, and assists the fusion. When the bubble is covered all over in the inside, and after it has cooled, it is cut into small round mirrors. This art is an old German invention, for it is described by Porta‡ and Garzoni,§ who both lived in the beginning of the sixteenth century, and who both expressly say, that it was

* This is related by Villaret in his continuation of *Histoire de France*, begun by Velly. Paris 1763, tome xi. p. 142.

† Voyage de Chardin. Rouen 1723, 8vo. iv. p. 252.

‡ Magia natural. xvii. 22. p. 618. *Zahn, Oculus artificialis.* Herbipoli 1686, fol. iii. p. 171.

§ Piazza universale, disc. 145, p. 383.

then common in Germany. Curious foreigners often attempted to learn it, and imagined that the Germans kept it a secret. Mr. Boyle* made various experiments in order to discover the process; and the secretary of the Royal Society endeavoured, by means of the ambassador from Charles II, who, perhaps about 1670, resided at Franckfort, to obtain a knowledge of it; but did not succeed, as we are told by Leibnitz.† It was called the art of preparing mirrors without foil; and it was highly esteemed, because it was supposed that it might be useful to those fond of catoptrics, by enabling them to form convex and concave mirrors themselves. This account of Leibnitz seems to have led Mr. Von Murr‡ into a small error, and induced him to believe that the art of making convex mirrors without foil was first found out at Nuremberg in 1670. I introduce this remark because I flatter myself he will not be displeased that I

* De utilitate philosophiæ natur. experimentalis. Lindaviæ 1692, 4to. exercit. viii. § 46, 48. p. 536. The original was printed at London in 1664.

† Miscellanea Berolinensia, tom. i. p. 263: De arte Norimbergensi specula vitrea conficiendi sine foliis. I find this account inserted also in *Historisch-diplomatisches magazin für das vaterland*, Nurnberg 1781, 8vo. i. p. 115; but nothing further is said respecting the art, than that it was daily used in the glass-houses. Had I an opportunity, I should make experiments of every kind in order to discover a method of forming plane mirrors also in the like manner.

‡ Beschreibung der merkwürdigkeiten in Nürnberg, 1778, 8vo. p. 737.

make the above service, rendered by his native city, to be a century and a half older. These small convex mirrors, which reflect a diminished, but a clearer image than our usual mirrors, are perhaps made still, though they are not now carried round so frequently for sale in Germany as they were thirty years ago, at which time, if I remember right, they were called (*ochsen-augen*) ox-eyes. They were set in a round painted board, and had a very broad border or margin. One of them, in my possession, is two inches and a half in diameter. It is probable that the low price of plane mirrors, when glass-houses began to be more numerous, occasioned these convex ones to be little sought after. The mixture employed in making them, was, according to Porta, antimony, lead, and colophonium; but according to Garzoni, it was *una mistura di piombo, stagno, marchesita d'argento, e tartaro,* which in the German edition is translated very badly, "lead, tin, flint, silver, and tartar." The following observation perhaps is not altogether useless: Colophonium, which is employed on many other occasions for soldering, was formerly called mirror-resin, and was sold under that name even in the beginning of the present century. Frisch assigns no reason for this appellation, and Jacobson gives a wrong one, viz. its having a bright shining surface when broken. The true reason was the above-mentioned use;

and as that is now very little known, it is called from that to which it is principally applied, violin-resin

It appears, that, instead of pouring melted metal over plates of glass, artists for some time applied to them the before-mentioned amalgam of tin, or covered them in some other manner, perhaps in the same as Boyle covered concave glasses in the inside.* Porta however saw almost the same process employed at Murano as that which is still followed at present. The tin hammered to thin leaves was spread out very smoothly; and quicksilver was poured over it, and rubbed into it, either with the hand or a hare's foot; and when the tin was saturated it was covered with paper. The glass, wiped exceedingly clean, was then laid above it; and while the workman pressed it down with his left hand, he drew out very carefully with his right the paper that lay between the tin and the glass, over which weights were afterwards placed.† This much at any rate is certain, that the method of covering with tin foil was known at Murano so early as the sixteenth century,‡ and

* Page 536. The receipt may be seen translated in that well-known work, *Croker's Mahler*. Jena 1778, 8vo. p. 421.

† Magia natural. xvii. 22. p. 619. The whole process is described by Zahn in a manner still clearer. See his work before quoted. Hartsoeker also gives directions for covering concave mirrors in the like manner, in *Acta Berolin.* i. p. 262.

‡ Wecker, in his book *De secretis*, lib. x. p. 572, seems to say, that one must lay the saturated tin leaf so carefully on the glass plate,

therefore it is much older than J. M. Hoffmann supposes.* To conclude, whether this ingenious invention belongs to the Venetians, as several later, and particularly Italian, writers assert, I can neither prove nor contradict; but it is well known, that till about the end of the seventeenth century, their mirrors were sold all over Europe and in both the Indies. After that period the glass-houses in other countries were improved, and new ones established; and the discovery made in France, that glass, like metal, could be cast into much larger plates than had been before prepared by blowing and rolling, was in more than one respect prejudicial to the sale of those made at Venice.

So early as the year 1634, attempts were made in France to establish glass-houses for manufacturing mirrors, and Eustache Grandmont obtained

that no air can settle between them. According to Garzoni, the tin leaf is spread out on a smooth stone table, and after it has been rubbed over with quicksilver, the glass is placed above it.

* Amalgama ex parte una Jovis et partibus tribus Mercurii vivi ad posticam speculorum superficiem obducendam usuale habetur, quamvis Veneti hodie ex tempore tale conficiant impositæ futuræ speculi superficiei interiori laminæ Joviali tenuiori Mercurium vivum superaffundendo, illius meatus in momento subintrante, atque amalgama relinquente, residuo fluido mox detergendo. *Acta laboratorii chemici Altdorfini.* Norimb. 1719, 4to. p. 245.—It appears to me, that the process is here described as if the glass plate were first covered with tin leaf and the quicksilver afterwards poured over it. It is described in the same manner by Macquer in *Algem. begriffe der chemie*, edition of Porner, ii. p. 635. Of that used at present I have given a short account in *Anleitung zur technologie*, p. 348.

a patent for that purpose; but his undertaking was not attended with success. As Colbert exerted himself very much to promote manufactures of every kind, Nicholas de Noyer proposed to make mirrors according to the Venetian method. This plan was adopted by Charles Riviere, sieur du Freni, valet-de-chambre to the king; and having procured the royal permission, he sold it afterwards for a large sum to De Noyer, who, in 1665, received a confirmation of the patent, and an advance of 12,000 livres for four years, on condition of his procuring workmen from Venice, who, after serving eight years in the kingdom, were to be naturalized. De Noyer was joined by several more, who entered into partnership with him, and particularly by one Poquelin, who had hitherto carried on the greatest trade in Venetian mirrors, and who engaged workmen from Murano. The glass-houses were erected at the village of Tourlaville, near Cherbourg, in Lower Normandy. After the death of Colbert, who was succeeded by Louvois, the charter of the company was in 1684 renewed for thirty years longer, and at that period Pierre de Bagneux was at the head of it.

Scarcely had five years of this period elapsed, when, in 1688, Abraham Thevart made a proposal to the court for casting glass mirrors of a much larger size than any ever before made. This plan, after an accurate investigation, was approved; and in the same year he received the royal permission

to use his invention for thirty years, but it was not registered till 1693 or 1694. The first plates were cast at Paris, and astonished every artist who saw them. They were eighty-four inches in height, and fifty in breadth. In order to lessen the excessive expense, the glass-houses were erected at St. Gobin, in Picardy; and to prevent all dispute with the old privileged company, Thevart was expressly bound to make plates at least sixty inches in length, and forty in breadth, whereas the largest of those made before had never exceeded forty-five or fifty inches in length. On the other hand, the old company were allowed to make plates of a smaller size, and were prohibited from employing any of the instruments or apparatus invented by Thevart. These however had not been so accurately defined as to remove all cause of litigation between the companies, and for that reason permission was at length granted, in 1695, for both to be united into one, under the inspection of François Plastrier, to whom the king in 1699 sold the palace of St. Gobin. After this they declined so rapidly, that in 1701 they were not able to pay their debts, and were obliged to abandon several of the furnaces. To add to their misfortune, some of the workmen whom they had discharged, retired to other countries, which were already jealous of the French invention, and wished to turn it to their advantage. The French writers assert, that their attempts never succeeded, and that most of the

workmen returned again to France, when a new company was formed in 1702, under the management of Antoine d'Agincourt, who by prudent œconomy improved the establishment, so as to render the profit very considerable. At present, mirrors are cast as well as blown, both at St. Gobin and at Cherbourg; and in 1758 the price of them was greatly reduced, in order probably to weaken the competition of the foreign glass-houses, among which there are many not inferior to the French.

This short history of the glass manufactories in France is collected from Savary* and Expilly.† A more particular account perhaps may be expected of the inventor, of his first experiments, and of their success; but notwithstanding a strict search, I have not been able to find any further information on the subject. We are told only that his name was sieur Abraham Thevart, though the historians who record that circumstance have filled their pages with uninteresting anecdotes, and even with the vices of many of the courtiers of the same period.

The principal benefit which has arisen to the art from this invention, properly is, that much

* Tome iii. p. 87. art. *Glace*. A translation of it has been inserted in *Gemeinnützige natur- und kunst-magazin*, i. p. 293.

† Dictionnaire géographique de la France. Amsterd. 1762, 1770, fol. v. p. 415. The article however seems to be taken from Savary. Some additions may be found p. 672.

larger mirrors can be obtained than formerly; for when attempts were made to blow very large plates, they were always too thin. Casting, however, besides great expense in apparatus,* requires so many expert workmen, and so tedious and severe labour, and is accompanied with so much danger, that it is only seldom that plates of an extraordinary size succeed, and the greater part of them must be cut into smaller plates which might have been blown. Those cast are never so even and smooth as those that have been blown; they require therefore a great deal of polishing, and on that account must be very thick. The monstrous mass requisite for a mirror of the largest size, stands ready melted in a very frail red-hot earthen pot, which is taken from the furnace and placed upon an iron plate, strongly heated, that the mass may be cast upon it into a glass plate. The latter must then be speedily conveyed to the cooling furnace, and if it be found free from faults, it is ground, polished, and silvered; but the last part of the process is generally done at the place where a purchaser can be found for so expensive an article, in order that less loss may

* A furnace for casting large glass plates, before it is fit to be set at work, costs, it is said, 3,500*l.* It seldom lasts above three years, and even in that time it must be repaired every six months. It takes six months to rebuild it, and three months to repair it. The melting-pots are as big as large hogsheads, and contain above 200 weight of metal. If one of them burst in the furnace, the loss of the matter and time amounts to 250*l.* TRANS.

be sustained in case it should happen to break by the way.

These great difficulties, which have excited the astonishment of every one who has seen the process, and that of finding sale for so expensive and magnificent wares, have obliged artists to return to the old method of blowing; and many have been so fortunate in improving this branch of manufacture, that plates are formed now by blowing, sixty-four Flemish inches in height, and twenty-three in breadth, which it was impossible to make before but by casting.

The mass of matter necessary for this purpose, weighing more than a hundred pounds, is by the workman blown into the shape of a large bag; it is then reduced to the form of a cylinder, and being cut up, is, by stretching, rolling it with a smooth iron, and other means not yet known but to those employed in the art, transformed into an even plane.

GLASS-CUTTING. ETCHING ON GLASS.

I DO not here mean to enter into the history of engraving on stone, as that subject has been already sufficiently illustrated by several men of learning well acquainted with antiquities. I shall only observe, that the ancient Greek artists form-

ed upon glass, both raised and engraved figures; as may be seen by articles still preserved in collections, though it is probable that many pieces of glass may have been moulded like paste; for that art also is of very great antiquity.* It appears likewise that they cut upon plates of glass and hollow glass vessels all kinds of figures and ornaments, in the same manner as names, coats of arms, flowers, landscapes, &c. are cut upon drinking-glasses at present.† If we can believe that learned engraver in stone, the celebrated Natter, the ancients employed the same kind of instruments for this purpose as those used by the moderns.‡ They undoubtedly had in like manner a wheel which moved round in a horizontal direction above the work-table, or that machine which by writers is called a lapidary's wheel.§

If this conjecture be true, what Pliny says‖ respecting the various ways of preparing glass is

* Traité des pierres gravées, par Mariette. Paris 1750, fol. i. p. 92, 210.

† If I am not mistaken, the two ancient glasses found at Nismes, and described in Caylus' *Recueil d'antiquités*, ii. p. 363, were both of this sort.

‡ Traité de la méthode antique de graver en pierres fines, comparé avec le methode moderne; par Laur. Natter. Londres 1754, fol.

§ I say by writers, because I never heard that word used by workmen; and the same is the case with the word *fritte*, which, though common in books, is in most glass-houses not known.

‖ Aliud flatu figuratur, aliud torno teritur, aliud argenti modo cælatur. *Lib.* xxxvi. 26. p. 758.

perfectly intelligible. It is turned, says he, by the wheel, and engraven like silver. In my opinion we are to understand by the first part of this sentence, that the glass was cut by the wheel, like stone, both hollow and in relief, though it is possible that drinking-cups or vessels may have been formed from the glass metal by means of the wheel also.* In the latter part of the sentence, we must not imagine that Pliny alludes to gravers like those used by silver-smiths, for the comparison will not apply to instruments, or to the manner of working, which in silver and glass must be totally different; but to the figures delineated on the former, which were only cut out on the surface in a shallow manner; and such figures were formed on glass by the ancient artists, as they are by our glass-cutters, by means of a wheel.

Many, however, affirm, that the art of glass-cutting, together with the necessary instruments, was first invented in the beginning of the 17th century. The inventor is said to have been Caspar Lehmann, who originally was a cutter of steel and iron; and who made an attempt, which succeeded, of cutting crystal, and afterwards glass, in the like manner. He was in the service of the emperor Rodolphus II, who, in the year 1609,

* Of this kind were the *calices audaces* of Martial, xiv. 94, and those cups which often broke when the artist wished to give them the finishing touch.

besides presents, conferred on him the title of lapidary and glass-cutter to the court, and gave him a patent by which every one except himself was forbidden to exercise this new art. He worked at Prague, where he had an assistant named Zacharias Belzer; but George Schwanhard the elder, one of his scholars, carried on the same business to a far greater extent. The latter, who was a son of Hans Schwanhard, a joiner at Rothenburg, was born in 1601; and in 1618 went to Prague to learn the art of glass-cutting from Lehmann. By his good behaviour he so much gained the esteem of his master, who died a bachelor in 1622, that he was left his heir; and obtained from the emperor Rodolphus a continuation of Lehmann's patent. Schwanhard, however, removed to Nuremberg, where he worked for many of the principal nobility; and by these means procured to that city the honour of being accounted the birthplace of this new art. In the year 1652 he worked at Prague and Ratisbon by command of the emperor Ferdinand III, and died in 1667, leaving behind him two sons, who both followed the occupation of the father. The elder, who had the same Christian name as the father, died so early as 1676; but the other, Henry, survived him several years. After that period Nuremberg produced in this art more expert masters, who, by improving the tools, and devising cheaper methods

of employing them, brought it to a much higher degree of perfection.*

That the art is of so modern date, seems to be confirmed by Zahn, who speaks of it as of a new employment carried on, at that time, particularly at Nuremberg. He describes the work-table, as well as the other instruments; and gives a figure of the whole, which he appears to have considered as the first.† It may be seen, however, from what I have already quoted, that this invention does not belong entirely to the moderns; and, to deny that the ancients were altogether unacquaint-

* This account may be found in *Sandrart's Teutsche akademie*, vol. i. part 2, p. 345, where the express words of the Imperial patent are given; but in the new edition by Dr. Volkman very little of it has been retained. Besides many other faults of this edition, much valuable information respecting the German artists has been omitted. Those who may be desirous of writing on the present subject must have the first edition. Compare also *Doppelmayr, Nachricht von Nürnberg künstlern*, p. 231, 232, 237.

† Non ita pridem innotuit pulcerrimum artificium quascunque imagines etiam contrafacturas, quascunque figuras, notas et scripturas curiosissime in vitra incidendi; præcipue autem vitra potiora illo solent ornari. Norimbergæ modo fuit artifex, qui imagines contrafacturas artificiosissime iisdem incidendo exhibuit. Vidi tale vitrum potorium ab eo elaboratum non adeo magnum, cujusdam principis Germaniæ effigiem nitidissime ac perfectissime præsentans, pretio quadraginta imperialium ab eodem coemptum; multo autem majoris adhuc pretii alia ab eodem artifice confecta audivi arte singularissima, qua incidendo ac interendo ita effigiat imagines, ut non intritæ ac impressæ compareant, velut in iis vitris quæ communiter distrahuntur ac venduntur, sed emineant et extent elatiores, perfectissimeque sint expolitæ. *Oculus artificial.* iii. p. 79. In the last part of this quotation Zahn alludes to images which were affixed to glass-ware intended for common use.

ed with it, would be doing them an injustice. It was forgotten and again revived; and this is the opinion of Caylus.*

I must here remark, that, before this invention, there were artists, who, with a diamond, cut or engraved figures on glass which were every where admired. Without entering, however, into the history of diamonds, which would require more materials than I have yet been able to collect, I will venture to assert that the ancient artists employed diamond dust for polishing or cutting other kinds of stones. Pliny† speaks of this in so clear a manner that it cannot be doubted. The same thing has been repeated by Solinus,‡ Isidore,§ and Albertus Magnus,‖ in a manner equally clear, and Mariette¶ considers it as fully proved; but it does not appear that the ancients made any attempts to cut this precious stone with its own dust: I mean to give it different faces and to render it brilliant. Whether they engraved on it in that manner I cannot pretend to decide, as the greatest artists are not agreed on the subject.

* Recueil d'antiquités, ii. p. 363.

† Expetuntur a scalptoribus, ferroque includuntur, nullam non duritiam ex facili cavantes. *Lib.* xxxvii. 4. p. 773.

‡ Fragmenta scalptoribus in usum insigniendæ cujuscunque modi gemmæ expetuntur. *Cap.* 52. p. 59.

§ Adamantis fragmentis scalptores pro gemmis insigniendis perforandisque utuntur. *Origin.* xvi. 8.

‖ Hic lapis penetrat ferrum et ceteras gemmas omnes, præter chalybem, in quo retinetur. *De miner.* lib. ii. 2.

¶ Mariette, Traité des pierres gravées, i. p. 90 and 156.

Mariette* denies that they did; whereas Natter† seems not to deny it altogether, and Klotz‡ confidently asserts it as a thing certain. But the last-mentioned author knew nothing more of this circumstance than what he had read in the above-quoted writers.

The question which properly belongs to my subject is, whether the Greeks and the Romans used diamond pencils for engraving on other stones. That many ancient artists assisted their labour by them, or gave their work the finishing touches, seems, according to Natter,§ to be shown by various antique gems. But, even allowing this to have been the case (for, at any rate, I dare not contradict so eminent a connoisseur), I must confess that I have found no proofs that the ancients cut glass with a diamond. We are, however, acquainted with the means employed by the old glaziers to cut glass: they used for that purpose emery, sharp-pointed instruments of the hardest

* Mariette, Traité des pierres gravées, p. 156.

† In the preface, p. 15.

‡ Ueber den nutzen der geschnittenen steine. Altenburg 1768, 8vo. p. 42. How little Klotz, who was so ready to remark and criticise the faults of others, was acquainted with the substances on which the ancients engraved, may be seen in p. 44, where he says, that the ancients engraved likewise on ambergris—Perhaps, also, on cheese! He had read in his French author the word *amlre*, but did not know the difference between *amlre gris* and *ambre jaune*.

§ Page 10, 36. The same thing is asserted by H. Doll, in *H. Meusels Museum für künstler*. st. 13.

steel, and a red hot iron, by which they directed the rents according to their pleasure.*

The first mention of a diamond being used for writing on glass occurs in the sixteenth century. Francis I of France, who was fond of the arts, sciences, and new inventions,† wrote the following lines with his diamond ring upon a pane of glass, at the castle of Chambord, in order to let Anne de Pisseleu, duchess of Estampes, know that he was jealous:

Souvent femme varie,
Mal habil qui s'y fie.

The historian recorded this not so much on account of the admonition, which is not new, as because it was then thought very ingenious to write upon glass.‡ About the year 1562, festoons and other ornaments, cut with a diamond, were extremely common on Venetian glasses, which, at

* Le Veil, Die Kunst auf glas zu malen. Nurnb. 1780, 4to. iii. p. 19.

† Daniel, Geschichte von Frankr. viii. p. 570.

‡ Le Veil, iii. p. 19. Where he found this anecdote, however, I do not know. It is not mentioned by Mezeray, Castlenau, or Laboureur; nor does it occur in *Galanteries des rois de France, Bruxelle* 1694, 8vo. i. p. 145, which is all taken from Varillas. Bellay, in his Memoirs of the Duchess, says nothing of it. Bayle must also have been unacquainted with it, else he would have introduced it into his long article on the *Duchesse d'Estampes*. Perhaps it may be in Brantome's *Dames galantes*. The king's acquaintance with that lady began in 1526. See *Daniel's Geschichte von Frankr.* viii. p. 328.

that period, were accounted the best.* George Schwanhard the elder was a great master in this art;† and, in more modern times, John Rost, an artist of Augsburg, ornamented, in a very curious manner with a diamond pencil, some drinking-glasses which were purchased by the emperor Charles VI.‡

I now come to the art of etching on glass, which properly was the subject of this article. As that acid which dissolves siliceous earth, and also glass, was first discovered in the year 1771, by Scheele the chemist,§ in sparry fluor, one might imagine that the art of engraving with it upon glass could not be older. It has indeed been made known by many as a new invention;‖ but it can be proved that it was discovered so early as the year 1670, by the before-mentioned artist Henry Schwanhard. We are told, that some aquafortis

* Matthesius says, in his fifteenth sermon, p. 902: "On the beautiful smooth Venetian glass people engrave with a diamond all kinds of ornaments and figures."

† Doppelmayr, p. 232.

‡ Von Stetten, Kunstgeschichte von Augsburg, i. p. 434.

§ Abhandlungen der Schwedischen Akademie, xxxiii. p. 122. It deserves to be remarked, that Henkel, in his *Kleinen schriften*, Dresden 1744, 8vo. p. 594 and 599, considered sparry fluor as a saline substance.

‖ Monatschrift der Akademie der Künste zu Berlin. Berlin, 1788. 4to. *Schriften der Berlinischen naturforschenden Geselschaft.* ii. p. 319. *Halle, Fortgesetzte magie.* Berlin 1788, 8vo. i. p. 516. The last author says that the invention came from England, where it was kept very secret; but the honour of the second invention belongs to H. Klaproth.

having fallen by accident upon his spectacles, the glass was corroded by it; and that he thence learned to make a liquid by which he could etch writing and figures upon plates of glass.* How Schwanhard prepared this liquid I find no where mentioned; but, at present, we are acquainted with no other acid but that of sparry fluor which will corrode every kind of glass;† and it is very probable that his preparation was the same as that known to some artists as a secret in 1721. The inventor, however, employed it to a purpose different from that for which it is used at present.

At present the glass is covered with a varnish, and those figures which one intends to etch are traced out through it; but Schwanhard, when the figures were formed, covered them with var-

* Schwanhard, by the acuteness of his genius, proved what was before considered as impossible, and found out a corrosive so powerful, that the hardest crystal glass, which had hitherto withstood the force of the strongest spirits, was obliged to yield to it, as well as metals and stones. By these means he delineated and etched on glass, figures of men, some naked and some dressed, and all kinds of animals, flowers, and plants, in a manner perfectly natural; and brought them into the highest estimation. *Sandrart, Teutsche Akademie*, i. 2. p. 346. The same account, but nothing more, may be found in *Wagenseilii Commentat. de civitate Norimbergensi.* Altdorfi 1697, 4to. p. 154. Doppelmayr, p. 250, says: After 1670 he accidentally found out by the glass of his spectacles, upon which some aquafortis had fallen, becoming quite soft, the art of etching on glass.

† I say all glass, because many kinds can be corroded by the marine and vitriolic acids. See *Baume, Experimental chemie*, iii. p. 302.

nish, and then by his liquid corroded the glass around them; so that the figures which remained smooth and clear, appeared, when the varnish was removed, raised from a dim or dark ground. He, perhaps adopted this method in order to render his invention different from the art known long before of cutting the figures on the glass as if engraven. Had he been able, however, to investigate properly what accident presented to him, he might have enriched the arts with a discovery which acquired great reputation to a chemist, a hundred years after.

I mentioned this old method of etching in relief to our ingenious Klindworth, who possesses great dexterity in such arts, and requested him to try it. He drew a tree with oil varnish and colours on a plate of glass, applied the acid to the plate in the usual manner, and then removed the varnish. By these means a bright, smooth figure was produced upon a dim ground, which had a much better effect than those figures that are cut into the glass. I recommend this process, because I am of opinion that it may be brought to much greater perfection; and Mr. Renard, that celebrated artist of Strasburgh, whose thermometers with glass scales, in which the degrees and numbers are etched, have met with universal approbation, was of the same opinion, when I mentioned the method to him while he resided here,

banished from his home by the disturbances in his native country.

It is probable that Schwanhard and his scholars kept the preparation of this liquid a secret, as the receipt for that purpose was not made known till the year 1725, though it is possible that one older may be found in some of those books which treat on the arts. In the above-mentioned year, Dr. John George Weygand, from Goldingen in Courland, sent to the editor of a periodical work* a receipt which had been written out for him by Dr. Matth. Pauli of Dresden, then deceased, who had etched in this manner on glass, arms, landscapes, and figures of various kinds.† We find by it that a strong acid of nitre was used, which

* Breslauer Sammlung zur natur-und medicin-geschichte.

† 1725. January, p. 107. "Invention of a powerful acid by which figures of every kind, according to fancy, can be etched upon glass.—When *spiritus nitri per distillationem* has passed into the recipient, ply it with a strong fire, and when well dephlegmated, pour it, as it corrodes ordinary glass, into a Waldenburg flask; then throw into it a pulverised green Bohemian emerald, otherwise called *hesphorus* (which, when reduced to powder and heated, emits in the dark a green light), and place it in warm sand for twenty-four hours. Take a piece of glass well cleaned and freed from all grease by means of a lye; put a border of wax round it about an inch in height, and cover it all equally over with the above acid. The longer you let it stand so much the better, and at the end of some time the glass will be corroded, and the figures, which have been traced out with sulphur and varnish, will appear as if raised above the plane of the glass." This receipt has been inserted by H. Krunitz, in his *Œkonomische encyclopedie*, xi. p. 678.

certainly disengages the acid of sparry fluor, though the vitriolic acid is commonly employed for that purpose.* That the Bohemian emerald or *hesphorus*, mentioned in the receipt, is green sparry fluor, cannot be doubted, and will appear still more certain from the history of this species of stone, as far as I am acquainted with it, which I shall here insert.

In the works of the old mineralogists, sparry fluor is either not mentioned, or is classed among their natural glasses and precious stones; and in those of the first systematic writers it is so mingled with quartz, and calcareous and gypseous spars, that it is impossible to discover it. The old German miners, however, distinguished it so early as the sixteenth century, and called it *fluss;* because they used it to accelerate the fusion of ores that were difficult to be reduced to that state. Agricola, who first remarked this, changed the German name into *fluor*, an appellation, which, like many others, formed by him from German words, such, for example, as *quarzum* from *quarz*, *spatum* from *spat*, *wismuthum*, *zincum*, *cobaltum*, &c. became afterwards common.† If a passage of the ancients

* Klindworth covers the glass with the etching ground of the engravers; but in the *Annals of Chemistry* for 1790, ii. p. 141, a solution of isinglass in water, or a turpentine oil varnish, mixed with a little white lead, is recommended. Complete instructions for acquiring this art may be found there also.

† Lapides sunt gemmarum similes, sed minus duri, fluores, liceat mihi verbum e verbo exprimere, nostri metallici appellant, nec, meo

can be quoted that seems to allude to sparry fluor, it is that of Theophrastus, where he says, that there are certain stones which, when added to silver, copper, and iron ores, become fluid.* The first systematic writer who mentioned this kind of stone, as a particular genus, was Cronstedt.

Besides, being known by its metallurgic use, sparry fluor is known also by having the colours of some precious stones, so that it may be sold, or, at least, shown as such to those who are not expert judges; because the first time when heated in the dark it shines with a blueish green lustre. It is possible that sparry fluor may have been among the number of that great variety of stones which the ancients, with much astonishment, tell us shone in the dark; though it is certain that the principal part of them were only light-magnets, as they are called, or such as retain, for a certain period, the light they have absorbed in the day-time.† The observation, however, that sparry fluor emits light, after it is heated, seems to have been first made when artificial phosphorus excited

judicio, inepte; siquidem ignis calore, ut glacies solis, liquescunt et fluunt. Varii autem et jucundi colores eis insidunt. *Bergmannus*, p. 466.

* De lapidibus, § 19.

† The greater part of those passages in the ancients which relate to this subject have been collected by Du Fay, Bose, and Cohausen. See a paper on the light of diamonds in *Physischen abhandlungen der Pariser academie*, xi. p. 38. *Discours sur la lumière des diamans*, published at Gottingen in 1745; and *Lumen novum phosphoris accensum, a Cohausen.* Amstel. 1717, 8vo.

the inquiry of naturalists and chemists; and when they began to search, in their own country, for stones which, in the property of emitting light, might have a resemblance to the Bologna spar, made known about the year 1630. It is well known that the latter is prepared for that purpose by calcination. Stones of the like kind were sought for; and among these sparry fluor, which is not scarce in Germany.

In my opinion, the observation was made in the year 1676; for in that year Elsholz informed the members of the society for investigating nature, that he was acquainted with a phosphorus which had its light neither from the sun nor from fire, but which, when heated on a metal plate over glowing coals, shone with a blueish white lustre; so that by strowing the powder of it over paper, one might form luminous writing. I doubt much whether this experiment was ever tried; at least I find no further account of it in the papers of the society, nor in the re-publication of the above author's first dissertation, which appeared in 1681.*

* Joan. Sigism. Elsholtii De phosphoris quatuor observatio. Berolini 1676, one sheet quarto. Also *De phosphoro liquido observatio.* Berol. 1677, half a sheet quarto; and *De phosphoris observationes, quarum priores binæ antea jam editæ, tertia vero prima nunc vice prodit.* Berol. 1681, two sheets quarto. This edition contains both the first papers with some new observations. The first papers may be found also in *Ephemerid. ac. nat. cur.* Dec. 1. an. 8. obs. 13. p. 32. The passage relating to this subject is as follows: Phosphorus sma-

As far as I know, Kirchmaier, professor at Wittenberg, was the first who disclosed the secret, in the year 1679.* Both call this phosphorus the smaragdine; because the ancients speak much of luminous emeralds; and because green sparry fluor is often exhibited as an emerald. Kirchmaier calls this mineral also *hesperus* and *vesperugo*; and these names have been often given since to sparry fluor, as in the receipt before mentioned for making a liquid to etch on glass. Kirchmaier's

ragdinus. Is splendorem suum non ex solaribus radiis, aut ex illuminato aere colligens; sed ex igne ipso. Ejus scilicet particulam si laminæ argenteæ aut cupreæ imponas, adhibito carbonum subtus calore, splendorem ex cæruleo albicantem mox percipies, adeo ut, si materiam illam in notas aut literas digesseris, legere nitentem commode scripturam, possis. Quare vero tertio huic (phosphoro) id nomen indiderim et qua ratione parandus ipse sit, alteri servo occasioni.

* Ante annos paucos admodum inventus mineralis alicujus, visu et proprietatibus in quibusdam similis smaragdo, ab artificibus duobus mihi peramice notis usus est. Conficiendi phosphori et repræsentandi modus levis atque brevis ille. Recipe q. v. mineralis viridis smaragdum pene referentis; contere in pulverem, aqua madefac communi, pulvis instar ut fiat. Pencillo postea in lamina cuprea, magnitudine vel orbis, vel majoris plani alicujus manubrio instructa literas, quascunque voles, in lamina describe crassiusculas. Ardentibus super impone prunis vasculo exceptis. Phænomenon spectabis in obscuro amœnissimum, sine fumo et odore lucens. Sed, ut verum fatear, nec usum, nisi curiosi animi explendi, artificium hoc, neque diuturnitatem habet. Pectus ergo avidum sciendi meliora satiare nequit, sive *hesperus* vocetur, sive *vesperugo*. *Geor. Casp. Kirchmaieri De phosphoris et natura lucis, nec non de igne, commentatio epistolica.* Wittebergæ, 1680, 4to. p. 7. This *hesperus* must not have been known to Thom. Bartholin in 1668; at least it is not mentioned in his book *De luce*. Hafniæ 1669, 8vo.

information, however, must have been very little known; for the Jesuit Casatus, who, in 1684, wrote his Treatise on Fire, was not acquainted with it, as he has inserted only the words of Elsholz.* This observation must have been new to Leibnitz himself, and to the Academy of Sciences at Berlin, in 1710; for the former then mentioned it to the society as a philosophical novelty.†

I shall remark, in the last place, that the manufacturing of vessels and ornaments of every kind from solid sparry fluor was begun in Derbyshire, in the year 1765.‡ The articles formed of it are in England called spar ornaments, and sometimes *blue-john*. Many beautiful colours must, as is said, be brought forward by means of fire. But the heat must be applied with great caution; for sparry fluor, as is well known, by a strong and particularly a sudden heating, cracks, and loses its transparency.—Since writing the above, I find that Mr. Raspe§ denies this bringing forward of colours by fire.

* Dissertat. physicæ de igne. Francof. et Lips. 1688, 4to. p. 353.

† Miscellanea Berolin. 1710, vol. i. p. 97: The sparry fluor earth, or phosphoric earth, as it is called, which, in latter times, has been found in marble quarries, and which some, at present, consider as an earth saturated with phosphoric acid, is mentioned by the Swede Hierne, in *Prodromus hist. nat. Sueciæ*. Henkel had never seen it. See his *Kleine schriften*, p. 599.

‡ Watson's Chemical Essays, ii. p. 277.

§ A descriptive catalogue of engraved gems, by James Tassie. London 1791, 2 vol. 4to. i. p. 51.

SOAP.

That the first express mention of soap occurs in Pliny and Galen, and that the former declares it to be an invention of the Gauls, though he prefers the German to the Gallic soap,* has already been remarked by many. Pliny says that soap† was made of tallow and ashes; that the best was made of goats' tallow and the ashes of the beech-tree, and that there were two kinds of it, hard and soft. The author of a work on simple medicines, which is ascribed to Galen, but which however does not seem to have been written by that author, and of which only a Latin translation has been printed, speaks of soap being made by a mixture of oxen, goats', or sheep's tallow, and a lye of ashes

* In those works which were certainly written by Galen, I have found the word σαπων twice. It occurs in *De compositione pharmac. secundum locos*, ii. 2. p. 270; and lib. v. cap. 5, p. 323: σαπωνος γαλλικου λιτραν μιαν.

Plin. xviii. 12. sect. 51. p. 475: Sevum caprinum cum calce - - - Prodest et sapo; Galliarum hoc inventum rutillandis capillis. Fit ex sebo et cinere. Optimus fagino et caprino; duobus modis, spissus ac liquidus. Uterque apud Germanos majore in usu viris quam feminis.

† It is beyond all doubt that the words *sapo* and σαπων were derived from the German *sepe*, which has been retained in the Low German, the oldest and original dialect of our language. In the High German this derivation has been rendered a little more undistinguishable by the *p* being changed into the harder *f*. Such changes are common, as *schap*, *schaf*; *schip*, *schiff*, &c.

strengthened with quicklime. He says the German soap was the purest, the fattest, and the best, and that the next in quality was the Gallic.* This account corresponds more exactly with the process used in Germany at present; whereas the French use mineral alkali, and instead of tallow employ oil, which appears to be a later invention. Pliny in his description does not speak of quicklime; but as he mentions a mixture of goats' tallow and quicklime a little before, it is probable that the use of the latter was then known at Rome. Gallic and German soap are often mentioned by later writers,† as well as by the Arabians,‡ some-

* Sapo conficitur ex sevo bubulo vel caprino, aut vervecino, et lixivio cum calce; quod optimum judicamus Germanicum; est enim mundissimum et veluti pinguissimum, deinde Gallicum. Verum omnis sapo acriter ralaxare potest, et omnem sordem de corpore abstergere, vel de pannis, et exsiccare similiter ut nitrum vel aphronitrum, mittitur et in caustica. *De simplicibus medicaminibus*, p. 90. G. In another book, ascribed to Galen, the greater part of which is taken from Aëtius, and of which a Latin translation only remains, *De dynamidiis*, p. 28. G, according to Gesner's edition stands: *Recipe saponem spatarenticum*, and p. 31. C, *emplastrum de sapone spathulano*. These epithets, in my opinion, signified soap which was so soft that it could be spread.

† The passages with which I am acquainted are as follows: *Theodor. Priscianus*, lib. i. cap. 3. De crementis capillorum - - - Attamen Gallico sapone caput lavabis. *Saponatum* occurs also lib. i. 18. *Sammon*, cap. 12. ver. 155: Attrito sapone genas purgare memento.

‡ Serapio, according to Brunfel's edition, cap. 348: Sapo est bonus ad maturandum apostema - - - *Rases De simplic.* p. 397: Sapo calidus existit, qui ulcerans corpus, in ipso fortem efficit abstersionem.

times on account of their external use as a medicine, and sometimes on account of their use in washing clothes. The latter purpose is that for which soap is principally employed in modern times; but it does not seem to have been the cause of German soap being introduced at Rome. Washing there was the occupation of indigent scowerers, who did not give themselves much trouble concerning foreign commodities. The German soap, with which, as Pliny tells us, the Germans coloured their hair red, was imported to Rome for the use of the fashionable Roman ladies and their gallants. There is no doubt that the *pilæ Mattiacæ*, which Martial recommends as a preventive of gray hair;* the *caustica spuma* with which the Germans dyed their hair;† and the Batavian froth or lather which the

memento. *Plin. Valer.* i. 23: Gallicus sapo; and cap. 21: Saponarius, which word Barth in his *Adversaria*, p. 1671, translates a retailer of soap. *Paul. Ægin.* lib. vii. in the alphabetical catalogue of drugs, p. 639: σαπων ρυπτικης δυναμεως. Sapo extersoriam vim habet. *Aretæus De diuturnis morbis*, ii. 13, p. 98: Ad curationem elephantiaseos sunt medicamenta innumera Celtarum, quos hac tempestate Gallos vocant. Nitrosis quoque illis factitiis globis, quibus velaminum sordes expurgant, saponemque vocant (*the soap therefore appears to have been formed into balls*), illis globis corpus in balneo detergere optimum est. *Aëtius De urte med.* vi. 54. and xiii. 126, Stephanus quotes from the scholiast of Theophrastus the diminutive σαπωνιον. The passage may be found *Idyl.* iii. 17. according to the edition of Reiske, p. 51: Σμηχω το καθαιρω, εξ ου σμηγμα το σαπωνιον. Trallianus: Γαλλικου σαπωνος αναλυσας εν τῳ χυλῳ.

* Mart. xiv. 27. This soap acquired the epithet of *Mattiacum* from the name of a place which was in Hesse.

† Caustica Teutonicos accendit spuma capillos,
Captivis poteris cultior esse comis. *Mart.* xiv. 26.

Romans employed for colouring theirs,* were German soap. It is probable that the Germans tinged it with those plants which were sent to Rome for dyeing the hair; † and according to the modern manner of speaking, it was more properly a kind of pomade than soap.

It appears that the Romans at first considered hair-soap as an ointment made from ashes; for we read in various passages of ancient authors, that the hair was dyed by means of ashes, or an

These lines are generally explained in this manner: "Dye thy hair with soap, and it will become more beautiful than that of the Germans." But in this case all the wit of the advice is lost; and the expression *eris cultior quam comæ captivæ*, seems to me to be very improper. I should rather translate them as follows: "Let the Germans dye their hair with pomade; as they are now subdued, thou mayst ornament thyself better with a peruke made of the hair of these captives." This was a piece of delicate flattery to Domitian and the Roman pride. That prince thought he had conquered the Germans; and the most beautiful German hair, that which was not dyed, could be procured, therefore, at Rome, much easier than before. If the title of this epigram was written by Martial himself, it contains the first mention of the word *sapo*.

* Fortior et tortos servat vesica capillos,
Et mutat Latias spuma Batava comas.
Mart. viii. 23, 19.

The first line of the above proves that people then covered their heads, in the night time, with a bladder to keep their hair, after it was dressed, from being deranged; and a bladder was undoubtedly as fit for that use as the nets and cauls employed for the like purpose at present.

† Femina canitiem Germanis inficit herbis.
Ovidius De arte amandi, iii. 163.

ointment made of ashes and a certain kind of oil. It is however possible that they may have had such an ointment, which undoubtedly would be of a saponaceous nature, before they were acquainted with the German soap, or that they imitated the German pomade with different variations.*

As soap is every where used for washing at present, a question arises what substitutes were employed before it was invented. Those with which I am acquainted I shall mention and endeavour to illustrate. They are all still used, though not in general; and they are all of a soapy nature, or, at least, have the same effects as soap; so that we may say the ancients used soap without knowing it.

Our soap is produced by a mixture of lixivious

* Valer. Max. i. 5, p. 135: Capillos cinere rutilarunt.

Ad rutilam speciem nigros flavescere crines,
Unguento cineris prædixit Plinius auctor.

Q. Serenus, De medic. iv. 56.

Serenus seems to allude to a passage of Pliny, xxiii. 2, p. 306, where he speaks of an ointment made from the burnt lees of vinegar and *oleum lentiscinum*. The same thing is mentioned in *Dioscorides*, v. 132, p. 379. *Servius, Æn.* iv. quotes the following words from Cato: Mulieres nostræ cinere capillum ungitabant, ut rutilus esset crinis. *Alex. Trallianus*, 1, 3, gives directions how to make an ointment for gray hair from soap and the ashes of the white flowers of the *verbascum*. The *cinerarii*, however, of Tertullian, lib. ii. *ad uxor.* 8, p. 641, seem to have been only hair-dressers, who were so called because they warmed their curling-irons among the hot ashes.

salts and tallow, by which means the latter becomes soluble in water. The greater part of the dirt on our linen and clothes consists of oily sweat or grease, or dust which that grease attracts, and which either cannot be washen out, or can be washen out only very imperfectly, by water alone. But if warm water, to which lixivious salts have in any manner been added, be taken, and if dirty cloth be rubbed in it, the greasy dirt unites with the salts; becomes saponaceous; and is so far soluble in water that it may be washed out. There are also natural juices which are of a soapy quality, in the state in which we find them, and which can be employed in the stead of artificial soap. Of this kind is the gall of animals, and the sap of many plants. The former being less strong in its effects on account of its slimy nature, is used at present particularly for coloured stuffs the dye of which is apt to fade. As far as I know, however, it was not employed by the ancients,* but it is certain that in washing they used saponaceous plants.

In the remotest periods, it appears that clothes were cleaned by being rubbed or stamped upon in water, without the addition of any substance whatever. We are told by Homer, that Nausicaa and her attendants washed their clothes by treading upon them with their feet in pits, into which they

* Plin. ii. p. 474, says: that spots of the skin may be removed by means of ox's gall. Maculas tollit fel tauri.

had collected water.* The epithet black, which the poet gives to the water, might induce one to conjecture that it had been mixed with ashes, which would convert it into a lye; but where were the ashes to be found? Had they brought them along with them, the bard, where he before enumerates every thing that they carried with them, and even oil, would not have failed to mention them; and such a conjecture is rendered entirely groundless by his applying the same epithet to pure water, in other places, where nothing can be supposed to have coloured it.† Water, when it stands in deep pits, reflects so few rays of light, that in a poetical sense it may very properly be called black.

We find however mention made at later periods of ashes and a lye of ashes employed for washing; but, I think, very seldom, and I do not know how old the use of them may be. According to Pollux,‡ *konia*, mentioned by Aristophanes and Plato, was a substance used for washing; and he

* — — — — — και εσφορεον μελαν ὑδωρ,
Στειβον δ' εν βοθροισι θοως εριδα προφερουσαι.
— — — — — et inferebant in nigram aquam;
Constipabant autem in scrobibus celeriter certamen proferentes.
Odyss. vi. 91.

† Iliad. ix. 14. ὡστε κρηνη μελανυδρος, ἡ - - - - δνοφερον χεει ὑδωρ. Sicut fons nigræ aquæ, qui obscuram fundit aquam. This comparison is repeated in the same words, *Iliad*, xvi. 4. Theocritus also, *Idyll.* xvi. 62, says: ὑδατι νιζειν θολεραν ιοειδεϊ πλινθον; aqua nigra lavare impurum laterem.

‡ Onomast. vii. 11, 39, p. 713, 714.

says expressly, that we are to understand by it a lye of ashes. This I mention for the sake of those who, like me, place little confidence in the terms of art given in dictionaries.* With the above lye, oil and wine-jars were cleaned; † and it was employed also for washing the images of the gods. ‡ The method of strengthening the lye by means of unslacked lime was known, at any rate, in the time of Paulus Ægineta; § but it appears that the Romans were not acquainted with the salt itself which is procured by dissolving common wood-ashes in water: I mean, they did not understand the art of producing it in a dry solid form, or of boiling potashes.

On the other hand, that fixed lixivious salt, the mineral which nature presents in many of the southern countries, was long known and used in washing. This was the *nitrum*, or, as the people of Attica pronounced it, the *litrum*, of the an-

* For abundance of these I shall refer to Dioscorides, i. 186, p. 88. The clear lye which drops from the ashes was called κονια στακτη και διηθημενη (from διηθεω, percolo). In the *Geopon.* x. 29, p. 697, the lye of the baths is called κονια βαλανευτικη.

† Geopon. vii. 6. p. 475. *Plin.* xiv. cap. 21, p. 727. *Columella* xii. 50. 14, p. 818.

‡ Sordescunt divi, et ad sordes eluendas lavantibus aquis opus atque cineris frictione. *Arnobius*, vii. p. 237.

§ Lib. vii. Κονια, το οιον περιπλυμα της τεφρας ονομαζεται. Ει δε προσλαβοι και τιτανου η τεφρα, καυστικην εργαζεται την κονιαν, ην δη και πρωτοστακτον ονομαζουσι. Lixivium quasi lotura cineris. Si calcem assumat cinis, ustoria vi præditum lixivium facit, quod etiam πρωτοστακτον nominant.

cients, as has already been remarked by others.* It would however be worth the trouble to investigate the proofs still further. By examining them with more mineralogical and chemical knowledge than have hitherto been employed for that purpose, they might be further strengthened, and serve to illustrate many obscure passages. For my part, I have neither leisure nor room here to undertake such a task, though I have collected many observations relative to that subject. It is certain at any rate, that the ancients employed *nitrum* for washing, and it is evident from the testimony of various authors, that it was much used in the baths.†

That the people of Egypt, in the time of Pliny, made mineral alkali also from the ashes of some plants, we have reason to conclude, because he says that it was necessary to put the Egyptian nitre into vessels well corked, else it became liquid.‡ Natural alkali is never liable to do so, unless it be very much burnt; and as no reason is assigned for its assuming that form, we may

* The word λιτρον in Pollux, x. 31, 135, p. 1317, ought not to have been translated *sapo*.

† Cicer. Epist. famil. viii. 14. *Cypriani Epist.* 76. *Pollucis Onom.* viii. 9, 39. p. 713, 714. x. 135, p. 1317. *Athanas. De virginitate*, i. p. 827. ed. Comelin. *Ovid. De medicam. faciei*, ver. 73 et 85. *Phavorini Dictionnar.* p. 527: Νιτρον σαπωνιον, ἡ ειδος ιατρικον, παρα το νιζω. Gynesius calls clothes washed with *nitrum*, νιτρουμενα, nitro perfricata.

‡ Ægyptium in vasis picatis affertur ne liquescat.

believe that the Egyptian alkali was the strongly burnt ashes of those plants which are still used in Egypt for making salt, and perhaps the same with which the Spaniards were made acquainted by the Arabians, and which they cultivate for making soda.

Strabo speaks of an alkaline water in Armenia, which was used by the scowerers for washing clothes.* Of this kind also must have been the lake *Ascanius*, which is mentioned by Aristotle,† Antigonus Carystius,‡ and Pliny.§ It is worthy of remark, that the ancients made ointments of this mineral alkali and oil, but not hard soap, though by these means they approached nearer to the invention than the old Germans in their use of wood-ashes; for dry solid soap can be made with more ease from the mineral than the vegetable alkali; and when Hungarian, French, and German soap are of equal goodness, the last does more credit to the manufacturers because they cannot employ the mineral alkali. I shall here observe, that this alkali was used for washing by the Hebrews, and that it occurs in the sacred writings under the name of *borith*.‖

* Lib. xi. p. 801.

† De mirabil. auscult. c. 54, p. 111.

‡ Histor. mirabiles, c. 162, p. 216.

§ Lib. xxxi. 10, p. 564.

‖ J. D. Michaelis Commentationes. Bremæ 1774, 4to. p. 151. I must mention also *C. Schoettgenii Antiquitates fulloniæ*, added to his *Antiquitat. trituræ*. Traj. ad Rhen. 1727, 8vo. My readers will

The cheapest, however, and the most common article used for washing, was the urine of men and animals. When this excrement becomes old, the alkali disengages itself, which may be perceived by its fetid smell; and such alkalised urine being warmed, and employed to wash greasy clothes, produces the same effects as the *nitrum* of the ancients. It is still used for the like purpose in our cloth manufactories.

To procure a supply of it, the ancient washers and scowerers placed at the corners of the streets, vessels which they carried away after they had been filled by the passengers, who were at liberty to use them; and the practice of having such conveniencies was certainly more decent than that of employing the walls of churches and other buildings, which the police of Dresden forbade some years ago, but with no effect. At Rome, that which at present spoils and renders filthy our noblest edifices, was converted to use. When clothes were washed, they were trod upon with

do me a pleasure if they compare the above work with this article. No one will accuse me of vanity when I pretend to understand the theory of washing better than the learned Schöttgen; but if I have explained the passages which he quotes, in a more satisfactory manner, and turned them to more advantage, I must ascribe this superiority to my knowledge of that art. I shall here take occasion to remark, that there is no subject, however trifling, which may not be rendered useful, or at least agreeable, by being treated in a scientific manner; and to turn such into ridicule, instead of displaying wit, betrays a want of judgment.

the feet, as is the case in the cloth-manufactories at Leeds, Halifax, and other places of England, where the urine is collected by servants, and sold by measure to the manufacturers under the name of *old lant*. On account of the disagreeable smell attending their employment, scowerers at Rome were obliged to reside either in the suburbs, or in some of the unfrequented streets.*

My readers here will undoubtedly call to remembrance the source of taxation devised by the emperor Vespasian, who, as his historians tell us, *urinæ vectigal commentus est.*† It is not certainly known in what manner this impost was regulated. Did the emperor declare that article, which was not *subterraneum rarius*, to be a regale as a *res derelicta*, so that the scowerers were obliged to pay him what he thought a reasonable sum proportioned to the benefit which they derived from it? Or was it imposed only as a poll-tax? For

* Plin. xxviii. 6. p. 466: Virilis urina podagris medetur, argumento fullonum, quos ideo tentari morbo negant. *Lib.* xxviii. 8, p. 459: Urinam camelorum fullonibus utilissimum esse tradunt. p. 459: Maculas e veste urina ablui. *Martial.* vi. ep. 93. *Athen. Deipnos.* xi. p. 484: Fullones, abstergendis vestium sordibus, eas urina madefaciunt. *Macrobius Saturn.* ii. 12, speaking of drunken people: Dum eunt, nulla est in angiporto amphora, quam non impleant, quippe qui vesicam plenam vini habeant. In the old editions this passage occurs, lib. iii. cap. 16, or, as Beroaldus says, cap. 17. It is quoted also in *Joh. Saresberg. Polior.* viii. 7, p. 479.

† Sueton. in Vita Vespas. viii. 23. *Lipsius De magnitudine Romana.* The principal part of the information on this subject, in the latter, is taken from G. Cedrenus.

every tax upon any thing indispensably necessary to all, is, to speak in the language of finance, the same as what is called a poll-tax, or a tax paid by every one who has a head. The latter conjecture is the most probable, especially as this tax continued two centuries, till the time of Anastasius, and as we read also of *vectigal pro urina jumentorum et canum*, which was exacted from every person who kept cattle. Vespasian therefore was not fortunate in the choice of a name for his tribute, which on that account must have been undoubtedly more detested. A poll tax at present is called by those who do not speak favourably of it, the Turkish-tax, because the Turks impose it on all unbelievers. When it was introduced by Louis XIV, in 1695, he called it *la capitation.*

Of plants with a saponaceous juice, the ancients, at any rate, used one instead of soap; but it is difficult or rather impossible to define it. I shall not therefore content myself merely with transcribing the passages where it is mentioned; but I shall arrange whatever I can find respecting it in such a manner, as, according to my opinion, the names of plants ought to be explained in dictionaries.

Στρουθιον, STRUTHIUM, Latinis HERBA LANARIA, et Plinio etiam RADICULA.

1. Est planta spinosa, *Th. Pl.*
2. Grata aspectu, sed sine odore, *Th. Pl.*

3. Folio oleæ, *Pl.* vel papaveris Heraclei, *Th.*
4. Caule ferulaceo, tenui, lanuginoso, eduli, *Pl.*
5. Radice magna, acri, medicinali, *Pl. D.* spumescente, *Luc.*
6. Floret æstate, *Th. Pl.* sed semen nullum, *Pl.*
7. Nascitur saxosis et asperis locis, *Pl.*
8. Sponte, præcipue in Asia Syriaque; trans Euphratem laudatissima; sativa ubique, *Pl.*
9. Radix conditur ad lanas lavandas, *Th. Pl. D. Col.* et alii.
10. Herba ovibus lac auget, *Pl.**

The above is all that the ancients have told us respecting this plant. The information is indeed

* *Pl.* here stands for Pliny; *Th.* for Theophrastus, *D.* for Dioscorides; *Luc.* for Lucian; and *Col.* for Columella. The following are the passages alluded to:

Plin. xix. 3. sect. 18, p. 161, xxiv. 11, p. 341; and 17, p. 352. xxix. 3, p. 500.

Theophrasti Hist. plant. vi. 7, p. 679. ed. Stap. vi. 3, p. 588. ix, 13, p. 1093. In the first passage it is said: Herba lanaria dicta; flos aspectu pulcer, sed caret odore. According however to the common reading of the original, it ought to be: Struthium dictum; flos adspectu pulcer, et est odoratus autumno. Scaliger's emendation is: Struthium dictum, flos adspectu pulcer, sed sine odore. Autumni floret lilii alterum genus. This is the more probable, as Pliny says in the same order: Grata adspectu, sed sine odore.

Dioscorid. ii. 193, p. 156. Notha. p. 447.

Lucianus, in Alexand. cap. xii. edit. Bipont. v. p. 75.

Columella, xi. 2, 35, p. 753: Radix lanaria.

It would appear that the ancients were acquainted with different kinds of *struthium*; for *Celsus*, vi. 5, p. 346, names in a receipt *struthium album*.

very scanty, and at the same time it is not altogether certain; but even if it were, it would be sufficient only to confute some conjectures, but not to establish the systematic name of the plant. I call the properties of it described to us uncertain: First, because I do not know whether Pliny did not mean to distinguish the wild plant from that which was cultivated, and many have understood as alluding to the former that which I have applied to both. Secondly, because the words of Theophrastus, being in one passage evidently corrupted, will admit of various constructions; and because in another, on account of some exceptions, of which he speaks, they appear at least to me unintelligible. Thirdly, because Pliny, who gives us the best account of it, is the only author who calls the *struthium* or soap-plant *radicula*, a name by which is rather to be understood a dye-plant of the same kind as madder. We have reason therefore to suspect that he has confounded the properties of the two plants, especially as the fourth property was ascribed by others to a *rubia, asperula*, or *galium*, which was cultivated in Syria, and named often *radicula Syriaca*. On the other hand, this diminutive is very ill suited to a root which Pliny himself calls large.

The words of that author, *tingenti, quicquid sit cum quo decoquatur*, have been by some explained, as if he meant that the *struthium* was a dye-plant, though as a soapy plant it must have been destitute

of colour; and they have hence deduced a proof that Pliny confounded the *struthium* with the *radicula* used in dyeing. On the other hand, Hardouin reads *unguentis* instead of *tingenti*. He assures us that he found the former in manuscripts, and is of opinion that the sap of the *struthium* was used also for ointments.

In my opinion, however, *tingenti* must be retained; and the meaning is that when cloth was to be dyed it was necessary to prepare it for that purpose by soaking it and washing it with the sap of this plant. This he expressly tells us himself: *tingentibus et radicula lanas præparat*. It is probable that the ancient dyers mixed their dye-liquors with the juice of the *struthium*, for the same purpose as bran and the seeds of fenugreek are added to dye-liquors at present; that is, to render them thicker and slimier, in order that the colouring particles may be longer and more equally suspended in or diffused through them.* The words *quidquid sit cum quo decoquatur* will now become intelligible. Whatever may be employed for dyeing, says the author, the addition of the juice of the *struthium* is serviceable.

As what has been said contains nothing that can enable us to determine the genus of the *struthium* according to the rules of botany, we may be allowed to conjecture that it was one of those plants

* Porners Anleitung zur Farbekunst, p. 31.

still used for the like purpose in Italy and other neighbouring countries. Fuchs thinks it must have been the *saponaria officinalis* (soap-wort), the roots of which indeed contain a saponaceous juice that readily changes the saliva into froth. The root was employed for that purpose by the impostor in Lucian; and the juice is used at present for cleaning wool and cloth. In the Helvetian Alps, the sheep, before they are shorn, are washed with a decoction of the plant and its roots; and with a mixture of ashes it serves for cleaning linen.* The taste of it is so sharp, that it is compared by some to that of the small burnet-saxifrage.†

This *saponaria officinalis*, however, differs too much from the remaining properties‡ of the *struthium*. Its root is as thick only as a quill, or at most as one's finger. The stem, which is three feet in height, throws out many branches, and cannot be called *caulis ferulaceus, tenuis*. It is not rough and prickly, and, instead of growing in poor, rocky soil, it is rather fond of deep ground, and the borders of corn-fields.

We may, therefore, conjecture with more pro-

* Bock, Kräuterbuch, p. 296. *Storr. Alpenreise*, ii. p. 185. *Bergius, Mater. med.* p. 371. *Böhmers Technische geschichte der pflanzen*, i. p. 774.

† Cartheuser, Dissertat. de radice sapon. 1760.

‡ Those numbered 3, 4, 5, 6.

bability that the *gypsophila struthium* LINN.* a plant still used for washing in the lower part of Italy and Spain, is the *struthium* of the ancients. This opinion acquires some strength by its being adopted among the Italians and Spaniards; and because the plant, as Pliny says, grows in a rocky soil and on the mountains. It is also still called *lanaria* by the Calabrian peasants. It has a tender stem; its leaves are so like those of the olive-tree, that they might be compared to them by those who are not botanists; and its root is large, but it is neither rough nor prickly. This contradiction may be accounted for by supposing that Pliny, through a mistake, of which I have already accused him, ascribed falsely to the soap-plant the prickly or rough leaves of the dye-plant which had an affinity to madder. But even after this explanation

* This plant belongs to those European vegetable productions which have not yet been completely described, and of which accurate figures have not been given. It was sent by Imperati to Casp. Bauhin, under the name of *lanaria veterum*; and the latter made it first known in his *Pinax plant.* iv. p. 206. The former described it himself, and gave a bad engraving of it, in *Hist. nat.* p. 871. Löfling found this plant on the Spanish mountains, as well as in the neighbourhood of Aranjues; and he relates, that in the province of la Mancha the people boil clothes that are to be washed, with the root of this plant *instead of soap.* (The three last words, however, appear to have been added by his translator.) *Reisebeschreibung*, p. 105. Linnæus did not hesitate to declare the *struthium* of the ancients and the *struthium* of his system to be the same plant; and he gave his countrymen reason to hope that their *gypsophila fastigiata*, which has a great resemblance to it, might be employed in the like manner. *Amœnitat. Academ.* v. p. 329.

there still remains to be got over a dubious passage of Theophrastus, who, indeed, seems to make the plant prickly also.

I do not, therefore, place entire confidence in this opinion; but suspect rather that we shall receive from the East an account of a plant, still used there, which will correspond more exactly with the soap-plant described by Pliny. I am inclined to think that I have already found some precursory information respecting it in Bauhin,* who says that, in Syria, there is another kind of soap-plant, which has prickly leaves like the thistle, and a thick root of a sharp acrid taste. The root, he adds, was employed for washing clothes and wool; and the confectioners of Damascus formed of it, with honey and wine, a kind of sweetmeat which appeared as white as if it had been made of the finest flour and sugar, and which was so hard

* Bellunensis radicem esse scribit plantæ foliis spinosæ carduorum modo, crassitie pollicis, intus subflavam, nigram foris, odore et gustu acrem; ejus decocto lanas laneosque pannos sordidos abstergi. Damascenos seplasiarios ejus decoctum immiscere confectionibus paratis e melle ac sapa, idque candoris tantum conciliare, ut ex amylo et saccharo purissimo constare videantur; quin etiam sic durare, ut tenaciores sint, et vix morsu divellantur. Constat, ejus radice in globos coacta, Syros vestium, linteorum et indusiorum sordes ac inquinamenta eluere, saponis aut lixivii modo. *Histor. plant.* xxix. 43, p. 347. This account was too unintelligible to be introduced by Tournefort or Linnæus into their systems. But who was this *Bellunensis?* In my opinion, the person meant is Andreas Bellunensis, who wrote *glossemata* on Avicenna, and who is sometimes quoted, and praised, by Conrade Gesner, on account of his acquaintance with the Arabic.

that it could scarcely be broken with the teeth. This plant seems to belong to those, the cultivation of which was abandoned in Europe, after the use of them was rendered superfluous by newer discoveries.

That the ancients employed their *struthium* for washing wool is confirmed by various authorities;* but I do not remember to have found any evidence of its being used for cleaning clothes which had been worn. Saumaise, however, quotes a passage from the works, unfortunately never printed, of the old chemist Zosimus, in which he gives directions for restoring, by means of the soap-plant, the lustre of pearls which have become yellow.†

As the sap of most plants is saponaceous, the meal of many kinds of seeds may be used for washing, as well as various kinds of bran. That of almonds, which on account of its oil is remarkably soft, is employed at present for washing the hands by those who are desirous of having a white delicate skin. Cloth, the colours of which easily fade, and which will neither endure soap nor hard rubbing, may be washen extremely well with bran. Our fullers, therefore, and stocking-manufacturers use oat, barley, and bean-meal, especially when

* Besides the testimony of the before-quoted authors, may be mentioned that of Hesychius and Isidore. Pliny, p. 500, calls washed wool, *lana radicula curata*. To be washed with it was στρουθιζεσθαι.

† Salmas. ad Solin. p. 818. a.

they wish the cloth to be slowly milled.* Whether the ancients employed bran in the same manner, I have not had an opportunity of examining. I am rather inclined to think that they did; and I can at any rate quote a passage of Galen, which seems to allude to the use of bean-meal.† In all probability, the beans of the ancients were the smallest and roundest variety of our horse-beans, or those used as fodder.‡

In the last place, the ancients, at those periods of which I speak, used fullers-earth much oftener than it is used at present. Till the countries where it was procured be described by travellers who unite a knowledge of antiquities with skill in mineralogy, the species of this earth, mentioned in the works of ancient authors, cannot be distinguished with accuracy. But from the purposes to

* See Physikal. œkonom. biblioth. xiv. p. 478.

† De alimentor. facultate, i. cap. 19, according to the Greek edition of Basle, vol. iv. p. 315: Την δ' ουσιαν ου πυκνην και βαρειαν, αλλα χαυνην τε και κουφην εχουσιν οι κυαμοι, και τι ρυπτικον εχουσαν ομοιως τη πτισσανη. Φαινεται γαρ εναργως τα εξ αυτων αλευρα τον ρυπον αποσμωντα του δερματος, ο καταυσησαντες οι τ' ανδροκαπηλοι και γυναικες οσημεραι χρωνται τω των κυαμων αλευρω λουομενας, καθαπερ αλλοι νιτρω τε και αφρονιτρω και ολως τοις ρυπτικοις. Επιχριουσι δε και το προσωπον αυτων παραπλησιως τη πτισσανη. Habent fabæ substantiam non densam nec gravem, sed fungosam ac levem; quæ vim quandam, quomodo ptisana, habet detergendi. Apparet enim perspicue ipsarum farina sordes a cute detergere, quod mangones ac mulieres intelligentes, in balneis quotidie fabarum farina utuntur, quemadmodum alii nitro atque aphronitro et in summo detergentibus. Hac propterea et faciem inungunt, quemadmodum ptisana. *Edit. Gesneri*, clas. 2. p. 26.

‡ See Physikal. œkonom biblioth. xvi. p. 213.

which they were applied we can with certainty conclude that they must have been partly of the nature of marl and partly of the nature of the soap-rock.

According to the then usual method of washing, by which the clothes were stamped with the feet,* the *cretæ fulloniæ*, as Pliny † calls them, acted in the same manner as our fullers-earth employed at present, partly by scouring and partly by absorbing the greasy dirt. The ancients, after their manner, gave them names only from the countries where they were produced; and hence we find mention made of *terra Cimolia*,‡ *Chia*,§ *Lemnia*,‖ *Sarda*,¶ *Umbria*,** *Samia*, *Tymphæa*,†† and others. Many of them, like that brought from

* A passage of Titinnius, quoted from *Nonius Marc.* iv. 34. p. 623, in *Gothofredi Auct. ling. Lat.* which Schottgen reads in the following manner, may serve as a proof:

— — — terra hæc non aqua
Ubi tu solitus pedibus argutarier;
Dum compescis cretam, et vestimenta eluis.

† Lib. xvii. 18, p. 54.

‡ Pollux, vii. 11, 39, p. 714. Plin. xxxv. 17, p. 718.

§ Dioscor. v. 174, p. 391. Χια σμηχει αντι νιτρου εν βαλανειῳ.

‖ This *terra Lemnia* is entirely different from sealing-earth. See *Galen. De simplic. medic. facultat.* ix. p. 132. ed. Gesneri.

¶ Plin. p. 718.

** Plin. l. c. The *Sarda* was cheap, and purchased by measure, the *Umbria* was dearer, and sold by weight.

†† Theophrast. De lapid. § 109. *Dioscorides.* v. 152, p. 387, says also of the *morochthus*: ᾧ και οἱ οθονοποιοι προς λευκωσιν των ιματιων χρωνται.

Sardinia, could not be used in cleaning coloured stuffs; and for this reason, perhaps, because some colours would not stand hard scouring, or endure their caustic nature.

The fullers, however, did not use these earths merely for washing, but also for whitening many kinds of cloth. This was done by rubbing fine white earth into the cloth, in the same manner as soldiers do to give some parts of their dress a brighter appearance. A like process is employed by glovers and those who wash or clean leather. The earth used by the latter is a yellowish white iron-ochre, called, from the purpose to which it is applied, collar-earth.* When a perfect white was required, a kind of white potters-clay or marl was employed; and the closer it adhered to the cloth, and the less easily it could be rubbed out, it was so much the better. The poor people at Rome rubbed it over their clothes on festivals, in order that they might appear brighter.†

It deserves here to be particularly remarked, that some of these earths, such as that of Chios, were employed in the baths instead of nitrum;‡

* I here mean that it got its name from being employed to clean that piece of armour, formerly used, which covered only the breast and the back, and which was called a *koller*. The Swedes also call yellow iron-ochre *kiöllerfärg*, or *kyllerfarg*. See *Waller. Min.* ii. p. 258.

† See Taubmann's Annotations to *Plauti Aulular.* iv. sc. 9. 6: Qui vestitu et creta occultant sese, atque sedent quasi sint frugi.

‡ Dioscorid. v. 174.

and this is the case in the Levant still. De la Valle* extols, in this respect, a kind of reddish earth, and says that people of the first distinction never bathe without it. Perfumes are often mixed with it; and it is formed into small balls which, when used, are suffered to dissolve in the water. Different kinds of vessels, and particularly those in which wine and oil had been kept, were cleansed with these earths also.† Glass flasks, which have had oil in them, cannot be cleansed better or more speedily than by shaking in them a mixture of fullers-earth or potters-clay. When these are not to be had, filtering-paper may be used. The oil is absorbed by the earth or the paper, and with them can be easily washed out.

To render cloth perfectly white, it was also fumigated with sulphur by the fullers, who were not ignorant that many colours were destroyed by the volatile steam of that substance.‡ We are told by Apuleius that the wife of a scourer concealed her gallant under a vessel of basket-work, over which cloth used to be laid to whiten by the effects of sulphur kindled under it.§ Our washer-women

* Reise, i. p. 217.

† Geopon. vii. 6. p. 475. *Plin.* xiv. cap. 21, p. 727. *Columella*, xii. 50, 14, p. 818.

‡ Pollux, vii. 11, 41, 715. *Plin.* xxxv. 17, p. 719; and xxxv. 15, p. 714: Tertio generi sulphuris unus tantum est usus ad suffiendas lanas, quoniam candorem tantum mollitiemque confert. - - - *Isidor. Origin.* xvi. 1.

§ Ergo nostra repente turbata præsentia, subitario ducta consilio,

employ for the same purpose a cask,* and our clothiers a small close apartment, in which the wet cloth is suspended upon hooks.

Pliny has described the method of washing used at Rome, but many things respecting it appear to me obscure.† The cloth was first washed with Sardian earth; it was then fumigated with sulphur, and afterwards rinsed with real Cimolian earth. The word *desquamatur* was undoubtedly a term of art which cannot be further explained, because we are unacquainted with the operation to which it alludes.‡ Pliny seems to have been particular in mentioning real Cimolian earth, because the

eundem illum subjectum contegit viminea cavea, quæ fustium flexu in rectum aggregata cumulum, lacinias circumdatas suffusa candido fumo sulfuris, inalbabat. *Apul. Metamorph.* ix. p. 292.

* I hope my readers will not misunderstand me. I mean for fumigating clothes with sulphur, and not for concealing a gallant.

† Ordo hic est. Primum abluitur vestis Sarda, dein sulphure suffitur; desquamatur Cimolia, quæ est coloris veri. Fucatus enim deprehenditur, nigrescitque et funditur sulphure. Veros autem et pretiosos colores emollit Cimolia, et quodam nitore exhilarat contristatos sulphure. Candidis vestibus saxum utilius a sulphure, inimicum coloribus. Græcia pro Cimolia Tymphaico utitur gypso. *Lib.* xxxv. cap. 17. sec. 57. p. 719.

‡ Imperati gives the following explanation of this word in *Hist. nat.* iv. 48, p. 137: Desquamatio, quam Cimolia gypsove Tymphaico fieri Plinius docet, idem est cum ea operatione quæ nunc fit gypso communi in pannis fumo obductis. - - - Quædam terræ usurpantur siccæ, ut gypsum, ad fumum e pannis excutiendum; namque si illis locus fumo infectus fricetur, gypsum cum fumo unitur, denuoque excusso panno, fuligo pannis adhærens simul excutitur. Huic itaque ministerio inservit gypsum simpliciter coctum, inquinatum, et siccatum. p. 136.

false kind became black by the steam of the sulphur which the cloth absorbed. Was it adulterated with some metallic earth or with white lead? It was dear enough to induce people to mix it with such articles; and in that case it must necessarily have become black.

The expression *funditur sulphure* seems to be attended with no less difficulty. In comparing the different readings, I find that the oldest editions have *offunditur*, which has been changed into *effunditur*, and lastly, into *funditur*.* It is probable, however, that instead of *offunditur* we ought to read *offenditur*, which would make the whole clear. I am much surprised that this reading was not adopted by Hardouin. As Pliny says in other parts of his work *offendit stomachum*, and *offendit aciem oculorum*, he might, undoubtedly, have applied that word to the earth and its colour.

Fast colours, which the acid of sulphur might render pale, but could not entirely destroy, would by washing with Cimolian earth be improved, or rather restored, as the earth would absorb and carry off the acid. There was also another kind of earth (*saxum*) which was useful in the preparation of cloth fumigated with sulphur, but which injured the dye, probably, because it was too calcareous, and which was perhaps our common chalk.

* See the small Elzevir edition, Lugd. Bat. 1635, 12mo. vol. iii. p. 575.

I do not intend to treat here of the whole art of the Roman fullers, which belongs rather to the history of weaving or manufacturing cloth in general; but I hope I shall be forgiven if I add the few following observations. The fullers received the cloth as it came from the loom, in order that it might be scoured, walked, and smoothed. It was walked by being stamped upon with the feet. The rough wool raised by this operation was combed off, partly with the skin of a hedge-hog, and partly with the tops of some plants of the thistle kind, in order to give the cloth a nap. Shearing seems not then to have been known: I have at least met with no passage where it is mentioned: and the case is the same with the use of presses; which, in my opinion, were not invented till the sixteenth century.* The whole process of smoothing seems to have consisted in making the wool or nap lie as evenly as possible one way, which certainly must have given to the cloth a much better appearance.

As cloth, at present, is more dressed and shorn on one side than another, the ancient fullers prepared theirs in the like manner; so that clothes could be turned, after the inside of them had been new dressed. Whether they made felt, also, I have not yet inquired; but I conjecture that the

* Schrevelii Harlemum, p. 296. The author, speaking of cloth in the year 1522, says: Eodem hoc anno prelorum usus cepit ad nitorem.

manufacturing of it was the occupation of those called *lanarii, coactores,* and *coactilarii.**

The occupation of the fullers was, at Rome very extensive, and afforded employment to a great number of people, but it at length entirely decayed. Schottgen is of opinion that it belongs to those arts which have been lost. But other writers have declared arts which are exercised

* The following explanation of some terms of art, employed by the ancients, will, perhaps, afford satisfaction to my readers:

Fullones, nactæ, κναφεις, νακται, cloth-dressers. The word cloth-dresser seems to express much better the employment of the ancient fullers than the word walker. For walking, properly so called, the Romans, as appears, had no particular term of art. The Greeks had κναπτειν and συμπατησαι· which words, like the German *durch-walken,* were used to express beating or basting: τη μαστιγι γναψειν ευμαλα, η συμπατησαι. Pollux, p. 712. The Greeks say also πλυνειν for λοιδορειν to wash one; to tell one an unpleasant truth; to reproach or revile one.

Κναφος, an instrument used for dressing cloth. At present a wooden cross planted with prickles (*spina fullonia,* PLIN.) The σωρος may have been constructed in the like manner. If Saumaise has conjectured right, that instrument was called also *inea*; but the passage of Pliny, b. xix. 1, 3. p. 156, *pectitur ferreis hamis,* does not allude to dressing cloth, but to dressing flax, which requires an instrument of iron; and has more affinity to the combing or carding of wool than to the dressing of cloth.

Vestes expolire, polire, to smooth cloth.

Vestes pexæ, cloth walked and dressed.

Politura, γναψις, the smoothing.

Prosa tunica, the right side of the cloth, which had been completely smoothed.

Vestes tritæ, worn cloth became threadbare.

Interpolire, interpolare vestes, to dress anew. *Non. Mar.* i. 145; Est tractum ab arte fullonia, qui poliendo diligenter vetera quæque quasi in novam speciem mutant.

now in greater perfection than formerly to be lost, merely because they were not acquainted with them; or because, on account of the alterations they have undergone, they did not know where to find them. All the different operations of fulling have become so complex by new methods, improvements, and inventions, that they can no longer be conducted by one man; and the whole business has, for that reason, been separated or divided into several distinct branches.

The scouring of cloth, when it comes from the loom, was, together with walking, separated from the rest, after the invention of the walk-mill. How old that invention may be, I cannot accurately determine; but we find it mentioned in the beginning of the thirteenth, and even at the end of the tenth century. Such a mill formerly was called *fullencium*, or *molendinum cum fullone*.* The dressing and smoothing of cloth, since the invention of shearing and pressing, requires so much art, that these operations can be performed only by skilful workmen, who are called cloth-shearers or cloth-dressers. The scouring of cloth, dirtied in manufacturing, is, by the invention of soap, bleaching, and other processes, become so easy, that it can be performed by women. The Romans, for the most part, wore a white dress, made in the form of a cloak; which, indeed, as

* Du Cange in his Glossarium.

shirts were not then used, must have often stood in need of being cleaned.* We, on the other hand, wear in general short close clothes of coloured cloth; which, by the fashion in which they are made, are less exposed to be dirtied; and we are more accustomed also to use clothes of linen or cotton, which can be washen with much less labour. Felt, which is employed almost for hats alone, is manufactured by our hat-makers. Whoever takes a general view of all these employments together, will be readily convinced that they maintain more people, and in a better manner, than the whole *ars fullonia* did at Rome.

* I acknowledge to be one of those who cannot form a proper idea of the Roman *toga*. It is certain that the weavers made each piece of cloth only so large as to be fit for this article of dress; or that when a *toga* was wove, it was cut from the loom, in order that another might be begun. On this account we find so often the expressions *texere vestes*, *texere togas*. It appears, also, that the *toga*, when it came from the hands of the weaver, was quite ready for use; and we therefore never read of tailors, but when torn clothes were to be mended. The *toga* had no sleeves, and perhaps no seam. If it was stitched along the edges before, half way up, the assistance of a tailor would not be necessary for that purpose. It was bound round the body with a girdle, and fastened with clasps. Such a mantle could be easily made and easily scoured. One may now readily comprehend why the Roman authors never mention cloth manufactories, or cloth, among the articles of commerce, but speak only of clothes; and why we never read of cloth being measured.

MADDER.

This plant, the root of which is either dried and bruised, or, according to the new method, used fresh, for dyeing red, has a weak, square, jointed stem; and rises to the height of eight feet when supported, otherwise it creeps along the ground. At each joint there are five or six leaves, about three inches in length, almost an inch broad in the middle, and pointed at both ends. The upper side of the leaves is smooth; but the middle fibre of the under side is armed with small rough prickles; and others of the same kind may be found on the stem. On this account, the leaves, which drop annually, adhere readily to other bodies, like those of the *asperugo*. The branches, which, in June, bear flowers divided into four yellow leaves, proceed from the joints. The fruit, a kind of berry, which, towards the time of its ripening, though that seldom happens among us, is first of a brownish colour, and then black, contains a round seed. The roots grow sometimes to the thickness of one's finger, push themselves deep into the earth, are surrounded by many small fibres, have a yellowish-red pith, and are covered with a black bark or rind.* This plant grows

* A complete figure of it may be seen in *Kerners Abbildungen der ækonomischen pflanzen*, tab. 236. Of the wild kind, which is

wild in the Levant, as well as in Italy, the southern parts of France, and in Swisserland. The cultivated kind is well known; and is propagated with much advantage in various countries of Europe.

When one compares this short description with what Dioscorides says of a plant which he calls *ereuthodanon*,* it will be readily seen that he meant our madder. He even compares its long square stem, armed with a great many hooks, to that of the *asperugo;* and he tells us that the leaves stand in the form of a star around the joints. The fruit was at first green, then red, and lastly black. The thin long roots, adds he, which are red, serve for dyeing; and on that account the cultivated kind (he must therefore have been acquainted with the wild sort) is reared with much benefit in Galilea, around Ravenna in Italy, and in Caria, where it is planted either among the olive-trees, or in fields destined for that purpose. It is remarked in some manuscripts, that this plant had a name given it by the Romans, which, as Marcellus Virgil observes, meant the same thing as *rubia sativa*; and that it was called in Hetruria *lappa minor*, doubtless because, like the

smaller in all its parts, a figure is given in *Memorie di osservazioni sopra la coltura di varie piante.* In Padova, 1766, 4to. tab. 9. p. 53.

† Ερευθοδανον. He calls it also ερυθροδανον. Lib. iii. cap. 160, p. 238 and 460.

bur, it adhered to other bodies. On account of the dye which it communicated, it was called also sometimes *cinnabaris.* *

In opposition to this asserted identity I find

* Some, also, may, with equal propriety, have called it *sandyx*; and I am of opinion that under this name we are to understand our madder, at least in a passage of Virgil, Eclogue iv. 45, where he says: Sponte sua sandyx pascentes vestiet agnos. As the wool of the sheep became red by eating the madder which grew in the fields, it could be immediately manufactured, without dyeing it artificially. We manufacture the wool of our brown sheep in its natural colour, and this was done also by the ancients. Cloths of this kind were the *panni nativi coloris,* as they are called by Pliny, b. xxxvi. 7; and the words of Martial. xiv. 133, allude to a dress made of such cloth:

Non est lana mihi mendax, nec mutor aëno,
— — — — — — me mea tinxit ovis.

I shall here take occasion to remark, that the word *lutum,* in the line preceding the above passage of Virgil, must be translated *yellow-weed,* and not *woad.* The former, *reseda luteola,* dyes yellow; but the latter, *isatis,* dyes blue. *Lutum,* however, in *Cæsar De bello Gallico,* v. 14, seems to have been *woad:* Omnes se Britanni luteo inficiunt, quod et cæruleum efficit colorem. It appears, therefore, that both names were liable to be confounded in the Latin, as they are in the German; unless Davis be right, who, instead of *luteo,* reads *vitro.* That *sandyx,* in Virgil, signifies a plant rather than a mineral, is to me far more probable. The author speaks of plants which the sheep ate while feeding (*pascentes*); and both the above-mentioned dye-plants, yellow-weed and woad, grow wild in Italy. The opinion of Pliny, who understood the passage so, is not to be despised; and therefore the poetical account, that the pasture dyed the wool, is not altogether without foundation; especially as not only the roots, but also the leaves of madder, communicate a colour to the solid parts of animal bodies. I will however allow, that most people readily fall into the error of being led away by imagination; and often suppose that they find in passages of ancient authors more than others can discover, or perhaps even than they contain.

only one doubt; namely, that among those plants which, on account of the position of their leaves, were called *stellatæ*, and which were all so like that we must reduce them to one natural class, there are more sorts, the roots of which dye red, and which, on that account, are very improperly called wild madder.* Why, therefore, should the plant of Dioscorides be our madder, and not some other plant of the like nature? For this reason, in my opinion: because the ancients, who were acquainted with all these plants, which grew wild in their lands, were equally prudent as the moderns, and cultivated that kind only which was the most productive or beneficial, viz. our *rubia tinctorum.*

This opinion will be strengthened by comparing the accounts given of that plant by other ancient writers. Theophrastus† agrees almost perfectly with Dioscorides; and adds, that it did not grow upright, but was fond of reclining. The comparison, therefore, with the leaves of ivy, cannot be just; but that I shall leave to the critics.‡

* See the catalogue in my Grundsätzen der landwirthschaft, § 310.

† Hist. plant. ix. 24. p. 111.

‡ Stapel reads ὁμοιον σχρῳ, because Pliny, xix. 3, says, *similitudine erviliæ.* In my opinion, Pliny in this comparison alluded to the stem of the plant, which in madder is formed almost like that of many kinds of pulse, and which reclines in the same manner; and he adds, very properly, that the stem of the *rubia* was jointed, and surrounded with five leaves, displayed in the form of a star. His

Pliny says expressly, that the *erythrodanum* or *ereuthodanum* was in his mother tongue called *rubia;* and that its red roots were used to dye wool and leather red.*

In the middle ages this plant was called *varantia*, a name which must have arisen from *verantia*. The latter means the real, genuine dye; as *aurantia* signified a golden yellow.† Till the year 1736, this plant was little regarded, except among dyers, farmers, and merchants, who purchased it from the farmers, in order to sell it to the dyers with profit; and among a few herb-dealers and physicians, who, on the authority of the ancients, ascribed to it eminent virtues, which others doubted or altogether denied. In the above year, however, a property of it was discovered, by accident, as usual, which rendered it an object of more attention. John Belchier, an English surgeon, having dined with a cotton-printer, observed that the bones of the pork which was brought to the table were red. As he seemed surprised at this circumstance, his host assured him that the

words are only not properly divided, and ought to be arranged as follows: Sponte provenit, seriturque. Similitudine erviliæ, verum spinosus ei caulis.———If one could introduce the word ωχρῳ into the passage of Theophrastus, so as to retain this meaning, it would appear intelligible; but that would be difficult on account of the word φυλλον.

* Lib. xxiv. 9. p. 341.

† Flame colour among the Greeks was called αληθινον. Myrepsius says that the rubia τα αληθινα βαπτει, that is, dyes red. *Salmasius ad Capitolini Macrinum*, p. 169, 170. *Ad Solinum*, p. 810.

redness was occasioned by the swine feeding on the water mixed with bran in which the cotton cloth was boiled, and which was coloured by the madder used in printing it. Belchier,* to whom this effect was new, convinced himself, by experiments, that the red colour of the bones had arisen from the madder employed in printing the cotton, and from no other cause; and he communicated his discovery to the Royal Society, in a paper which was printed in their Transactions.

This singularity was now soon known to all the naturalists, several of whom made new experiments, the result of which brought to light many truths useful to physiology. Besides the roots of madder, those of the *galium* (yellow ladies-bed-straw) and other plants which have an affinity to madder, produce the like effects; but this is the case neither with saffron nor woad, nor with many others much used in dyeing. The colouring takes place soonest in young animals; and is strongest

* The first account of this circumstance may be found in the Philosophical Transactions, vol. xxxix. n. 442. p. 287. n. 443. p. 299; and in the French translation, *Transactions, traduites* par M. de Bremond, année 1736, p. 155 and 169. Among the principal experiments made on this subject, are those of the Italian Matth. Bazanus, and H. J. Benj. Böhmer. Those of the former may be found in *Comment. Bononiens.* ii. 1. p. 129, and 2. p. 124; and those of the latter in a dissertation entitled *Radicis rubiæ tinctorum effectus in corpore animali*, Lips. 1751. Other works and observations relative to this singularity are mentioned in Haller's *Elementa Physiologiæ*, v. p. 327.

where the bones are hardest and thickest. On the other hand it does not reach the soft parts; appears only a little in the milk; and, in general, is not perceptible in the animal juices.*

As the English calico-printers were acquainted

* That the *rubia* colours the milk has been denied by many, who are mentioned in *Haller's Physiol.* viii. p. 328. Young, in his Treatise *de lacte*, says only that it has no effect on carnivorous animals. Being once engaged in making experiments on the madder dye, I gave the plant to a cow for several days, and I found that the milk became reddish and streaked with veins which were of a darker colour than the other parts. Stief also, whom I shall quote hereafter, speaking of this plant, says, p. 11: Inde vaccarum lacti aliquid rubicundi coloris communicatur, quæ mutatio ex opposito lacte e mammis vaccæ alio pabulo enutritæ, magis apparet. Incolæ fere omnes Wratislavienses eodem rubescente lacte utuntur, et nulla incommoda sentiunt.—That well-known farmer, Gugenmus, gave the madder-plant, formed into hay, to his cows, which ate it readily. Their milk was somewhat reddish, and the butter and cheese acquired by these means, in winter, an agreeable colour. See *Bemerkungen der Pfälzischen ökonomischen Gesellschaft.* 1771. p. 253. Perhaps the effects do not take place when the animals get other food at the same time. Or may not the state of their health occasion some difference? This much is certain, that *chelidonium* (swallow-wort) makes the milk of cows that are weak appear bloody, while the same effect does not follow, or at least immediately, in those that are strong. *Ruellius, De natura stirpium*, Basiliæ, 1543. fol. p. 572. says of the rubia: Folia capillum tingunt. If he meant that the hair became red by eating the leaves, he committed a mistake; for Böhmer says, p. 17: Constanti et perpetua observatione cognovimus quadrupedum pilos et setas nunquam a rubiæ radicis adsumptæ colore infectas fuisse. From his error, however, one might conjecture that he knew something of the property which this plant has of communicating its colour when used as food. The first edition of his book was printed in 1536.

with this effect of madder, before it was known to naturalists, it is not improbable that it was known much sooner, in other places, where the plant has been much cultivated and used since the earliest periods. From what J. E. Stief says, we have reason to believe, that the people in the neighbourhood of Breslau, his native city, who gave the stalks of the madder-plant to their cows instead of straw, must have first discovered that it possessed the property of communicating a red colour to the bones.*

As many truths not yet investigated by means of new experiments, and which on that account have not yet been acknowledged, are concealed among the evidently false assertions to be found in the works of the ancients, and as these works were thrown aside too early, before their contents were properly examined, I was induced to suspect that some hints of this colouring property might also be mentioned in them, which indeed is the case.

We learn from the works of Galen and Dioscorides,† that the ancient physicians remarked that the use of certain roots, which they administered to their patients, communicated a colour to their

* Dissertatio de vita nuptiisque plantarum. *Lipsiæ*, 1741, p. 11.

† Dioscor. iii. 160. p. 238. Radix crassam et copiosam urinam pellit, ac interdum etiam sanguinem. Bibentes quotidie lavari oportet, et excrementorum quæ redduntur differentiam contemplari. *Galen.* lib. vi. *Simp.* One may readily perceive here that urine tinged red was considered as blood.

urine and excrements; and this observation has been repeated by Cardan,* Thurneisser,† Porta,‡ Castor Durantes,§ and others. Had those ancient physicians, who often prescribed these roots, and paid attention to the colour of the excrements of their patients, been accustomed to open their bodies when they died under their hands, they would have perhaps remarked, in human bones, what was observed long after in the bones of animals, when the roots were no longer used in medicine; and what, if I am not mistaken, was never, yet observed in the bones of the human species.‖

Böhmer, who made researches respecting the antiquity of this observation, found it neither in

* De subtilitate. Basiliæ 1664. 4to. lib. xviii. p. 669.

† Von kalten, warmen und metallischen wassern. Strasburg, 1612. fol. iv. 6. p. 78.

‡ Magia natural. Francof. 1591. 8vo. viii. 13. p. 355.

§ Herbarium novum. Venet. 1617. fol. p. 400.

‖ I do not know that any one ever remarked human bones to have been dyed by madder, though the proposal for using the roots of it against the rachitis might have given occasion to make observations on that subject. See *G. L. Hansen, Diss. de rachitide.* Gottingæ 1762, p. 36. Professor Arnemann, who has a very numerous and valuable collection of skeletons, and who carefully examined many of the like kind during his travels, assured me that he never saw any bones that had been dyed by madder in the human body. He said it was probable, however, that the colouring of the bones depends on the attractive power which the calcareous earth has in regard to the colouring particles; and that therefore the effects on human bones, and those of warm-blooded animals, would be the same.

Rombert. Dodonæus,* Mich. Ettmuller,† Morin,‡ Will. Salmon,§ nor others, who, however, speak of coloured urine. In his opinion the oldest writer who speaks of coloured bones is Mizaldus; but what he relates is all taken from the treatise of Lemnius *De miraculis occultis naturæ;* and the latter therefore is the oldest writer whom I at present can mention, as acquainted with this property. He was a physician in Zealand, where madder has been cultivated since the earliest ages, and where he had an opportunity of remarking it. He says that the bones of animals became red, as had been observed when the flesh was dressed, by their eating only the leaves, and not the roots. In the first edition of the above work, printed in octavo, in the year 1559, which consists of two books, this information will not be found; but it may be contained in the second of 1564, which comprehends four books.‖ On the other hand,

* Stirp. hist. pempt. 3. lib. i. cap. 28. p. 353.

† Colleg. pharmaceut. in Schröder, p. 645. Opp. i. Francof. 1696. fol.

‡ Mem. de l'Acad. des sciences, 1701. p. 273.

§ Botanolog. lib. i. cap. 461. p. 664. Lond. 1710, fol.

‖ Bayle, Diction. iii. p. 72. More editions are quoted in Haller's *Biblioth. botan.* i. p. 335, and *Biblioth. pract.* ii. p. 136. In my edition, Coloniæ Agrip. 1581, the following passage occurs, lib. iv. p. 423: Erythrodanum seu rubia ossa pecudum sandicino rubentique colore imbuit, si quando herbam virentem depastæ sunt, intacta etiam radice, quæ rutila existit; quod etiam in elixis decoctisque ejus pecoris carnibus perspici potest, et in ovis, quæ rubicundo colore

the work of Mizaldus, as far as I can find, was first printed in octavo, at Paris, in 1566; and consisted then of no more than nine centuries. The dedication which stands before my edition, printed in duodecimo, at Franckfort in 1559, is dated the same year. In that section where the author gives an account of the effects produced by madder, he refers several times to Lemnius.*

JUGGLERS.

Under this title I comprehend not only those properly called jugglers, who, for the sake of money, by quick and artful motions of their hands, bodies, and limbs, and by various preparations, delude the senses in an agreeable manner, or practise an innocent deception on the spectators, so that they think they hear and see what they do

radicis hujus decocto fucantur. That the green leaves contain also a red dye, and can really communicate a red colour, I have proved already in my *Experimenta emendandi rubiæ usum tinctorium*, p. 65. It may be found in *Commentar. Societ. Gotting.* vol. viii.

* Erythrodanum, vulgo rubia tinctorum dictum, ossa pecudum rubenti et sandycino colore imbuit, si dies aliquot illud depastæ sint oves, etiam intacta radice, quæ rutila existit. Res ea similiter perspici potest in carnibus hujus pecoris elixis et assatis. Nam rubicundæ apparent, sicuti etiam ova in decocto ejus radicis elixata. *Centuriæ novem memorabilium, utilium ac jucundorum.* Cent. vii. p. 160. See *Halleri Biblioth. botan.* i. p. 327. *Biblioth. pract.* ii. p. 92.

not really hear and see, but also rope-dancers; people who place their bodies in positions according to all appearance dangerous; and those who for pay exhibit animals taught to perform uncommon tricks, as well as automata, which by their concealed construction seem to produce wonderful effects.

But is it worth while to inquire into the antiquity of all these arts, unprofitable to the public, which form the favourite amusements of the populace? The selfish question *cui bono*, which is often thrown out by way of reproach to men of letters, but oftener to naturalists, and even to jurists, when, in their researches, they advance beyond the beaten track, I might easily get rid of by civilly telling the querists to pass over this article if they think they are not likely to derive benefit from it. I might also apologize for employing my time and labour on this subject, by using the words of a certain historian: *Frivola hæc fortassis cuipiam et nimis levia esse videantur, sed curiositas nihil recusat.* I shall, however, adopt neither of these methods; as I flatter myself that this essay may afford as much amusement as many that are read daily; and that therefore it may not only be excused but even justified.

Those arts and employments which are most necessary in life were, undoubtedly, the earliest, and they have still continued to be the most important; but when these were sufficiently occu-

pied, or carried on by as many persons as could live by them, the rest, who were excluded from them, conceived the idea of amusing the former when tired with their labour, that by these means they might obtain from them a part of the fruits of their industry. I request my readers to reflect how many occupations have been devised for no other purpose. They will find that several of these have acquired a pre-eminence over the necessary or useful arts; and to the same class belong jugglers.*

All political writers tell us, as a fundamental principle of government, that population ought to be increased. This maxim, however, is just only under certain circumstances: that is, when employment can be procured to a greater number of inhabitants than a country already possesses. Of beggars we have to maintain too many. All

* Etudiez les progrès de la societé, et vous verrez des agriculteurs dépouillés par des brigands; ces agriculteurs opposer à ces brigands une portion d'entr' eux, et voila des soldats. Tandis que les uns récoltent, et que les autres font sentinelles, une poignée d'autres citoyens dit au laboureur et au soldat, Vous faites un métier pénible et laborieux. Si vous vouliez, vous soldats, nous defendre, vous laboureurs, nous nourir, nous vous déroberions une partie de votre fatigue par nos danses et nos chansons. Voila le trobadour et l'homme de lettres. Avec le tems, cet homme de lettres s'est ligué, tantôt avec le chef contre les peuples, et il a chanté la tyrannie; tantôt avec le peuple contre le tyran, et il a chanté la liberté. Dans l'un et l'autre cas, il est devenu un citoyen important. *Hist. philos. des établissem. et du commerce des Européens dans les Indes*, ii. p. 284.

our trades and occupations are not only filled up with workmen, but overflow. Our farmers can employ no more labourers; and our manufacturers no more hands than they have at present; our regiments are full; and in every employment there are more candidates and more supernumeraries than is consistent with the good of the public. Must it not therefore give us pleasure, when necessity invents new means of acquiring a livelihood, although they could be dispensed with? It is much better that those who have learned no useful art; who have lost their youth in the service of others; or who are destitute, through any other cause, should gain their bread by amusing their fellow citizens, than that they should either beg or steal.

These arts, are, indeed, not unprofitable, for they afford a comfortable subsistence to those who practise them; but their gain is acquired by too little labour to be hoarded up; and, in general, these roving people spend on the spot the fruits of their ingenuity; which is an additional reason why their stay in a place should be encouraged. I have, however, known some who saved so much from their earnings that, in their old age, they were enabled to enter into some business more certain as well as more profitable.

People of this description will never want encouragement and support while they exhibit with confidence any thing uncommon, and know how to suit the nature of their amusements to the taste

of the spectators. The greater part of mankind love deception so much, that they reward liberally those who impose on their senses, as is proved by the ready sale of gilt articles, artificial gems, and a thousand other things which are not in reality what they appear to be. I do not know whether Montagne is right in considering it as a sign of the weakness of our judgment, that we take a pleasure in beholding objects on account of their rarity, novelty, or the difficulty that attends them, though they may be subservient to no useful purpose.* This appears to me to proceed from that innate curiosity which serves as a spur to incite us to enlarge our knowledge, and to engage in researches and undertakings that often lead to discoveries of greater importance.

Jugglers, indeed, seldom exhibit any thing that can appear wonderful to those acquainted with natural philosophy and mathematics; but these even often find satisfaction in seeing truths already known to them applied in a new manner; and they readily embrace every opportunity of having them further illustrated by experiments. Many, however, are too precipitate, and attempt to explain before they have sufficiently examined, of which the golden tooth at the end of the sixteenth

* C'est un tesmoinage merveilleux de la foiblesse de nostre jugement, qu'il recommande les choses par la rareté, ou nouvelleté, ou encore par la difficulté, si la bonté et utilité n'y sont joinctes. *Essais*, i. 54. vol. i. p. 217, according to the London edition 1739.

century; the conjuring-rod at the end of the seventeenth; and the chess-player and speaking-machine at the end of the eighteenth, may serve as instances. But it often happens, that what ignorant persons first employ, merely as a show, for amusement or deception, is afterwards ennobled by being applied to a more important purpose. The machine with which a Savoyard, by means of shadows, amused children and the populace, was by Liberkühn converted into a solar microscope; and, to give one example more, which may convince female readers, if I can hope for such, the art of making ice in summer, or in a heated oven, enables guests, much to the credit of their hostess, to cool the most expensive dishes. The Indian discovers precious stones, and the European, by polishing, gives them a lustre.

But, if the arts of juggling served no other end than to amuse the most ignorant of our citizens, it is proper that they should be encouraged for the sake of those who cannot enjoy the more expensive deceptions of an opera. They answer other purposes, however, than that of merely amusing: they convey instruction in the most acceptable manner, and serve as a most agreeable antidote to superstition, and to that popular belief in miracles, exorcism, conjuration, sorcery, and witchcraft, from which our ancestors suffered so severely. Wherever the vulgar were astonished at the effects

of shadows, electricity, mirrors, and the magnet, interested persons endeavoured by these to frighten them; and thus misapplied the powers of nature to promote their own advantage. The pontiffs and their clergy ought, undoubtedly, to be detested for discouraging experimental philosophy. That science they considered as a formidable enemy; and they thought they gained no small advantage when they induced the house of Medici, by granting it the cardinalship, to suppress the *Academy del Cimento.* When Gasner exhibited his deceptions, some one proposed to him to try his art at Berlin or Gottingen, and to drive out there if it were only the smallest of all the devils; but these cities were not theatres where he was likely to succeed, and he never ventured to appear in them.* It is, however, better that the populace, if they will absolutely pay for being deceived, should be exposed to a momentary deception from jugglers than to a continual deception from priests. As the former are not covered with the sacred cloak of religion, their deceptions are more easily seen through and detected; and they consequently soon cease to be hurtful. So late as the year 1601, a horse, which had been taught to perform a number

* The juggler, mentioned in Xenophon, requested the Gods to allow him to remain only in places were there was much money, and abundance of simpletons: Οπου αν η, διδοναι καρπου μεν αφθονιαν, φρενων δε αφοριαν.

of tricks, was tried, as possessed by the devil, and condemned to be burnt.* At present horses of this kind are so often exhibited publicly in the heretical countries of Europe, that the Spanish Inquisition, perhaps, will soon be ashamed of considering such proofs of the docility of these animals, and of the patient dexterity of their teachers, as the work of the devil, as they did at the above period. Those who view the art of the juggler in the same light as I do, will, I hope, forgive me for introducing these observations, and allow me to continue them while I inquire into the antiquity of this employment; especially as I shall endeavour by these means to illustrate more fully my subject.

Had that book which Celsus wrote against the *Magi* been preserved, we should have been much better acquainted with the art of the ancient conjurors or jugglers. This Celsus, without doubt, is the same author whose virulent attack against the Christians was refuted by Origen; and we

* Le Siècle de Louis XIV. Berlin 1751, 12mo. i. p. 44. This horse was seen in the above-mentioned year by Casaubon, to whom the owner, an Englishman, discovered the whole art by which he had been trained. See *Casauboniana*, p. 56. We are assured by Jablonski, in his *Lexicon der künste und wissenschaften*, p. 547, that he was condemned to the flames at Lisbon. In the year 1739, a juggler, in Poland, was tortured till he confessed that he was a sorcerer, and without farther proof he was hanged. The whole account of this circumstance may be found in the *Schlesischen gelehrten neuigkeiten* for the year 1739.

have, therefore, greater cause to regret that a work on the above subject, by so learned and acute a philosopher, should have been lost. He is mentioned with respect by Lucian, and even by Origen; and the former derived from him the account which he gives of Alexander the impostor.* More ancient authors also wrote upon the same subject. Some of them are mentioned by Diogenes Laertius in his preface; and Suidas quotes the Magicon of Antisthenes, though neither of these speaks of Celsus; but of all those writings none are now extant.

The deception of breathing out flames, which at present excites in a particular manner the astonishment of the ignorant, is very ancient. When the slaves in Sicily, about a century and a half before our æra, made a formidable insurrection, and avenged themselves in a cruel manner for the severities which they had suffered, there was amongst them a Syrian named Eunus,† a man of

* See Luciani Opera, ed. Bipont. v. p. 388 and 407. *Spenceri Annotat. in libr. i. Origenis contra Celsum*, p. 3. *Fabricii Biblioth. Græca*, vol. ii. p. 809.

† Syrus quidam nomine Eunus, fanatico furore simulato, dum Syriæ Deæ comas jactat, ad libertatem et arma servos quasi numinum imperio concitavit; idque ut divinitus fieri probaret, in ore abdita nuce, quam sulphure et igne stipaverat, leniter inspirans, flammam inter verba fundebat. *Florus*, iii. 19, 4. Τελευταιόν δια τινος μηχανης πυρ, μετα τινος ενθουσιασμου, και φλογα δια του στοματος ηφιει, και ὑυτω τα μελλοντα απεφοιβαζεν. εις γαρ καρυον η τι τοιουτο τετρημενον εξ ἑκατερου

great craft and courage, who, having passed through many scenes of life, had become acquainted with a variety of arts. He pretended to have immediate communication with the gods; was the oracle and leader of his fellow-slaves; and, as is usual on such occasions, confirmed his divine mission by miracles. When, heated by enthusiasm, he was desirous of inspiring his followers with courage, he breathed flames or sparks among them from his mouth while he was addressing them. We are told by historians, that for this purpose he pierced a nut-shell at both ends, and, having filled it with some burning substance, put it into his mouth and breathed through it. This deception, at present, is performed much better. The juggler rolls together some flax or hemp, so as to form a ball about the size of a walnut; sets it on fire; and suffers it to burn till it is nearly consumed; he then rolls round it, while burning, some more flax; and by these means the fire may be retained in it for a long time. When he wishes to exhibit, he slips the ball unperceived into his mouth and breathes through it; which again revives the fire, so that a number of weak sparks proceed from it;

μερους ενετιθει πυρ, και την συνεχειν αυτο δυναμενον ὑλην. ειτα εντιθεις τῳ στοματι, και ωροσπνεων, ποτε μεν σπινθηρας, ποτε δε Φλογα εξεκαεν. Diodor. Sic. *ecl.* 34, p. 526. Sulphur, which is mentioned by Florus, would hardly be fit for the purpose. Compare *Alexand. ab Alex. Gen. dies*, ii. 11, p. 345. Sulphur, however, is used for the like end in the East, even at present. See *Shaw's Reisen*, p. 214.

and the performer sustains no hurt, provided he inspire the air not through the mouth but the nostrils.*

By this art the rabbi Bar-Cocheba, in the reign of the emperor Hadrian, made the credulous Jews believe that he was the hoped-for Messias; † and two centuries after, the emperor Constantius was thrown into great terror, when Valentinian informed him that he had seen one of the body-guards breathing out fire and flames in the evening.‡

For deceptions with fire the ancients employed also naphtha, a liquid mineral oil, which kindles when it only approaches a flame. Galen informs us, that a person excited great astonishment by extinguishing a candle and again lighting it, with-

* Directions for performing this trick may be found in various works, such as Joh. Walbergen's *Sammlung natürlicher zauberkünste*. Stuttgard 1754, 8vo. p. 25. and *Naturliches zauberbuch*. Nurnberg 1740, 8vo. p. 110.

† Tu videlicet flammeus, immo fulmineus, qui in loquendo fulminas, atque ut ille Barchochebas auctor seditionis Judaicæ stipulam in ore succensam anhelitu ventilabat, ut flammis evomere videretur. *Hieronymi Apolog.* ii. *adversus Ruffinum*. See *Bayle's Diction.* i. p. 450. art. Barchochebas.

‡ Valentinianum aiunt vidisse quendam ex iis qui silentiarii vocantur flammam ignis ore evomentem, πυρος φλογα του στοματος αφιεντα, vidisse id vero circa vesperam, quando post cibum somnum capere solemus, et hæc quidem Constantio significasse, qui nuncio hoc in suspicionem metumque versus est. *Philostorgii Hist. eccles.* vii. 7, p. 93.

out any other process than holding it immediately against a wall or a stone. The whole secret of this consisted in having previously rubbed over the wall or stone with sulphur.* But as the author a few lines before, speaks of a mixture of sulphur and naphtha,† there is reason to think that he alludes to the same here. Plutarch‡ relates how Alexander the Great was astonished and delighted with the secret effects of naphtha, which were exhibited to him at Ecbatana. The same author, as well as Pliny, Galen and others, has already remarked, that the substance with which Medea destroyed Creusa, the daughter of Creon, was nothing else than this fine oil.§ She sent to the unfortunate princess a dress besmeared with it, which burst into flames as soon as she approached the fire of the altar. The blood of Nessus, wherein the dress of Hercules, which took fire likewise, had been dipped, was undoubtedly naphtha also;‖ and this oil must have been always employed when offerings caught fire in an imperceptible manner.

* Jam illud ceu rem mirandam quidam ostentavit; extinxit lucernam, ac rursus muro admovens accendit. Alter lapidi eam admovit. Fuerant autem tum murus, tum lapis sulfure contacti, quod ubi deprehensum est, desiit mirum videri, quod ostentabant. Ετεθειωτο δε αρα και ὁ τοιχος και ὁ λιθος. Galen. De temperamentis, iii. 2. p. 44.

† Δια τε θειου και της ὑγρας ασφαλτου.

‡ Vita Alexandri, p. 687. § Galen. l. c.

‖ Ovid. Metamorph. lib. ix. 160.

tible manner.* In all periods of the world priests have acted as jugglers to simple and ignorant people.

In modern times, persons who could walk over burning coals or red-hot iron, or who could hold them in their hands and their teeth, have often excited wonder. In the end of the 17th century, an Englishman named Richardson, who, as we are assured, could chew burning coals; pour melted lead upon his tongue; swallow melted glass, &c. rendered himself very famous by these extraordinary feats.† Laying aside the deception practised on the spectators, the whole of this secret consists in rendering the skin of the soles of the feet and hands so callous and insensible, that the nerves under them are secured from all hurt, in the same manner as by shoes and gloves. Such callosity will be produced if the skin is continually compressed, singed, pricked, or injured in any other manner. Thus do the fingers of the industrious sempstress become horny by being frequently pricked; and the case is the same with the hands of fire-workers, and the feet of those who walk bare-footed over scorching sand.

* Instances may be found collected in *Huetii Alnetanæ question.* lib. ii. cap. 12, 21, p. 171; and in *Bayle's Dictionary*, art. Egnatia, p. 344.

† *Journal des sçavans*, 1667, p. 54, 222; and 1680, p. 292. *Deslandes, Mémoires de physique*, ii. and *Bremenscher Magazin*, i. p. 665. See also *Busbequii Omnia.* Basil. 1740, 8vo. p. 314.

In the month of September, 1765, when I visited the copper works at Awestad, one of the workmen, for a little drink-money, took some of the melted copper in his hand, and after showing it to us, threw it against a wall.* He then squeezed the fingers of his horny hand close to each other; put it a few minutes under his armpit, to make it sweat, as he said; and, taking it again out, drew it over a ladle filled with melted copper, some of which he skimmed off, and moved his hand backwards and forwards, very quickly, by way of ostentation. While I was viewing this performance, I remarked a smell like that of singed horn or leather, though his hand was not burnt. The workmen at the Swedish melting-houses showed the same thing to some travellers in the 17th century; for Regnard saw it in 1681, at the copper-works in Lapland.† It is highly probable that people who hold in their hands red-hot iron, or who walk upon it, as I saw done at Amsterdam, but at a distance, make their skin callous before, in the like manner. This may be accomplished by frequent moistening it with spirit of vitriol; according to some the juice of certain plants will produce the same effect; and we are assured by others that the skin must be very frequently rubbed, for a long time, with

* The same thing was performed when Mr. Schreber was there, in 1760. See his father's *Neue Sammlung*, i. p. 113.

† Algem. histor. der reisen, xvii. p. 308.

oil, by which means, indeed, leather also will become horny.*

Of this art traces may be found also in the works of the ancients. A festival was held annually on Mount Soracte, in Etruria, at which the Hirpi, who lived not far from Rome, jumped through burning coals; and on this account they were indulged with peculiar privileges by the Roman senate.† Women also, we are told, were accustomed to walk over burning coals at Castabala, in Cappadocia, near the temple dedicated to Diana.‡ Servius remarks, from a work of Varro now lost, that the Hirpi trusted not so much to their own sanctity as to the care which they had taken to prepare their feet for that operation.§

I am not acquainted with every thing that concerns the trial by ordeal, when persons accused were obliged to prove their innocence by holding in their hands red-hot iron; but I am almost convinced that this also was a juggling trick of the priests, which they employed as might best suit their views. It is well known that this mode of

* Haller, Elementa physiolog. v. p. 16.

† Plin. vii. 11, p. 372. *Virg. Æn.* xi. 785. *Silius Ital.* v. 175. Strabo, v. p. 372. ed. Almel. The latter calls this festival θαυμαστὴν ἱεροποιΐαν. Solin. cap. ii. 26.

‡ Strabo, xii. p. 811.

§ Virgil. quidem dixit: freti pietate, sed Varro, ubique expugnator religionis, ait, cum quoddam medicamentum describeret: et ut solent Hirpini, qui ambulaturi per ignem medicamento plantas tingunt.

exculpation was allowed only to weak persons, who were unfit to wield arms, and particularly to monks and ecclesiastics, to whom, for the sake of their security, that by single combat was forbidden. The trial itself took place in the church entirely under the inspection of the clergy; mass was celebrated at the same time; the defendant and the iron were consecrated by being sprinkled with holy water; the clergy made the iron hot themselves; and they used all these preparatives, as jugglers do many motions, only to divert the attention of the spectators. It was necessary that the accused persons should remain at least three days and three nights under their immediate care, and continue as long after. They covered their hands both before and after the proof; sealed and unsealed the covering: the former, as they pretended, to prevent the hands from being prepared any how by art; and the latter to see if they were burnt.*

Some artificial preparation was therefore known, else no precautions would have been necessary. It is highly probable that, during the first three days, the preventive was applied to those persons whom they wished to appear innocent; and that the three days after the trial were requisite to let the hands resume their natural state. The sacred

* See Grupen's learned Dissertation in the *Hannoverschen gelehrten anzeigen*, 1751, p. 679.

sealing secured them from the examination of presumptuous unbelievers: for to determine whether the hands were burnt, the last three days were certainly not wanted. When the ordeal was abolished, and this art rendered useless, the clergy no longer kept it a secret. In the thirteenth century an account of it was published by Albertus Magnus, a Dominican monk.* If his receipt be genuine, it seems to have consisted rather in covering the hands with a kind of paste than in hardening them. The sap of the *althæa* (marsh-mallow), the slimy seeds of the flea-bane, which is still used for stiffening by the hat-makers and silk-weavers, together with the white of an egg, were employed to make the paste adhere; and by these means the hands were as safe as if they had been secured by gloves. The use of this juggling trick is very old, and may be traced back to a pagan origin. In the Antigone of Sophocles, the guards placed over the body of Polynices, which had been carried away and buried contrary to the orders of Creon, offered, in order to prove their

* In his work *De mirabilibus mundi*, at the end of his book *De secretis mulierum*, Amstelod. 1702, 12mo. p. 100. Experimentum mirabile quod facit hominem ire in ignem sine læsione, vel portare ignem vel ferrum ignitum sine læsione in manu. Recipe succum bismalvæ, et albumen ovi, et semen psylli et calcem, et pulveriza, et confice cum illo albumine ovi succum raphani; commisce; ex hac confectione illineas corpus tuum vel manum, et dimitte siccari, et postea iterum illineas, et post hoc poteris audacter sustinere ignem sine nocumento.

innocence, to submit to any trial: "We will," said they, "take up red-hot iron in our hands, or walk through fire.*"

The exhibition of balls and cups, which is often mentioned in the works of the ancients, as the most common art of jugglers, is also of great antiquity. It consists in conveying speedily, and with great dexterity, while the performer endeavours by various motions and cant phrases to divert the attention of the simple spectators from observing his movements too narrowly, several light balls, according to the pleasure of any person in company, under one or more cups; removing them sometimes from the whole; and conveying them again back in an imperceptible manner. In general, three leaden cups are used, and as many balls of cork; and to prevent all discovery by their slipping from the thumbs of the juggler, or making a noise, as he must lay hold of them with much quickness,† the table before which he sits is covered with a cloth.‡

These small balls were by the ancients called

* Ημεν δ' ετοιμοι και μυδρους αίρειν χεροιν,
Και πυρ διερπειν, και θεους ὁρκωμοτειν
Το μητε δρασαι, μη τε τω ξυνειδεναι
Το πραγμα βουλευσαντι, μητ' ειργασμενω.
Antigone, 270, p. 248, ed. Cantabrigiæ 1665, 8vo.

† Κλεπτειν, which word was often used when any thing was done speedily and unperceived. Xenophon says, κλεπτειν ορη, montes clam hostibus occupare.

‡ Natürliches zauberbuch, p. 3.

calculi; and the cups *acetabula,* or *paropsides.** Casaubon† has already quoted most of those passages in ancient authors which relate to this subject; and they have been repeated by Bulenger;‡ but neither of these writers makes mention of the fullest and clearest description given in the letters of Alciphron.§ We have there an account of

* Λιθιδια or ψηφοι, calculi; παροψιδες, acetabula, or paropsides. The performer was called ψηφοκληπτης, or ψηφοπαικτης, and ψηφολογος; and the exhibition ψηφοπαιξια.

† Animadvers. in Athenæi Deip. lib. i. 15, p. 46.

‡ De theatro, lib. i. 40, in *Grævii Thesaurus antiquit. Roman.* ix. p. 902.

§ Lib. iii. epist. 20. ed. Bergler. p. 321. Unum autem ut vidi, hisco jam et prope sum mutus factus. Quidam enim in medios progressus, collocata mensa tripode, tres exiguas apponebat patellas; deinde sub istis occultabat parvos quosdam candidos et rotundos lapillos, quales nos in ripis torrentium reperimus; hos modo singulatim sub una quavis occultabat patella; modo, nescio qua ratione, sub una aliqua omnes ostentabat: modo, ut sub patellis disparerent efficiebat, et in ore ostendebat. Deinde cum deglutiisset (adductis in medium qui prope adstabant) alium ex nare, alium ex aure, alium ex capite depromebat; deinde iterum sublatos ex oculis hominum removebat. Maxime clancularius ille homo est. - - - - Ne mihi existat ruri talis bestia, non enim deprehendetur a quoquam, omniaque domi surripiens, evanida quæ ruri habeo faciet. *Seneca, epist.* 45: Sic ista sine noxa decipiunt, quomodo præstigiatorum acetabula et calculi, in quibus fallacia ipsa delectat. Effice, ut quomodo fiat intelligam, perdidi usum. *Sextus Empiric.* Sicuti præstigiatores spectantium oculos agilitate manuum suffurantur ac illudunt, ita et rhetores. - - - *Gregor. Nazian. in Athanas.* Idem erat calculis ludere decipientibus oculos celeritate transpositionis - - - ταυτον ην ψηφοις τε παιζειν την οψιν κλεπτουσαις τῳ ταχει της μεταθεσεως. Compare *Suidas, Pollux* and *Athenæi Deipn.* 4. It is probable that Quintilian alludes to this art in his *Institut.* x. 7, 11. Quo constant miracula illa in scenis pilariorum ac ventilatorum, ut ea,

a countryman who came to town, and was conducted by a merchant to the theatre, where he saw, with great astonishment, the exhibition of cups and balls. "Such an animal," says he, "as the performer I would not wish to have near me in the country; for, in his hands, my property would soon disappear." The art of oratory, because it deceives the auditors, is frequently compared to that of balls and cups. From the Latin word *gabata*, mentioned by Martial, together with *paropsides*, the French have made *gobelets;* and hence their common expressions *jouer des gobelets*, and *joueur des gobelets*, which they use when speaking of jugglers.

In all ages of the world there have been men who excited great wonder by extraordinary strength. Instances of this have been already collected; but they do not belong to my present subject.* I can, however, prove that, above fifteen hundred years ago, there were people who, by applying a knowledge of the mechanical powers to their bodies, performed feats which astonished every ignorant spectator; though it is certain that any sound man of common strength could perform the same by employing the like means.

quæ emiserint, ultro venire in manus credas, et qua jubentur decurrere.

* Plin. vii. 20, p. 385. *Martial.* v. 12. *Suidas,* speaking of Theogenes Thasius. *Haller, Elementa physiolog.* iv. p. 486; of the edition in quarto.

Of these one may say with Celsus: *Neque Hercule scientiam præcipuam habent hi, sed audaciam usu ipso confirmatam.*

About the beginning of the last century, such a strong man, or Sampson, as he called himself, a native of Germany, travelled over almost all Europe; and his pretended art has been mentioned by so many writers, that we may conclude it had not been often exhibited before; and that it was then considered as new.* His name was John Charles von Eckeberg; he was born at Harzgerode in Anhalt; and, at that time, was thirty-three years of age. When he fixed himself between a couple of posts, on any level place, two or more horses were not able to draw him from his position; he could break ropes asunder, and lift a man up on his knee while he lay extended on the ground. But what excited the greatest astonishment was, that he suffered large stones to be broke on his breast with a hammer, or a smith to forge iron on an anvil placed above it.

This last feat was exibited even in the third century, by Firmus, or Firmius, who, in the time of Aurelian, endeavoured to make himself emperor in Egypt. He was a native of Seleucia in Syria;

* Breslauer Sammlung von natur- und kunst-geschichten, i. p. 82; ii. p. 822; iii. p. 882; v. p. 1511; xxv. p. 333; and xxxiii. p. 320. *Hauber, Bibliotheca magica,* part xxi. p. 577, where the ar is illustrated with figures.

espoused the cause of Zenobia, the celebrated queen of Palmyra; and was at length executed publicly by order of the emperor Aurelian.* It is of this Firmus, and not of another, who a century after was overcome in Africa by the father of the emperor Theodosius,† that Vopiscus speaks where he relates that he could suffer iron to be forged on an anvil placed on his breast. For this purpose he lay on his back; but he put himself in such a position, by resting with his feet and shoulders against some support, that his whole body formed an arch; so that he seemed rather to be suspended than to lie at full length.‡ This art, which is explained and illustrated by Desaguliers,§

* Algemeine welthistorie, xiii. p. 621.

† Ibid. xiv. p. 269.

‡ Vopiscus, Vita Firmi: Incudem superpositam pectori constanter aliis tundentibus pertulit, cum ipse reclivus ac resupinus et curvatus in manus penderet potius quam jaceret. The whole passage will be better understood, when one sees the figure in Desaguliers, tab. xix. fig. 5, only that *in manus* occasions some difficulty. I conjecture that Vopiscus wrote *in arcum*, as Virgil, *Georg.* ii. 448, says: *taxi curvantur in arcus*. Desaguliers, p. 266, describes the position thus: The pretended Sampson puts his shoulders (not his head, as he used to give out), upon one chair, and his heels upon another (the chairs being made fast), and supports one or two men standing on his belly, raising them up and down as he breathes, making with his backbone, thighs, and legs, an arch whose abutments are the chairs. Seneca, in his treatise *De Ira*, ii. 12, says of these people: Didicerunt ingentia vixque humanis toleranda viribus onera portare.

§ A course of experimental philosophy. London 1745, 4to. i. p. 266 and 272.

and professor Kuhn,* of Dantzic, has now become so common that it is often exhibited without occasioning much surprise.

In the works of the ancients, rope-dancers are frequently mentioned. The passages where they occur have been collected by various authors, though never completely; and I am inclined to think that those who have seen many performers of this kind would be able to clear up some that are obscure. I have seen many myself; but I have forgot the greater part of what I observed; and there are other reasons also which prevent me from undertaking that task: I dread the reproach of *multum agendo nihil agis.* That I may not, however, pass over this subject entirely, I shall present the reader with what follows.† We meet with various appellations given to rope-dancers, which do not, as some have imagined, point out different kinds, but allude only to new-invented arts, leaps, or dexterities, which, while recommended by novelty, were much wondered at, though they were afterwards imitated by all. To

* Versuche und abhandl. der Naturforch. Geselsch. in Danzig, i. p. 15.

† A great many of these passages of the ancients have been collected by Boulenger, in his work *De theatro,* i. cap. 41; but without order and without any explanation. Something more is done by Des Camps in *Dissertat. sur une medaille de Caracalle, représentant des danseurs de corde,* which may be found in *Recherches curieuses d'antiquité, par Spon.* A Lyon 1683, 4to. p. 407. An extract from it is inserted in *Journ. des sav.* 1677, p. 309. See also *Hier. Mercurialis De arte gymnast.* and *Fabricii Biblioth. antiquar.* p. 995.

these belong the *schœnobatæ*, *oribatæ*, *neurobatæ*, *petaminarii*, *funambuli*, &c. Some of the ancient rope-dancers seem to have used a balancing-pole, or, at least, to have had weights in their hands to preserve an equipoise.* It is certain, also, that rope-dancers were not wanting in the middle ages. In the year 1237 they were very common in Italy; † and in 1393 there were some of them at Augsburg, who exhibited their dexterity on the rope, and received from each spectator three German halfpence. ‡

To place men upon the shoulders of each other in such a manner that every row consists of a man fewer, till they form a pyramid ending in a single

* An epigram, ascribed to Petronius, which is not to be found in most editions of that author, and which I shall here transcribe from that of Hadrianides, p. 542, belongs to this subject:

Stupea suppositis tenduntur vincula lignis,
Quæ fido ascendit docta juventa gradu.
Quæ super aërius prætendit crura viator,
Vixque avibus facili tramite currit homo.
Brachia distendens gressum per inane gubernat,
Ne lapsa e gracili planta rudente cadat.
Dædalus adstruitur terras mutasse volatu,
Et medium pennis prosecuisse diem.
Præsenti exemplo firmatur fabula mendax,
Ecce hominis cursum funis et aura ferunt.

A passage of Nazianzenus, in his *Apologia*, alludes to the same art also: Ut iis, qui in ligno alto et suspenso ambulant, non tutum est in hanc vel illam partem propendere vel leviter, securitatem autem affert iis æquale libramentum. Ασφαλεια δε αυτοις ἡ ισορροπια καθισταται.

† Muratori Antiquit. Ital. med. ævi, ii. p. 846.

‡ Von Stetten, Kunstgeschichte von Augsburg, ii. p. 177.

person, upon whose head a boy often stands with his feet upwards, is likewise an ancient piece of dexterity. This exhibition is varied many ways; and, on that account, it is difficult to form even conjectures respecting it, especially as the description given of it by a Roman poet is very unintelligible.*

I am, however, still less acquainted with an art in which hoops and wheels were employed by the *petauristæ*, who excited great astonishment among the populace. The first part of the art may have consisted in nothing more than the varied contortions and tumbling which we still see practised by children trained for that purpose. Cilano explains a well-known passage of Manilius, as if the performers had darted through suspended iron hoops, made often red hot. Of this I entertain less doubt than how we ought to understand the *corpora jactata petauro* of Juvenal;† and the *corpora valido excussa petauro* of Manilius,‡ which many have attempted to explain already. At any rate this wheel was different from that upon which a female dancer, as mentioned by Xenophon,

* Claudian. de Mallii consul. 320. In Cilano's *Römischen alterthümer*, ii. p. 573, fig. 8. there is a representation like what I have often seen exhibited. But the most dangerous and the most curious is that of which an engraving is given in *Splendor urbis Venetiarum*, to be found in *Thesaurus antiquit. Italiæ*, v. 3. p. 374.

† Sat. xiv. 265.

‡ Lib. v. 433.

wrote and read while it turned round with great velocity.*

The art of exhibiting various feats of horsemanship, which has been practised so much in modern times, seems to have come first from the East. At any rate, those performers in that way who, in the thirteenth century, were at the Byzantine court and who travelled all over Europe, came from Egypt. They could stand on the horses when at a gallop; mount and dismount while on full speed at the chase; tumble on horseback, and do many

* Symposium, p. 655, edition of Basle, 1555. fol. Εισεφερετο τη ορχηστριδι τροχος των κεραμεικων εφ' ου εμελλε θαυμασιουργησειν. In the old edition of J. Ribittus, this passage is thus translated: Allata est saltatrici orbis saltatorius, in quo admiranda erat editura. The first question that arises is, what was τροχος των κεραμεικων. The last word alluded to a place at Athens where wrestling was exhibited every year; and on that account Aristophanes uses the expression πληγαι κεραμεικαι. This, however, affords no explanation. Boulenger, who quotes the same passage, translates it in the following manner: Illata est saltatrici figularis rota, per quam se trajiceret, et miracula patraret. He means here therefore a potter's wheel, the invention of Anacharsis, but that was always called κεραμικος τροχος and not τροχος των κεραμεικων. But even allowing that a potter's wheel is meant, it is wrong to add *per quam se trajiceret;* for the potter's wheel is not like a hoop, but like a plate or dish; and when turned round revolves not vertically but horizontally. Besides, how the performer could write or read on a wheel that she jumped through, he has not thought proper to explain. Τοτε επι του τροχου αμα περιδινουμενου γραφειν τε, και αναγινοσκειν, θαυμα εστι. Scribere et legere in rota dum versatur, mirabile quiddam est. If a potter's wheel be meant, I consider it as certainly possible for a person to stand upon it whilst it revolves with the greatest velocity, and even to read or write; but it would be necessary to lift up the legs, in turn, with the utmost quickness.

other things equally extraordinary.* At the end of the sixteenth century, an Italian, who had learned this art while a slave in Turkey, went about exhibiting his dexterity in various parts of Europe.† Montagne saw him at Rome in 1581;‡ and the year following he was at Paris.§ Some of these feats were performed by the ancient *desultores.*‖

Whether the ancients taught horses, dogs, birds,

* Nicephorus Gregor. viii. 10. p. 215. This company of rope-dancers came from Egypt. They travelled through the greater part of Asia, and all Europe as far as the extremity of Spain. At Constantinople they extended the ropes, on which they first exhibited their art, between the masts of ships. As the above book is not to be met with in every library, I would have inserted here the whole account, had it not been transcribed by Cilano, ii. p. 570. One is almost induced to believe that stupid superstition did not then prevail so much in Europe as at the beginning of the last century. The historian says, that the company at first consisted of forty persons; but that the half of them were cast away on their passage to Constantinople. He does not, however, tell us that they or their horses were any where burnt as conjurors or possessed with the devil. On the contrary, he adds: Quæ ab illis agebantur, erant illa quidem monstrosa et sane mirabilia; non tamen quicquam cum diabolicis præstigiis commune habebant; sed erant studia quædam dextri ingenii, longo tempore in hujusmodi rebus versati. Επιτηδευματα φυσεως δεξιας, εγγυμνασθεισης εκ πλειονος ες εργων τοιουτων ασκησιν.

† Anthologia Romana, iii. p. 113.

‡ See the German translation of his Travels, ii. p. 238.

§ Journal du regne de Henry III. p. 57. It may be found in *Recueil de diverses pièces servant à l'hist. de Henry* III. Cologne 1666, 12mo.

‖ The playing at ball on horseback mentioned by Meursius in his *Glossarium Græco-barbarum,* Lugd. Bat. 1614. 4to. p. 556, from the works of Achmet, does not belong to this subject.

and other animals, to perform various tricks which are frequently exhibited at present for money, I do not know; but it is certain that what they made the elephant, which, undoubtedly, is the most sagacious and tractable of all animals, perform, exceeds every thing yet known of the kind. Without repeating what has been so often related, I shall only mention the elephant which walked upon a rope backwards and forwards, as well as up and down; and which Galba first caused to be shown to the Roman people. After this, so much confidence was placed in the dexterity of the animal, that a person sat on an elephant's back while he walked across the theatre upon a rope extended from the one side to the other. Lipsius, who has collected the testimonies, thinks they are so strong that they cannot be doubted. *

The training of horses to obey a private signal,

* Epistolarum selectarum centuria. Antverpiæ 1605. 4to. i. epist. 50. p. 59. *Plin.* viii. 1 and 3. *Seneca, epist.* 86. *Suetonii Vit. Galbæ. Dio Cassius.* A great many also may be found collected in *Hartenfels Elephantographia,* Erfordiæ, 1715. 4to. It appears that in the thirteenth century some ventured to ride a horse upon a rope. In the Chronicle *Alberichi monachi Trium-Fontium,* inserted by Leibnitz in *Accessiones historicæ,* vol. ii. we read the following passage, where a description is given of the solemnities at the wedding of Robert, brother to the king of France, in the year 1237: Ministelli in spectaculo vanitatis multa fecerunt, sicut ille, qui in equo super chordam in aere equitavit.

[Several instances of the dexterity of the elephant may be found in *Lipsii Laus Elephantis,* inserted in *Dissertat. Ludicrarum et amœnitatum scriptores varii,* Lugd. Bat. 1638. TRANS.]

imperceptible to the most attentive spectator, and to perform actions which appear, to those unacquainted with the art, to display rational faculties, I have never found mentioned in the works of the ancients. That the Sybarites, however, taught their horses to dance to the sound of music, is asserted by a variety of authors. * In the sixteenth century, dogs trained in the like manner excited great wonder. †

In the year 1766, an Englishman, named Wildman, made himself much known by taming or training bees, in such a manner that they not only followed him wherever he went, but settled even on his face and hands without stinging him, and

* Æliani Hist. animal. xvi. 28. vi. 10. *Athenæus*, lib. xii. *Plinius*. *Eustathius* ad *Dionys. de situ orbis*, 372. p. 52. edit. Stephani, 1577. 4to.

† One instance may be found in *Theophanis Chronographia*, which was printed at Paris 1655, fol. and at Venice in 1729. It occurred in the seventeenth year of the reign of Justinian, or 543: Eodem anno planus ac circulator quidam, Andreas nomine, ex Italicis partibus adfuit, fulvum et orbum lumine circumducens canem, qui ab eo jussus, et ad ejus nutum, mira edebat spectacula. Is siquidem in forum, magna populi circumstante caterva, prodiens annulos aureos, argenteos, et ferreos, clam cane, a spectatoribus depromebat, eosque in solo depositos aggesta terra cooperiebat. Ad ejus deinde jussum singulos tollebat canis, et unicuique suum reddebat. Similiter diversorum imperatorum numismata permixta et confusa, nominatim et sigillatim proferebat. Quinetiam, adstante virorum ac mulierum circulo, canis interrogatus mulieres uterum gestantes, scortatores, adulteros, parcos et tenues, ac denique magnanimos, idque cum veritate, demonstrabat. Ex quo eum Pythonis spiritu motum dicebant.

seemed as if obedient to his orders.* Some years after, a person who practised the like art, travelled about through Germany, and gave himself out to be Wildman; but Mr. Riem proved that he was not Wildman, and published the secret by which he acquired so much power over these insects.† I cannot say whether the ancients were acquainted with this art; but I shall here remark, that it was known in the kingdom of Galam, at Senegal, a hundred years before Wildman; for when Brue, a Frenchman, was there, in 1698, he was visited by a man who called himself the king of the bees. "Let his secret," says that traveller, "consist in what it may, this much is certain, that they followed him wherever he went, as sheep do their shepherd. His whole body, and particularly his cap, was so covered with them that they appeared like a swarm just settled. When he departed they went along with him; for besides those on his body, he was surrounded by thousands which always attended him."‡

* Universal magazine, 1766, October, p. 217. A translation may be seen in *Neues Bremensche Magazin*, 1767, ii. p. 217.

† Der entlarvte Wildman, betrüger grosser höfe. Berlin 1774, 8vo. See also *Göttingische Gelehrte anzeig.* 1775, p. 816. The name of *impostor* given to Wildman was, however, too harsh; for I do not think that he who performs any thing extraordinary, never done by any one before, becomes an impostor when another discovers his art.

‡ The voyage of Brue may be found in Labat's *Afrique occidentale*, iv. p. 200. The passage alluded to occurs in *Algemeine historie der reisen*, ii. p. 365.

In modern times, persons destitute of arms and hands, or who have these limbs formed very imperfectly, but who possess the art of supplying that want by the use of their feet and toes, show themselves sometimes for money; and as they entertain the spectators by exciting their wonder, they deserve from them that support which they are not able to obtain in any other manner. Instances of such people who had acquired this art, have been very common within the two last centuries; *

* The most remarkable instances of this kind are mentioned by Moscati, in his treatise entitled *Vom unterschiede zwischen der structur der thiere und der menschen*, Gottingen 1771, 8vo. p. 10. See also *Breslauer Sammlung zur natur und kunst*, 1770. Febr. p. 200. Sauval in *Histoire de Paris*, ii. p. 544. *Recucil servant à l'hist. de Henry* III. p. 92. and *Camerarii Horæ subcisivæ*, cent. i. 37. p. 170. iii. 80. p. 302.

[Several instances of the like kind may be found also in *Monstrorum historia memorabilis a Joanne Georgio Schenkio a Grafenberg filio*, Francofurti 1609, 4to. p. 28 et seq. One of the most curious is that of Thomas Schweicker, born at Halle, in Swabia, in the year 1586. The author gives the following account of him from Camerarius, who saw him not only write, but even make a pen with his feet: Mira est providentia et sollicitudo naturæ, quam creator omnium rerum ei tanquam optimæ matri attribuit. Ea enim in animalibus membris distortis, vel mutilatis aut debilitatis, vel etiam omnino deficientibus, plerumque aliis membris, præter suum officium ad quod destinata sunt, tale robur et dexteritatem ex diuturna consuetudine suppeditat, ut dicere aliquis possit, non in distinctione membrorum sed in continuo usu perfectionem consistere. Hac de re sæpius cogitavi, cum essemus Comburgi, apud vere nobilem et præstantissimum virum D. Erasmum Neienstetterum. Is enim, cum nulla benignitatis erga nos prætermisisset officia, jussit accersi ex vicinis salinis Suevicis Thomam Schweickerum, natum triginta annos, et quidem honestis parentibus. Quem

but, in the works of the ancients, I have found only one. An Indian king, named Porus, sent to the emperor Augustus an embassy with presents, among which were some rare animals, and a man without arms, who with his feet, however, could bend a bow; discharge arrows; and put a trumpet to his mouth and blow it. Dio Cassius confesses that he did not know how this was possible; but Strabo refers for his authority to Nicolaus of Damascus, who saw all the presents as they passed through Antioch.* Had this deformed

licet mater sua absque brachiis enixa fuisset in lucem, omnia tamen munia manuum, pedum subsidio, ita exequebatur, ut quod in uno desideraret, in altero sibi compensatum esse, affirmare non erubesceret.

Nam cum in editiore loco, qui æquaret altitudinem tabulæ, in qua esculenta opposita erant, consedisset, apprehenso pedibus cultro, scindebat panem, et alios cibos; pedes ea postea, nec non et potum, veluti manus, ori porrigebant. Peracto prandio pedibus pingebat nobis omnibus videntibus, tam elegantes Latinas litteras ac Germanicas, ut exempla earum, quasi rem insolitam, nobiscum sumeremus. Postulantibus etiam nobis, cultello parabat calamos ad scribendum aptissimos, quos postea nobis donabat. Cum esset ita occupatus, diligenter inspexi formam pedum, quorum digiti erant ita oblongi et ad res tenendas apti, ut procul aspicientibus (pallio enim suo verecunde admodum crura tegebat) manus viderentur. Hoc spectaculum sane jucundum, et ante non visum nobis fuit. Jussus etiam fuerat, paulo ante, Cesareæ majestati, divo Maximiliano II, cum Halam urbem ad comitia Spirensia transiret, et Electoribus Palatinatus atque Saxoniæ, Ludovico et Augusto se exhibere; quorum Majestas et Celsitudo hanc mirandam naturæ compensationem, non absque munificentia, et cum admiratione spectavit. TRANS.]

* Strabo, lib. xv. p. 1048. ed. Almel. Dio Cassius, lib. liv. p. 739: Μειρακιον δι ανευ ωμων (οιους τους Ἑρμας ὁρωμεν) εδωκαν. και μεντοι

person, whom Strabo compares to a Hermes, travelled about, according to the modern practice, as a show, he would have been better known, and in all probability his example would have induced others to imitate his art.* Manilius says, however, that there were people, who, in playing at ball, could use their feet with as much dexterity as their hands, who could catch the ball with them, and again throw it back; but the poet, perhaps, did not allude to the small hand-ball, but to the large one which is struck with the fist, and which may be stopped also by the foot. Besides, the passage is read and explained different ways.†

Figures or puppets, which appear to move of themselves, were employed formerly to work miracles; but they could hardly be used for that

τοιουτον ον εκεινο, εϛ παντα τοις ποσιν ατε και χερσιν εχρητο. Porro adolescens quidam brachiis carens (cujusmodi Hermæ solent) qui, manuum loco, pedum omnia officio peragebat, iis arcum tendebat, sagittas emittebat, tuba canebat; quod quomodo potuerit, equidem nescio, ab aliis tamen tradita scribo. Suetonius, Eutropius, Eusebius, and Orosius, speak of this embassy; but make no mention of the presents.

* Non enim manus ipsæ hominum artes docuerunt, sed ratio; manus autem ipsæ sunt artium organa. *Galen De usu partium*, 1, 3.

† Casaubon reads the passage in the following manner:

Ille potens curvo pede fundere concita pila,
Ille pilam celeri fugientem prendere planta,
Et pedibus pensare manus et ludere saltu,
Per totumque vagas corpus disponere plantas.

Manilii Astron. lib. v, 165.

purpose at present in any catholic country of Europe, though they still serve to amuse the vulgar. Among these are the *marionettes*,* as they are called, the different parts of which are put in motion imperceptibly by a thread. Of a still more ingenious construction are those which are moved by the turning of a cylinder, as is the case in the machines with which some of the old miners in Germany earn a livelihood; but the most ingenious of all are those which are kept in continual movement for a certain time, by the help of wheels with a weight or spring. The latter are called *automata*; and, when they represent human figures, *androides*. Under the former general name are comprehended our watches, the most useful of all, and also jacks,† with many

* Frisch derives this word from *morio* a fool or buffoon.

† This piece of kitchen furniture was known in the middle of the sixteenth century. Montagne saw one at Brixen, in Tyrol, in the year 1580, and wrote a description of it in his Journal, as a new invention. He says it consisted entirely of wheels; that it was kept in motion by a heavy piece of iron, as clocks are by a weight, and that when wound up, in the like manner, it turned the meat for a whole hour. He had before seen, in some other place, another driven by smoke. *Reise*, i. p. 155 and 249. The latter kind seem to be somewhat older. Scappi, cook to pope Pius V, gave a figure of one, about the year 1570. His book, *Opera di M. Bartolomeo Scappi, cuoco secreto di Papa Pio* V, is exceedingly scarce. See *Theoph. Sinceri Nachrichten von alten büchern*, i, p. 331; *Scheibens Gedanken aus der historie, critik und litterat.* Frankenthal an der Werra 1737, 8vo. i. p. 171; *Merkwürdigkeiten der Dresdner bibliothek*, i. p. 396. I lately saw a copy, which, instead of eighteen, had twenty-four engravings. This work was printed at Venice in 1570,

others. The latter appellation is given to small puppets, which, when their inner works have been wound up, run upon the table or pavement, and as they advance move their head, eyes, and hands. They have been exhibited sometimes under the name of *courrante Margarethe*, which gave rise perhaps to the word *marionette*.

The proper *marionettes* are very old. They were common among the Greeks, and from them they were brought to the Romans. They were known by the name of *neurospasta*, and were much used at their shows. Aristotle speaks of some which moved their head, eyes, hands and limbs in a very natural manner.* They are mentioned with equal precision by Galen,† Xenophon,‡ Antoninus,§

and twice afterwards at the same place, viz. in 1571 and 1605, in quarto. The third edition says, *con due aggiunte, cio é il Trinciante et il Maestro di casa.* Bayle seems to confound this book with that of Platina *De honesta voluptate*, or to think that the latter was the real author of it. This however cannot be, as there were more than a hundred years between the periods when Scappi and Platina lived. Platina died in 1481, and not in 1581, as we read in Bayle. Scheiben also is in an error, when he tells us that Scappi was cook to Paul V; he should have written Pius V.

* De mundo, cap. vi. Ὁμοιως και οι νευροσπασται, μιαν μηρινθον επισπασαμενοι ποιουσι και αυχενα κινεισθαι, και χειρα του ζωου και ωμον και οφθαλμον. εστι δε ὁτε παντα τα μερη μετα τινος ευρυθμιας. Apuleius translates this passage as follows: Illi, qui in ligneolis hominum figuris gestus movent, quando filum membri, quod agitari solet, traxerint, torquebitur cervix, nutabit caput, oculi vibrabunt, manus ad omne ministerium præsto erunt; nec invenuste totus videbitur vivere.

† De usu partium. At the end of the third book: Ὁσοι δια τινω μηρινθων τα ξυλινα των ειδωλων κινουσιν, επεκεινα των αρθρων εις την κεφαλην μελλοντος κώλου κινηθησεσθαι, καταπτουσιν αυτας. Qui per quosdam funi-

Horace,‖ Gellius,¶ and others. To these belong the *phalli*, which were carried round during the festivals of Osiris and Bacchus, and of which one member only, that properly meant by the name, and which was almost as large as the whole body, moved upon certain threads being pulled.* Count Caylus has given an engraving of the body of a small puppet, made of ivory or bone; but he requires too much, when he desires us to consider that fragment, merely on his word, as a

culos lignea idola movent, ultra articulos, ad caput coli movendi eos applicant.

‡ Symposium.

§ De se ipso, ii. 2. iii. 5. vi. 16. vii. 3. xii. 19.

‖ Sat. ii. 7, 82.

¶ Lib. xiv. 1; where Oiselius in his notes has collected a great many passages; but I doubt much whether the *larva argentea sic aptata, ut articuli ejus vertebræque in omnem partem laxarentur*, in Petronius, chap. 34, belongs to these puppets. In my opinion, the author speaks of an artficial skeleton, the different parts of which were moveable in every direction. I think also, that a passage of Ausonius, in the preface to his *Cento nuptialis*, where he speaks of the στοματιον, cannot be employed to explain that of Petronius. Ausonius alludes to pieces of ivory cut into geometrical figures, which, for amusement, were put together so as to represent various objects, and again separated. Children, in the like manner at present, have boxes filled with small bits of wood which they join and form into houses and other things.

* Herodot. ii. 48. p. 127. Festum Baccho Ægyptii celebrant, exceptis choris, fere per omnia eadem Græcis. Sed loco phallorum sunt ab eis excogitatæ aliæ statuæ circiter cubitales nervis mobiles, quas feminæ circumferunt per pagos, veretro nutante, quod non multo minus est cætero corpore. -- *Lucian. de Syria Dea*, 16. ed. Bipont. ix. p. 99: Φερουσι ανδρας μικρους εξ ξυλου πεποιημενους, μεγαλα αιδοια εχοντες. Καλεονται δε ταδε νευροσπαστα.

piece of Greek or Roman antiquity. He at least ought to have informed us where it was found, and by what means he procured it. In regard to such articles, it is as easy to deceive as to be led into an error; and objects of bone are certainly of no great duration.*

The question concerning the antiquity of automata, properly so called, which are moved by wheels, weights, and springs, I shall leave to those who have read the works of the ancient mathematicians, and who may be desirous of writing on the history of mechanics. As far as I know, the ancients were not acquainted with the art of making them, unless some propositions of Ctesibius, mentioned by Vitruvius, allude to that subject. When clocks were brought to perfection, some artists added to them figures, which, at the time of striking, performed various movements; and as they succeeded in these, some attempted to make, detached from clocks, single figures, which either moved certain limbs, or advanced forward and ran. In the middle of the sixteenth century, when Hans Bullmann,† a padlock-maker at Nuremberg, constructed figures of men and women which moved backwards and forwards by clock-work, and beat a drum, and played on the lute according to musical time, they excited universal astonishment as a new invention. It was

* Recueil des antiquit. iv. p. 259.

† Doppelmayr von Nürnberg. künstlern, p. 285.

about the same period that watches came into use. The accounts however which speak of much older automata deserve to be examined with more attention.

The most ancient of all are undoubtedly the tripods constructed by Vulcan,* which being furnished with wheels, advanced forwards to be used, and again returned to their places. But what was impossible to the gods of Homer? An unbeliever might conjecture that these tripods, which are mentioned also by Aristotle,† and which perhaps were only a kind of small tables, or dumb-waiters, had wheels so contrived, that they could be put in motion and driven to a distance on the smallest impulse, like the fire-pans in our country beer-houses, at which the boors light their pipes.

That Dædalus made statues, which could not only walk, but which it was necessary to tie, in order that they might not move, is related by Plato,‡ Aristotle, and others. The latter speaks of a wooden Venus, and remarks, that the secret of its motion consisted in quicksilver having been

* Iliad. xviii. 373. Tripodas viginti fabricabatur qui starent ad parietem bene fundatæ domus. Aureas autem ipsis rotas unicuique fundo subdiderat, ut sponte sua divinum ingrederentur cœtum, ac rursus domum redirent, mirabile visu. It deserves to be remarked, that there were also such τριποδες αυτοματοι at the banquet of Iarchas. See *Philostrat. Opera*, ed. Olearii, p. 117 and 240.

† Polit. i. 3.

‡ In his Mænon, p. 426. Eutyphron, p. 8 and 11. edition of Francfort 1602, fol.

poured into it.* What the author here means I cannot comprehend; but I do not imagine that this Venus threw itself topsy-turvey backwards, like the Chinese puppets. However this may be, it is astonishing that the Chinese should have fallen upon the invention of giving motion to puppets by means of quicksilver, and in so ingenious a manner that Muschenbroek† thought it worth his while to describe their whole construction, and to illustrate it by figures. But before this method was known in Europe, Kircher had an idea of putting a small waggon in motion by adding to it a pipe filled with quicksilver, and heating it with a candle placed below it.‡ The account of Aristotle is more mysterious, for he does not inform us how the quicksilver acted.

Calistratus, another writer, who was the tutor of Demosthenes, gives us to understand that the statues of Dædalus were made to move by the mechanical powers.§ But what has been asserted by

* Φησι γαρ τον Δαιδαλον κινουμενην ποιησαι την ξυλινην Αφροδιτην εγχεαντα αργυρον χυτον. Theophrast. De lapid. and Alexand. Aphrodis. use also αργυρος χυτος, instead of ὑδραργυρος.

† Introduct. in philosoph. natur. i. p. 143.

‡ Physiologia Kircheriana. Amstelodami 1680, fol. p. 69.

§ Calistrati Ecphrasis seu statuæ, in *Philostrati Opera*, ed. Olearii, p. 899: Δαιδαλου μεν εξην ιδειν, του περι Κρητην, πιστευειν θαυμαστα, κινουμενα μηχαναις τα ποιηματα, και προς ανθρωπινην αισθησιν εκβιαζεσθαι τον χαλκον. Dædali quidem Cretensis videre erat, quæ fidem fere superarent, machinis quibusdam mobilia opera, utque artis vi æs adactum fuerit ad sensus humani speciem præbendam.

Palæphatus,* and by Gedoyn,† Banier,‡ Goguet,§ and others among the moderns, is most probable. The first statues of the Greeks were imitations of those of the Egyptians, for the most part clumsy figures, with their eyes shut, their arms hanging down close to the body on each side, and their feet joined together. Those made by Dædalus had their eyes open, as well as their feet and hands free; and the artist gave them such a posture, that they seemed either reclining, or appeared as if ready to walk or to run. As Anacreon,‖ struck with wonder, exclaimed when he saw a waxen image of his favourite object, "Begone, wax, thou wilt soon speak!" the astonished Greeks, in like manner, cried out, when they beheld the statues of Dædalus, "They will soon walk." The next generation affirmed that they really walked; and their posterity, adding still to what was told them, asserted that they would have run had they not been bound.

Equally imperfect is the account given of the wooden pigeon constructed by Archytas of Tarentum. We are informed that it flew; but when it had once settled, it could not again take flight. The latter is not incredible; but even if we allow

* De Incredib. cap. 22.

† In Mémoires de l'Academ. des Inscript. xiii. p. 274, and thence translated into the *Hamburgisch. magazin.*, vii. p. 476,

‡ Götterlehre, iv. p. 448.

§ Ursprung der gesetze und künste, ii. p. 198.

‖ Ode xxviii: Απεχει. ταχα, κηρε, και λαλησεις.

that aërostatic machines were then known, it is impossible to believe the former. At present one cannot determine with any probability, what piece of mechanism gave rise to this relation.* The head of Albertus Magnus, which is said not only to have moved but to have spoken, is too little known for any opinion to be formed concerning it. The construction of it must have been very ingenious and complex, if it be true that he was employed upon it thirty years.†

In the fourteenth and following centuries, automata, as I have said, were frequently made. Among these was the iron fly of John Muller, or Molitor, or, as he is sometimes called, Regiomontanus, which is said to have flown about; and his artificial eagle, which flew to meet the emperor Maximilian on his arrival at Nuremberg, June the 7th, 1470. None of the cotemporary writers, however, though they often speak of this very learned man, make the least mention of these pieces of mechanism; and it is probable that the whole tale originated from Peter Ramus,‡ who never was at Nuremberg till the year 1571.

* Aulus Gellius, x. 12. Professor Schmid of Helmstadt treats particularly on this dove, in a dissertation *De Archyta*, printed at Jena in 1683, which I have never had an opportunity of seeing.

† See *Naudé's Apology*, *Bayle's Dictionary*, &c. Thomas Aquinas is said to have been so frightened when he saw this head, that he broke it to pieces, and Albert thereupon exclaimed; *Periit opus triginta annorum!*

‡ Schol. mathemat. lib. ii. p. 65.

J. W. Baier* endeavours to prove that the above-mentioned fly, moved by wheel-work, leaped about upon a table; and that the eagle perched upon the town-gate, stretched out its wings on the emperor's approach, and saluted him by an inclination of its body. We know that Charles V, after his abdication, amused himself during the latter period of his life with automata of various kinds.†

The most ingenious, or at least the most celebrated automata, were those made by Vaucanson, which he exhibited publicly at Paris, for the first time in 1738. One of them, which represented a flute-player sitting, performed twelve tunes, and, as we are assured, by wind issuing from its mouth into a German-flute, the holes of which it opened and shut with its fingers. The second was a standing figure, which in the like manner played on the Provençal shepherd's pipe, held in its left hand,

* Dissertat. de Regiomontani aquila et musca ferrea. Altorfi 1709. See *Mémoires de Trevoux* 1710, Juillet, p. 1283. I have never read them. *Doppelmayr*, p. 23. *Fabricii Biblioth. med. ætat.* iv. p. 355. *Heilbronner Hist. math. Lipsiæ* 1742, 4to. p. 504.

† Strada De bello Belgico. Moguntiæ 1651, 4to. p. 8. He calls the artist Jannellus Turrianus Cremonensis.—Sæpe a prandio armatas hominum et equorum icunculas induxit in mensam, alias tympana pulsantes, tubis alias occinentes, ac nonnullas ex eis feroculas infestis sese hastulis incursantes. Interdum ligneos passerculos emisit cubiculo volantes revolantesque; cœnobiarcha, qui tum forte aderat, præstigias subverente. Fecit et ferreas molas per se versatiles tantæ subtilitatis parvitatisque, ut manica occultatas monachus facile ferret, cum tamen quotidie molerent tantum tritici, quantum hominibus octo in singulos dies alendis abunde esset.

and with the right beat upon a drum, or *tambour de Basque.* The third was a duck, of the natural size, which moved its wings, exhibited all the gestures of that animal, quacked like a duck, drank water, ate corn, and then, after a little time, let drop behind it something that resembled the excrement of a duck.* These pieces must have been often imitated. I saw some of the like kind in the year 1764, at the palace of Zarsko-Selo, near Petersburgh, and was told that they had been purchased from Vaucanson. As far as I can remember, the tambourin was damaged. I saw there also a regiment of soldiers, which went through their exercise, moved by wheel-work.†

In the year 1752, one Du Moulin, a silversmith, travelled about through Germany, with automata like those of Vaucanson. In 1754, he wished to dispose of them to the markgrave of Bayreuth; but he was obliged to pawn them in Nuremberg, at the house of Pfluger, who offered to sell them for 3000 florins, the sum lent upon them. They were afterwards purchased by counsellor Beireis, at

* In the year 1738, *Le méchanisme du fluteur automate, par Vaucanson,* was printed at Paris, in three sheets quarto. It contains only a short description of the flute-player, which is inserted in the *Encyclopédie,* i. p. 448, under the article *Androide.* An extract from it may be found in *Hamburgisch. magazin,* ii. p. 1, and in *Wiegleb's Magie,* i. p. 283. The duck, as far as I know, has been no where described.

† I am surprised that Georgi has not mentioned these automata in his *Beschreibung der stadt St. Petersburg* 1790, 8vo. p. 420. Vaucanson died at Paris in 1782.

Helmstadt, who was so kind as to show them to me. It is much to be regretted that the machinery of them is greatly deranged; the flute-player emits only some very faint tones; but the duck eats, drinks, and moves still. The ribs, which are of wire, had been covered with duck's feathers, so as to imitate nature; and as these are now lost, one can see better the interior construction; respecting which I shall only observe, that the motion is communicated by means of a cylinder and fine chains, like that of a watch, all proceeding through the feet of the duck, which are of the usual size. Nicolai* says, that Du Moulin came to Petersburg in 1755, and died at Moskow in 1765. It is probable that he made the automata which I saw in Russia. Those which he left behind him at Nuremberg seem either not to have been completed, or to have been designedly spoiled by him; for they appeared to have defects which could not be ascribed to any accident. Mr. Beireis however has begun to cause them to be repaired.

Of all these automata, the duck I confess appeared to me the most ingenious; but I can prove, that like pieces of mechanism were made before the time of Vaucanson. We are told by Labat,† that the French general De Gennes, who, about

* Nicolai Reise, i. p. 287.

† Nouveau voyage aux isles de l'Amerique. A la Haye 1724, 2. vol. 4to. ii. p. 298 and 384. From his county he was called Count de Gennes.

the year 1688, defended the colony of St. Christopher against the English, constructed a peacock which could walk about, pick up from the ground corn thrown before it, digest it, according to appearance, and afterwards drop something that resembled excrement. This man was of an ancient noble family in Brittany, which had however been so reduced, that the father carried on a handy-craft. The son became acquainted with the marquis de Vivonne, who, on account of his promising talents, bred him to the sea. He rose to be commander of a vessel, conducted a squadron to the Straits of Magellan, where it was intended to form a colony, and obtained in Cayenne a tract of land, which he got erected into a county, under the name of Oyac. He invented machines of various kinds useful in navigation and gunnery, and, as we are told, constructed clocks that moved without weights or springs.

The flute-player also of Vaucanson was not the first of its kind. In the beginning of the sixteenth century, the anonymous author of that well-known poem *Zodiacus Vitæ* saw at Rome a figure made in the like manner by a potter. It is much to be regretted that no account is given of its construction.

> Vidi ego dum Romæ, decimo regnante Leone,
> Essem, opus a figulo factum, juvenisque figuram,
> Efflantem angusto validum ventum oris hiatu.*

* Zodiacus Vitæ, xi. 846.

I shall here beg leave to say a few words respecting an object of juggling, which, however old it may be, still excites astonishment, and has often imposed upon the credulity of men of learning.* I mean those speaking machines, which, according to appearance, answer various questions proposed to them, sometimes in different languages, sing, and even blow a huntsman's horn. The figure, or only a head, is often placed upon a box, the forepart of which, for the better deception, is filled with a pair of bellows, a sounding board, cylinder and pipes, supposed to represent the organs of speech. At other times the machine is only like a peruke-maker's block, hung round with a Turkish dress, furnished with a pair of arms, and placed before a table, and sometimes the puppet stands upon the table, or against a wall. The sounds are heard through a speaking-trumpet, which the figure holds in its mouth.

Many jugglers are so impudent as to assert, that the voice does not proceed from a man, but is produced by machinery, in the same manner as the music of an organ. Some, like the last whom I saw, are more modest or timorous, and give

* See the Erlangische Realzeitung 1788, part 53; or a small treatise *Ueber H. D. Muller's redende maschine, und über redende maschinen überhaupt.* Nurnberg 1788, 8vo. I am acquainted with the latter only by the *Algem. Teutsches biblioth.* vol. lxxxvii. p. 473. The speaking figure and the automaton chess-player exposed and detected. London 1784, 8vo.

evasive answers to the questions asked them respecting the cause of the voice, with as much art as those who exhibit with balls and cups. Concerning these speaking machines, however, different opinions are entertained. Some affirm that the voice issues from the machine; others, that the juggler answers himself, by speaking as ventriloquists do, from the lower part of his belly, or by having the power to alter his voice; and some believe that the answers are given by a man somewhere concealed. The violence with which these opinions are maintained exposes the juggler often to the danger of losing his life; for, when the illusion is detected, the populace, who in part suffer themselves willingly to be deceived, and who even pay the juggler for his deception, imagine that they have a right to avenge themselves for being imposed on. The machines are sometimes broken; and the owners of them are harshly treated as impostors. For my part, I do not see why a juggler, with a speaking machine, is a more culpable impostor than he who pretends to breathe out flames and to swallow boiling oil, or to make puppets speak, as in the Chinese shadows. The spectators pay for the pleasure which they receive from a well-concealed deception, and with greater satisfaction the more difficult it is for them to discover it. But the person who speaks or sings through a puppet, is so well hid,

that people of considerable penetration have imagined that such concealment was impossible. At present this art is well known.

Either a child or a woman is concealed in the juggler's box: or some person, placed in a neighbouring apartment, speaks into the end of a pipe which proceeds through the wall to the puppet, and which conveys the answers to the spectators. The juggler gives every necessary assistance to the persons by signs previously agreed on. I was once shown, in company with Mr. Stock, upon promising secrecy, the assistant in another apartment, standing before the pipe, with a card in his hand on which the signs were marked; and he had been brought into the house so privately that the landlady was ignorant of the circumstance. The juggler, however, acknowledged that he did not exhibit without fear; and that he would not venture to stay long at a place like Gottingen, or to return with his Turks, though the populace were so civil as to permit him to depart peaceably with what he had gained.

The invention of causing statues to speak, by this method, seems so simple that one can scarcely help conjecturing that it was employed in the earliest periods to support superstition; and many have imagined that the greater part of the oracles spoke in the same manner.* This, however, is

* Van Dale De Oraculis. Amstelod. 1700, 4to. i. 10. p. 222.

false, as has been proved by the Jesuit Baltus, and the author of an answer to Fontenelle's History of oracles.* It appears that the pagan priests, like our jugglers, were afraid that their deceptions, if long practised, might be discovered. They considered it, therefore, as more secure to deliver the answers themselves; or cause them to be delivered by women instructed for that purpose, or by writings, or by any other means. We read, nevertheless, that idols† and the images of saints once spoke; for at present the latter will not venture to open their mouths. If their votaries ever really heard a voice proceed from the statue, it may have been produced in the before-mentioned manner.‡

Whether the head of Orpheus spoke in the island of Lesbos, or, what is more probable, the answers were conveyed to it by the priests, as was the case with the tripod at Delphi, cannot with certainty be determined. That the impostor Alexander, however, caused his Æsculapius to speak in this manner, is expressly related by Lucian.§

* Réponse à l'Histoire des oracles de M. de Fontenelle. The author of this work has not disclosed his name.

† A few instances are related by Livy, Valerius Maximus, and Plutarch. Among the fables of the Christian church they are more numerous.

‡ The passages relating to this subject I have already quoted, in a note to *Antigoni Carystii Histor. mirabil.* p. 10.

§ Vol. v. p. 90, according to the edition of Deux-Ponts. Commissis gruum arteriis, γεραιων αρτηριας, et per caput illud, ad simili-

He took, says that author, instead of a pipe, the gullet of a crane, and transmitted the voice through it to the mouth of the statue. In the fourth century, when bishop Theophilus broke to pieces the statues at Alexandria, he found some which were hollow, and placed in such a manner against a wall that a priest could slip unperceived behind them, and speak to the ignorant populace through their mouths.* I am acquainted with a passage which seems to imply that Cassiodorus, who, it is well known, constructed various pieces of mechanism, made also speaking machines; but I must confess that I do not think I understand the words perfectly.†

That people ventured more than a hundred years ago to exhibit speaking machines for money, has been proved by Reitz in his annotations to Lucian, where he produces the instance of one Thomas Irson, an Englishman, whom he himself knew, and whose art excited much wonder in king Charles II and his whole court. When the astonishment, however, became general, one of the pages discovered, in the adjoining chamber, a popish priest who answered, in the same language, through a pipe, the questions proposed to

tudinem humani fabricatum, transmissis, alio quodam extra inclamante, ad interrogata respondit, voce per linteum illum Æsculapium accidente.

* Theodoreti Histor. eccles. v. 22, p. 228,

† Cassiodori Variar. i. ep. 45.

the wooden head by whispering into its ear. This deception Irson often related himself.

I shall now add only a few observations respecting the Chinese shadows, which I have occasionally mentioned before. This ingenious amusement consists in moving, by pegs fastened to them, small figures cut of pasteboard, the joints of which are all pliable, behind a piece of fine painted gauze placed before an opening in a curtain, in such a manner as to exhibit various scenes, according to pleasure; while the opening covered with gauze is illuminated, towards the apartment where the spectators sit, by means of light reflected back from a mirror; so that the shadows of the pegs are concealed. When it is requisite to cause a figure to perform a variety of movements, it is necessary to have several persons, who must be exceedingly expert. When a snake is to be represented gliding, the figure, which consists of delicate rings, must be directed, at least, by three assistants.*

This amusement, which one can hardly see the first time without pleasure, is really a Chinese invention. Many years ago, I have seen Chinese boxes on which such moveable figures were apparent only when the box was held against the light. In China, these shadows are used at the

* A very imperfect description of these shadows may be found in *Wieglebs Magie*, i. p. 173; and also in *Hallens Magie*. Berlin 1783, p. 267.

well-known feast of lanterns; and a description of them may be found in the works of some travellers.* That they were common also in Egypt, we are informed by Prosper Alpinus,† who admired them much; but he was not able to discover the method by which they were produced, as it was kept a secret. I was told by an Italian, who exhibited them at Gottingen, some years ago, that they were first imitated, from the Chinese, at Bologna.

CAMEL.

In the Zuyder-Zee, opposite to the mouth of the river Y, about six miles from the city of Amsterdam, there are two sand-banks, between which is a passage called the *Pampus*. This passage is sufficiently deep for small ships; but not for those which are large and heavily laden. On this account vessels, which are outward-bound,

* Algemeine historie der reisen, vi. p. 178.

† Sunt qui intra scenam ex tenuissimis linteis paratam latitantes, quadam mirabili arte ex umbris in scena productis, faciunt apparere personas varias recitantes, cujusque sexus et ætatis, atque animalia itidem cujuscunque generis, prout ad historiæ representationem est opus. - - - Si nostri comici hanc artem callerent, ut quæ volunt, per umbras repræsentare possent, quam admirabiles comœdias facerent, admirabiliaque in suarum comœdiarum intersceniis quam minimo sumtu repræsentare possent, nimirum per umbras fingentes homines et animalia, domos, arbores, flumina, fontes, et quæcunque illis placuerint. *Historia Ægypti natural.* Lugduni Bat. 1735, 4to. p. 60.

take in before the city only a small part of their cargo. They receive the rest when they have got through the Pampus; and those which are homeward-bound must, in a great measure, unload before they enter it. For this reason, the goods are put into small vessels called lighters; and in these conveyed to the warehouses of the merchants at the city; and the large vessels are then made fast to boats,* by means of ropes, and in that manner towed through the passage to their stations.

Though measures were adopted, so early as the middle of the sixteenth century, by forbidding ballast to be thrown into the Pampus, to prevent the further accumulation of sand in this passage,† that inconvenience increased so much, from other causes, as to occasion still greater obstruction to trade; and it, at length, became impossible for ships of war and others heavily laden to get through it. About the year 1672, no other remedy was known than that of making fast to the bottoms of ships large chests filled with water, which was afterwards pumped out, so that the ships were buoyed up, and rendered sufficiently light to pass the shallow. By this method, which was attended with the utmost difficulty, the

* These vessels are called *water-schepen*; and, if I remember right, are those in which fresh water is conveyed to Amsterdam.

† Amsterdam in zyne opkomst, aanwas, geschiedenissen beschreeven door Jan Wagenaar. Amsterdam 1760, 8vo. i. p. 258.

Dutch carried out their numerous fleet to sea in the above-mentioned year.* This plan, however, gave rise soon after to the invention of the camel, by which the labour was rendered much easier.

The camel consists of two half ships, built in such a manner that they can be applied, below water, on each side of the hull of a large vessel. On the deck of each part of the camel there are a great many horizontal windlasses, from which ropes proceed, through openings in the one half, and, being carried under the keel of the vessel, enter like openings in the other, from which they are conveyed to the windlasses on its deck. When they are to be used, as much water as may be necessary is suffered to run into them; all the ropes are cast loose; the vessel is conducted between them; and large beams are placed horizontally through the port-holes, with their ends resting on the camel on each side. When the ropes are made fast, so that the ship is secured between the two parts of the camel, the water is pumped from it; and it then rises, and raises the ship along with it. Each half of the camel is generally a hundred and twenty-seven feet in length; the breadth, at the one end is twenty-two feet, and at the other thirteen. The hold is divided into several compartments, that it may be kept in equipoise while the

* Le Long, Koophandel van Amsterdam, i. p. 14.

water is flowing into it. An East India ship, that draws fifteen feet of water, can, by the help of this machine, be made to draw only eleven; and the heaviest ships of war, of ninety or a hundred guns, can be so-much lightened as to pass, without obstruction, all the sand-banks of the Zuyder-Zee.*

Leupold says, that the camel was invented by one Cornelius Meyer; and the same account is given by a writer in the German Cyclopædia.† This Meyer was a Dutch engineer; and towards the end of the 17th century was invited to Rome by the Apostolic Chamber, to clean the Tyber and render it navigable.‡ Some of his plans were carried into execution; but the most important and greater part of them were never adopted; chiefly through the jealousy of the Italians. In order to do himself justice, and prevent others from claiming his inventions, he published an account of them, in a work ornamented

* A complete technical description of the camel with a proper figure I have never yet met with. The best figures, which I know, may be found in the following works: *Niewe Hollandse Scheepsbouw - - door Carel. Allard,* Amsterdam 1705, 4to. ii. p. 8. tab. 5. *L'Art de batir les vaisseaux.* Amsterdam 1719, 4to. ii. p. 93. *Encyclopédie,* Paris edition, iii. p. 67. *Planches, sixième livraison,* art. *Marine,* tab. v. fig. 2. *Leupold's Theatrum machinarum,* p. 96, tab. 24.

† Vol. iv. p. 815.

‡ Keysler's Reise, i. p. 623. *Volkmann, Nachrichten von Italien,* ii. p. 152.

with many beautiful copper-plates.* In this work a method is proposed for carrying large ships over shallows; which has a great resemblance to that in which the camel is employed; for the author says, that a vessel must be constructed in such a manner as to embrace the hull of the ship, like a case; and that when placed under the ship, it will raise it up.† But though this machine or case, as

* L'Arte di restituire à Roma la tralasciata navigazione del suo Tevere—Dell' Ingegniero Cornelio Meyer, Olandese. In Roma 1683, fol.

† As the book is scarce, I shall here insert the description, though it refers to a figure which I cannot add. Con occasione, che mi è convenuto parlare delli sostegni hò voluto toccare di passagio, ch'essi sono servibili a molti altri usi, et in specie quando si trovano nelli canali, ò nel mare secchi, ò scanni d'arena coperti da cosi poca acqua, che le navi non possono passare sopra di essi ne proseguire il loro viaggio. Occorrendo dunque provedere à simili incontro, accio le navi non havessero da trattenersi con le merci, e d'aspettare sinche vicne qualche crescente d'acqua, pottrebono farsi nel sudetto sostegno alcune viti fermati dentro le mura di esso, e tenere in pronto una scafa fatta in forma di cassa ò fodera d'una nave, la quale si pone sotto alle sudette viti, e mediante queste si manda tanto sott'acqua, che la nave pnole essere tirata in essa scafa, e rallentate poi dette viti, verrà la medema nave ad alzarsi sopra acqua, in modo che se prima haveva di bisogno per navigare otto ò dieci palmi d'acqua, le bastaranno cinque, ò sei. Conciosiache se un peso exempli gratia di cento mila libre manda sott'acqua il corpo d'nna nave da otto in dieci palmi, aggiunto poi à questa nave il corpo d'una scafa, che possa portare altretanto peso segue necessariamente, ch'essa nave pescarà assai meno acqua perche viene sostenuta da un altro corpo, che ricercarebbe altretanto peso. Il che si rende anche più intelligibile con la seguente considerazione: supponiamo, che una nave carica di quattro cento mila libre vadi sotto acqua palma dieci, si che poste nella medema nave due cento mila libre solamente, resta indubitato, ch'essa nave andarà solamente sott'acqua palmi cinque, perche non

Meyer himself calls it, is founded on the same principles as those on which the camel is constructed, it is different, as it consists of one piece, and can be placed under a ship only in a dock, by the help of a number of screws. The author does not say that it is provided with pumps ; and it must indeed be acknowledged that this method would require much more costly apparatus than the camel, and must be less extensive in its use. We do not find, therefore, that it was ever tried or employed. On the contrary, Meyer's account seems to prove that, at the time when he wrote, that is, a little before the year 1683, the camel was not invented ; for had it been known, he would certainly have mentioned it.

The Dutch writers, almost unanimously, ascribe the invention of the camel, with more probability, to a citizen of Amsterdam, who calls himself Meeuves Meindertszoon Bakker. Some make the year of the invention to have been 1688, and others 1690. We are assured, on the testimony of Bakker, written in 1692, and still preserved, that, in the month of June, when the water was at its usual height, he conveyed, in the space of

porta, che la meta delli sudette libre quattro cento mila; et il medesimo opera la sudetta scafa posta sotto ad una nave perche sostenta quella con potenza tale, come se fusse mezza carica, con che credo d'haver a sofficienza dimostrato il modo di poter navigare sopra i luoghi coperti da poc'acqua, per essere questa propositione facile d'essere concepita da ogn'uno, e massime da chi hà pratica delle materie di queste genere.

twenty-four hours, by the help of the camel, a ship of war, called the *Maagt van Enkhuysen*, which was a hundred and fifty-six feet in length, from *Enkhuysen hooft* to a place where there was sufficient depth; and that this could have been done much sooner had not a perfect calm prevailed at the time.* In the year 1693 he raised a ship, called *the Unie*, six feet by the help of this machine, and conducted her to a place of safety.

At later periods, this Dutch invention has been employed in other countries. Ships built in the Newa cannot be conveyed to the harbour, on account of the sand-banks formed by the current. On one of these a trading vessel from Lubec, in which I was a passenger, ran aground in the year 1763. To carry ships over these shoals camels are used by the Russians; and they have them of various sizes. Bernoulli† saw one, each half of which was two hundred and seventeen feet in length, and thirty-six in breadth. Camels are used likewise at Venice.‡

But, however beneficial this invention may be, we have reason to suppose that such heavy vessels as ships of war cannot be raised up, in so violent a manner, without sustaining injury. A sure proof of this is, the well-known circumstance, that the

* De Koophandel van Amsterdam, i. p. 14—16.

† Bernoulli Reisen durch Brandenburg, u. s. w. v. p. 23.

‡ See *Wright's Travels*, in the translation of *Blainville's*, iv. p. 68.

ports of a ship, which had been raised by the camel, were so much strained that they could not be shut closely afterwards.*

ARTIFICIAL ICE. COOLING LIQUORS.

The art of preserving snow, for cooling liquors during the summer, in warm countries, was known in the earliest ages. This practice is mentioned by Solomon,† and proofs of it are so numerous in the works of the Greeks and the Romans, that it is unnecessary for me to quote them, especially as they have been collected by others.‡ How the repositories for keeping it were constructed, we are not expressly told; but what I know on the subject I shall here lay before the reader.

That the snow was preserved in pits or trenches, is asserted by many.§ When Alexander the Great besieged the city of Petra, he caused thirty

* Muschenbroek, Introductio ad philosophiam natur. ii. p. 521.

† Proverbs, chap. xxv. ver. 13: As the cold of snow in the time of harvest, so is a faithful messenger to them that send him: for he refresheth the soul of his masters.

‡ Thomæ Bartholini De niviș usu medico observationes variæ. Hafniæ 1661, 8vo.

§ *Seneca, Quæst. natur.* iv. 13: Invenimus quomodo stiparemus nivem, ut ea æstatem evinceret, et contra anni fervorem defenderetur loci frigore. In another place he says: Didicerunt Romani, luxuria monstrante, nives ad tempus æstatis locis subterraneis custodire. *Plin.* xix. 4: Servatur algor æstibus, excogitaturque ut alienis mensibus nix algeat.

trenches to be dug, and filled with snow, which was covered with oak branches, and which kept in that manner for a long time.* Plutarch says, that a covering of chaff and coarse cloth is sufficient;† and at present a like method is pursued in Portugal. Where the snow has been collected in a deep gulf, some grass or green sods, covered with dung from the sheep-pens, is thrown over it; and under these it is so well preserved, that the whole summer through it is sent the distance of sixty Spanish miles to Lisbon.‡

When the ancients therefore wished to have cooling liquors, they either drank the melted snow or put some of it in their wine, or they placed jars filled with wine in the snow, and suffered it to cool there as long as they thought proper. It appears that in these trenches it could not remain long

* Chares Mitylenæus, in suis de Alexandro Historiis qua industria nix conservari debeat exposuit, quo loco Petræ urbis Indorum obsidionem enarrat. Scribit enim, Alexandri jussu fossas triginta, parum inter se distantes, excavatas fuisse, easque nive impletas superinjectis quercus ramis (δρυος κλαδους), ac nivem longo sic tempore perdurasse. *Athenæi Deipnos.* iii. p. 124.

† Sympos. vi. quest. 6. p. 691. Nivem paleis involventes et rudibus pannis per multum temporis integram retinent. Αχυροις σπαργανουντες αυτην, και περιστελλοντες ἱματιοις αγναπτοις.—Augustinus De civitate Dei, xxi. 4. p. 610: Quis paleæ dedit vel tam frigidam vim, ut obrutas nives servet; vel tam fervidam, ut poma immatura maturet?

‡ Memoires instructifs pour un voyageur, Or the German translation *Gegenwärtiger staat von England, Portugal, und Span.* Danzig 1755, 8vo. i. p. 205. How the snow repositories at Constantinople are constructed, is related by Bellon in his *Observat.* iii. 22.

clean; on the contrary, it was generally so full of chaff, that the snow-water was somewhat coloured with it, and had a taste of it, and for this reason it was necessary to strain either it or the wine that had been cooled by it.*

That ice also was preserved for the like purpose, is probable from the testimony of various authors,† but it appears not to have been used so much in warm countries as in the northern. Even at present, snow is employed in Italy, Spain, and Portugal; but in Persia, ice.‡ I have never any where found an account of Grecian or Roman ice-houses. By the writers on agriculture they are not mentioned §

* This circumstance will make a passage of Seneca, *Quæst. nat.* iv. 13, intelligible: Quid Lacedæmonii fecissent, si vidissent reponendæ nivis officinas, et tot jumenta portandæ aquæ deservientia, cujus colorem saporemque paleis, quibus custodiunt, inquinant? The *colum nivarium*, or *saccus nivarius*, which occurs in several passages that may be found in Bartholin and Latin dictionaries, was used for the above purpose.---The dissipated Heliogabalus caused whole mounts of snow to be heaped up in summer in order to cool the air. See *Lampridius, Vita Heliogab.* cap. 23.

† Plin. xix. 4: Hi nives, illi glaciem potant. *Seneca:* Nec nive contenti sunt, sed glaciem, velut certior illi ex solido rigor sit, exquirunt, ac sæpe repetitis aquis diluunt. See the passage before quoted.—*Latinus Pacatus* in *Panegyr. Theodos:* Delicati parum se lautos putabant, nisi æstivam in gemmis capacibus glaciem Falerna fregissent.

‡ De la Valle, Reisen, iii. p. 60, where the Persian ice-pits are described, as well as in *Voyages de Chardin*, iv. p. 195.

§ We read in *Joh. Boecleri Dissert. de potu frigido*, Argentorati 1700, a translation of which may be found in *C. F. Schwertners Kraft und würkung des schlechten wassers*, Leipzig 1740, 8vo. part i.

Mankind however soon conceived the idea of cooling water without snow or ice, from having remarked that it became cold more speedily when it had been previously boiled, or at least warmed, and then put in a vessel among snow, or in a place much exposed to the air. Pliny seems to give this as an invention of Nero;* and a jocular expression in Suetonius† makes it at any rate probable, that he was fond of water cooled by this method; but it appears to be much older. It seems to have been known even to Hippocrates:‡ at least Galen§ believes so. And Aristotle‖ was

p. 23, that Pliny speaks of the ice-pits as follows: Itali, ut gelu perennet in æstatem, fontis aquam hyeme in cavum locum deducunt, ut glacie concrescat; rumpunt securibus glaciem, eamque in turrim profundam substrata palea stipant, turrim implent, glaciem palea tegunt. These words however I cannot find in Pliny, nor do I know whence they have been taken. They seem to have been written by some modern traveller.

* Neronis principis inventum est, decoquere aquam, vitroque demissam in nives refrigerare. Ita voluptas frigoris contingit sine vitiis nivis. Omnem utique decoctam utiliorem esse convenit; item calefactam magis refrigerari, subtilissimo invento. *Hist. nat.* xxxi. 3, 23, p. 552.

† Vita Neronis, cap. 48: Hæc est Neronis decocta.

‡ De morbis vulgar. lib. vi. 4, p. 274.

§ In lib. vi. Hippocrat. de morbis vulgar. comment. 4, 10, p. 396.

‖ Meteorol. i. cap. 12: Confert adhuc ad celeritatem congelationis et præcalefactam fuisse aquam; citius enim infrigidatur. Quapropter multi, cum aquam infrigidare cito voluerint, ad solem ponunt primo. Et qui circa Pontum, cum in glacie habitaculum faciunt ad piscium venationes (venantur enim intercidentes glaciem) aquam calidam arundinibus circumfundunt, propterea quod citius congelatur; utuntur enim glacie tanquam plumbo, ut quiescant arundines: χρωνται γαρ τῳ κρυσταλλῳ ὡσπερ τῳ μολυβδῳ, ἱν ηρεμωσιν ἱε

undoubtedly acquainted with it; for he says, that some were accustomed, when they wished water to become soon cold, to place it first in the sun and suffer it to grow warm. He relates also, that the fishermen near the Black Sea poured boiling water over the reeds which they used in fishing on the ice to cause them to freeze sooner. Galen* on this subject is still more precise. He informs us that the above practice was not so much used in Italy and Greece, where snow could be procured, as in Egypt and other warm countries, where neither snow nor cool springs were to be found. The water after it had been boiled was put into earthen vessels or jars, and exposed in the evening on the upper part of the house to the night air. In the

καλαμοι. This passage, like many others in the above curious work, deserves to be more accurately examined.

* In the place before quoted. Porro in Alexandria totaque Ægypto ipsos aquam in testaceis quibusdam vasis hoc modo refrigerare conspexi. Occidente sole aquam prius calefactam in vascula fundebant, deinde sublime totum hoc vas in fenestris vento adversis, ut ibi per totam noctem refrigesceret, suspendebant; postea ante solis ortum vas humi depositum frigida aqua circumfundentes, frigida etiam folia toti vasi circumdabant, nonnunquam vitium, aut lactucæ, nonnunquam vero et aliarum id genus herbarum, ut ea quam sub nocturno aere acquisiverat, diutius permaneret frigiditas.—A passage also in *De composit. medic. secundum locos*, lib. ii. cap. 1, p. 256, alludes to the same custom: Frigidorum fontium multa Romæ ubertas est, et nivis, quemadmodum apud nos in Pergamo et in plurimis Asiæ Græciæque civitatibus. At vero in calidis regionibus qualis est Ægyptus, in qua et fontium frigidorum et nivis penuria est, necessarium est præfrigerato rosaceo per expositionem sub divum, per integram noctem et per obversionem ad auræ alicujus afflatum, ita demum addere ei sempervivi succum.

morning these vessels were put into the earth, (perhaps in a pit) moistened on the outside with water, and then bound round with fresh or green plants, by which means the water could be preserved cool throughout the whole day. Athenæus,* who gives a like account from a book of Protagorides, remarks, that the pitchers filled with water, which had become warm by standing all day long in the sun, were kept continually wet during the night, by servants destined to that office, and in the morning were bound round with straw. In the island Cimolus,† water which had become warm in the day-time was put into earthen jars, and deposited in a cool cellar, where it grew as cold as snow. It was generally believed therefore, that water which had been warmed or boiled, was soonest cooled, as well as acquired a greater degree of refrigeration;‡ and on this account

* Interdiu aquam insolantes, et sub noctem quod crassissimum erat colo secernentes, reliquum urnis fictilibus exceptum in excelsissima ædium parte sinunt, pueris duobus tota nocte urnas aqua irrigantibus; diluculo vero urnis deorsum revectis, et fæce quæ sidit, rursum detracta, aqua sic extenuata, et ad tuendam ea ratione bonam valetudinem maxime idonea, urnas in paleis recondunt, et aquam sic purgatam bibunt, nive prorsus nihil egentes. *Deipnos.* iii. p. 124.

† Semus Delius scribit, in Cimolo insula, per æstatem frigidarias specus effodi, in quibus aquæ tepentis æstu plena dolia reponant, illam post inde haurientes nive ipsa non minus frigidam. *Ibid.* p. 123.

‡ Alexand. Aphrodisiensis Quæst. natur. 1, 51: Δια τι θερμαινομενον ὑδωρ εις φρεαρ χαλωμενον ψυχοτατον ὑδωρ ποιειται. Cur aqua fervida in puteum demissa aqua frigidissima redditur?

boiled water is mentioned so often in the works of the ancients.*

The same opinion prevails at present in the southern countries of Asia, and people there still let their water boil before they expose it to the air to cool.† The experiments however which have been made on this subject by philosophers, have proved very different in the result. When one indeed places boiling and cold water, all other circumstances being equal, in frosty air, the latter will become ice before the former has cooled; but when one exposes to the cold, water that has been boiled, and unboiled water of equal temperatures, it may then be expected that the former will be converted into ice somewhat sooner.

Water by being boiled loses a considerable portion of its air, while that of unboiled water must be disengaged before it can freeze, and by this its particles are kept in continual motion, which may retard its congelation. Boiled water however in cooling, imbibes air again, but for that purpose seven or eight days are necessary, according to the observations of Mariotte. One might therefore conjecture that the Indians are right.

The experiments, however, made by Mariotte,‡

* The passages have been collected by those authors who are quoted in *Pitisci Lex antiq. Rom.* under the word *Decocta.*

† Philosophic. transact. vol. lxv. part i. p. 126.

‡ Traité du mouvement des eaux.

Perrault,* the Academy del Cimento,† Mairan‡ and others, showed no perceptible difference in the time of freezing, between boiled and unboiled water; but the former produced ice harder and clearer: the latter ice more full of blisters. In later times, Dr. Black of Edinburgh has, from his experiments, asserted the contrary. Boiled water, he says, becomes ice sooner than unboiled, if the latter be left at perfect rest; but if the latter be stirred sometimes with a chocolate stick, it is converted into ice as soon as the former. This difference he explains in the following manner: Some motion promotes congelation; this arises in the boiled water, through its re-imbibing air; and, therefore, it must necessarily freeze before the unboiled; provided the latter be kept at perfect rest. Fahrenheit had before remarked that water not moved, would show a cold some degrees below the freezing point, without becoming ice.§

Mr. Lichtenberg, with whom I conversed on these contradictory results, assured me that he was not surprised at this difference in the experiments. The time of congelation is regulated by circumstances, with which philosophers are not yet sufficiently acquainted. A certain, but not every degree of stirring hastens it; so that every

* Du Hamel, Hist. de l'Academ. l. i. s. i. c. 3, p. 99.

† Tentamina experimentorum Acad. del. Cim. p. 183.

‡ Dissertation sur la glace. Paris 1749, 12mo. p. 187.

§ Philosoph. transact. vol. lxv. part i. p. 124.

icy particle which is formed on the side of the vessel, or which falls from the atmosphere, may convert the water sufficiently cooled into ice instantaneously; and such unavoidable accidents must, where all other circumstances are equal, cause a great difference in the period of freezing. A variation, therefore, in the time may be well expected; both because the boiling of river water expels the aerial acid; and because it produces also a kind of inspissation, and because by both these effects united the water must undergo some change.

I am inclined to think that the cooling of water, in ancient times, of which I have already spoken, is not to be ascribed so much to the boiling as to the jars being kept continually wet, and to the air to which it was exposed. A false opinion seems therefore to have prevailed respecting the cause; and because it was considered to be the boiling, many have not mentioned the real cause, which appeared to them only to afford a trifling assistance, though it has been remarked both by Galen and Athenæus. We know at present that the heat decreases by evaporation, or that coolness is produced. A thermometer kept wet in the open air, falls as long as evaporation continues. With æther of vitriol, and still better with that of nitre, which evaporates very rapidly, one can in this manner bring water even in the middle of summer to freeze; and Cavallo saw in summer a Fahrenheit's

thermometer, which stood at 64°, fall in two minutes, by means of æther, to + 3, that is to 29 below the freezing point.*

On this principle depends the art of making artificial ice at Calcutta and other parts of India, between 25° 30′ and 23° 30′ of north latitude, where natural ice is never seen. Trenches two feet deep, dug in an open plain, are strewed over with dry straw; and in these are placed small shallow unglazed earthen pans, filled with water at sunset. The ice which is produced in them is carried away before sunrise next morning, and conveyed to an ice-cellar fifteen feet deep; where it is carefully covered with straw to be preserved from the external heat and air. A great deal, in this process, depends upon the state of the atmosphere. When calm, pure, and serene, it is most favourable to the congelation; but when the winds are variable, or the weather heavy and cloudy, no ice is formed; and the same is often the case when the nights are raw and cold.†

It was once believed that this freezing was occasioned principally by the water having been boiled; but it seems to be owing much rather to evaporation. It is not, however, said that the

* Philosoph. transact. vol. lxxi. part ii. p. 511.

† Ibid. p. 252: The process of making ice in the East Indies; by Robert Barker. A translation of this paper is inserted in the *St. Peterburgisches Journal*, 1776. Januar. p. 59.

vessels are kept continually wet on the outside, but that they are unglazed, and so porous or little burnt, that the water oozes through them; and on that account their exterior surface appears always moist.* By vessels of this kind the trouble of wetting is saved. What has been said respecting the influence of the weather serves, in some measure, to confirm my conjecture. The more it favours evaporation, the ice is not only formed more easily, but it is better; and when evaporation is prevented by the wind or the weather, no ice is produced. The latest accounts, how ice is made at Benares, say expressly that boiled water is not employed; and that all those vessels the pores of which are stopped by having been used, do not yield ice so soon or so good. In porcelain vessels none is produced; and this is the case also when the straw is wet.†

Another method of cooling water also seems to

* - - - a number of small, shallow, earthen pans. These are unglazed, scarce a quarter of an inch thick, about an inch and a quarter in depth, and made of an earth so porous, that it was visible from the exterior part of the pans, the water had penetrated the whole substance.

† See the account of Lloyd Williams, in the *Universal Magazine*, June 1793, p. 410; and a translation of it, in *Lichtenberg und Voigt Magazin für das neueste aus der physick*. Gotha 1794, ix. part 2. p. 86. Thin unglazed vessels are employed at present in Egypt also for cooling water, as we are told in several books of travels. The art of glazing is not yet known in that country. See *Norden's Reise durch Egypten*. Breslau und Leipz. 1779, 8vo. p. 121.

have been known to Plutarch. It consisted in throwing into it small pebbles or plates of lead.* The author refers to the testimony of Aristotle; but this circumstance I cannot find in the works of that philosopher which have been preserved. It seems to be too unintelligible to admit of any opinion being formed upon it; and the explanation given by Plutarch conveys still less information than the proposition itself. This is the case, in general, with almost all the propositions of the ancients. We, indeed, learn from the questions that they were acquainted with many phenomena; but the answers scarcely ever repay the trouble which one must employ in order to understand them. They seldom contain any further illustration; and never a true explanation.

It appears that the practice of cooling liquors, at the tables of the great, was not usual in any country besides Italy and the neighbouring states, before the end of the sixteenth century. In the middle of that century there were no ice-cellars in France; for when Bellon relates, in the Account of his travels, in 1553, how snow and ice were preserved at Constantinople throughout the whole summer, for the purpose of cooling sherbet, he assures us that the like method might be adopted by his countrymen; because he had found ice-

* Sympos. vi. 5. p. 690: Δια τινα αιτιαν οι χαλικες και οι μολιβδιδες εμβαλλομεναι ψυχροτερον το ὑδωρ ποιουσιν. Quare lapilli et plumbeæ laminæ in aquam injectæ frigidiorem eam faciunt.

cellars in countries warmer than France.* The word *glacière* also is not to be met with in the oldest dictionaries; and it does not occur even in that of Monet, printed in 1635.† Champier the physician who attended Francis I, when he had a conference with the emperor Charles V and Pope Paul III at Nice, saw the Spaniards and Italians put snow, which they caused to be brought from the neighbouring mountains, into their wine in order to cool it. That practice, which excited his astonishment, he declared to be unhealthful; and this proves that, in his time, it had not been introduced at the French court.‡

Grand d'Aussy quotes an anecdote, related by Brantome, from which he forms the same conclusion. The dauphin, son of Francis I, being accustomed to drink a great deal of water at table, even when he was overheated, Donna Agnes Beatrix Pacheco, one of the ladies of the court, by way of precaution sent to Portugal for earthen vessels, which would render the water cooler and more healthful; and from which all the water used at the court of Portugal was drunk. As these vessels are still used in Spain and Portugal, where the wine is cooled also with snow, both methods might have been followed in France. I have in

* Observation, iii. 22. p. 184.

† That was the fifth edition. The word *glacière*, however, may be found in *Dictionnaire par Richelet*, Geneve 1680, 4to.

‡ J. Bruyerini Campegii Libri xxii. de re cibaria, xvi. 9. p. 669.

my collection of curiosities, fragments of these Portuguese vessels; they are made of red bole; are not glazed, though they are smooth, and have a faint gloss on the surface like the Etruscan vases. They are so little burnt that one can easily break them with the teeth; and the bits readily dissolve in the mouth. If water be poured into such vessels, it penetrates their substance; so that, when in the least stirred, many air-bubbles are produced; and it at length oozes entirely through them.* The water that has stood in them acquires

* Most vessels of this kind in Portugal are made at Estremos, in the province of Alentejo. The description given of them by Brantome is as follows. "Cette terre étoit tannée, si subtile et si fine qu'on diroit proprement que c'est une terre sigillée; et porte telle vertu, que quelque eau froide que vous y mettiez dedans, vous la verrez bouillir et faire de petits bouillons, comme si elle estoit sur le feu; et si pourtant elle n'en perd sa froideur, mais l'entretient, et jamais l'eau ne fait mal à qui la boit, quelque chaud qu'il fasse, ou quelque exercice violent qu'il fasse." This clay seems to be the same as that which the ladies in Spain and Portugal chew for the sake of its pleasant taste, though to the prejudice of their health. They are so fond of it that their confessors make them abstain from the use of it some days by way of penance for their transgressions. See *Madame D'Aunoi, Reise durch Spanien*, ii. p. 92 and 109. *Mémoires instructifs pour un voyageur*, or the before-quoted translation, *Gegenwärtiger staat von England, Portugal, und Spanien*, ii. p. 162, and Dr. Taube in *Hannoversches magazin*, 1784, part 75, p. 1199. A vessel of the above kind is called *bucaro* and *barro*. In *Diccionario Castellano, su autor El. P. Esteb. de Terreros y Pando*, it is said: *Bucaro*, poculum ex argilla odorifera confectum. In *Diccion. de la lengua Castellana*, Madrid 1783, fol. it is added, that all these vessels are brought to Spain from Portugal or India: *Bucaro*, vaso de barro fino hecho de tierra olorosa que traen de Portugal y de las Indias. Sirven para beber agua - - -

a taste which many consider as agreeable; and it is probable that it proceeds from the bark of the fir-tree, with which, as we read, they are burnt. When the vessels are new, they perform their service better; and they must then also have a more pleasant smell. If they really render water cold, or retain it cool, that effect, in my opinion, is to be ascribed to the evaporation. Their similarity to those in which the Indians make ice is very apparent.

Towards the end of the sixteenth century, under the reign of Henry III, the use of snow must have been well known at the French court, though it appears that it was considered by the people as a mark of excessive and effeminate luxury. In the witty and severe satire on the voluptuous life of that sovereign and his favourites, known under the title of *L'Isle des Hermaphrodites*,* a work highly

Barro, lutum, argilla. *Barro*, vaso de differentes figuras y tamaños hecho de tierra olorosa para beber agua. Llamase tambien *Bucaro*. That such vessels, but of white clay, were made also in the island of Malta, is affirmed by Bartholin, in his *Epistolæ medicinales*, i. p. 224: In Melita ex terra alba fictiles urnas elegantes conficiunt, quæ aquam conservant frigidam, etiam soli expositam.

* This curious work contains so much valuable information respecting the French manners in the sixteenth century, that some account of it may not prove unacceptable to my readers. The edition which I have is entitled, *Description de l'isle des Hermaphrodites, nouvellement decouverte - - - pour servir de supplement au Journal de Henry* III. A Cologne, chez les heritiers de Hermann Demen. 1726, 352 pages, 8vo, In the library of our university there is an edition of 1724, which is entirely like the above. Marchand says that the name of the place and publisher are false; and

worthy of notice, but which is exceedingly scarce, we find an order of the Hermaphrodites that large

that it ought to have been, *à Bruxelles, chez Francois Foppens.* The preface, to which there is no signature, says that the book was printed for the first time in 1605. In the first editions neither date nor place is mentioned; but one edition is dated 1612. It appears to have been written in the reign of Henry IV, after the peace of Vervins, concluded in 1598, which the author mentions in the beginning. Henry IV. would not suffer any inquiry to be made respecting the author that he might be punished, because, he said, though he had taken great liberty in his writing, he had written truth. He is not therefore known. Some have conjectured that it was the production of Cardinal Perron, and others of Thomas Artus. But the former would not have chosen to lash vices such as those mentioned in his satire, with so much wit and severity; and the latter could not have done it. The one was too vicious, and the other too vehement. The cardinal must have delineated his own picture; and Artus have exceeded what he was capable of. The same opinion respecting Artus is entertained by Marchand. See his *Dict. Historique.* The frontispiece, which in many editions is wanting, represents an effeminate voluptuary with a womanish face, dressed half in men's and half in women's clothing. Marchand says the inscription is *Les Hermaphrodites.* In the editions with which I am acquainted it is, however, much more cutting: *Pars est una patris; cætera matris habet.* This pentameter is taken from Martial, lib. xiv. ep. 174. The whole work is inserted also in *Journal de Henri* III, par Pierre de l'Estoiles, à la Haye 1744, 8vo. iv. p. 1; but without the engraving: and some pieces which stand at the end of my edition, and which could not be in the first, because they are of more modern date, are omitted: viz. every thing that follows p. 287, the *Discours de Jacoph. à Limne. Privileges, franchises, et liberté de la ville capitale de Bois-Belle.* (This piece, as mentioned in the margin, should be contained in *Recueil de diverses pieces servant à l'histoire de Henry* III: but in my edition, Cologne, chez Pierre du Marteau, 1666, 12mo, which is not to be found in Le Long, it is wanting.) See *Bibliotheque de Madame de Montpensier,* p. 291; *Remarques sur la Biblioth. de Mad. de Montpensier,* p. 298; and *Discours sur la vie du R. Henri* III, par Le

quantities of ice and snow should, every where, be preserved, in order that people might cool their liquors with them, even though they might occasion extraordinary maladies, which, it seems, were then apprehended.* In the description of an entertainment we are told that snow and ice were placed upon the table before the king; and that he threw some of them into his wine;† for the art of cooling it without weakening it was not then known. The same method was practised even during the whole first quarter of the seventeenth century.‡

Laboureur, p. 331; which may be found also in *Mémoires de Castelnau*; Paris 1659, fol. p. 883. See *Le Long*, ii. p. 326. n. 19133, who ought properly to have said that it was added to the new editions of *L'Isle des Hermaphrodites*. I shall refer those who wish for further information on this subject to *Le Long*, *Bibliotheque historique de la France*, ii. p. 326. n. 19128; and to the works there quoted—*Dictionnaire historique de Prosper Marchand*, i. p. 305—*Ducatiana*, p. 67. Had the author of the *Gynæologie*, Berlin 1795, been acquainted with this satire, he might have extracted from it, to enlarge, in the part on amours, ii. p. 290, the picture which he gives of the manners of the sixteenth century.

* En été on aura toujours de reserve, en lieux propres pour cet effet, de grands quartiers de glace et des monts de neige, pour mesler parmi le breuvage, quand bien cela devroit engendrer des maladies extraordinaires. P. 61. There were then no *glacières*, nor was the word known.

† On apporta de la neige et de la glace sur des assiettes. L'Hermaphrodite prenoit tantôt de l'une tantôt de l'autre, selon qu'il lui venoit en fantaisie, pour les mettre dans son vin, afin de le rendre plus froid. P. 106.

‡ In the *Contes de Gaulard*, printed in 1620, it is said: Il alla un jour d'esté souper chez un voluptueux, qui lui fit mettre de la glace en son vin.

Towards the end of the above century this luxury must have been very common in France. At that period there were a great many who dealt in snow and ice; and this was a free trade which every person might carry on. Government, however, which could never extort from the people money enough to supply the wants of an extravagant court, farmed out, towards the end of the century, a monopoly of these cooling wares. The farmers, therefore, raised the price from time to time; but the consumption and revenue decreased so much that it was not thought worth while to continue the restriction; and the trade was again rendered free. The price immediately fell; and was never raised afterwards but by mild winters or hot summers.*

The method of cooling liquors by placing them in water in which saltpetre has been dissolved, could not be known to the ancients, because they were unacquainted with that salt. They might, however, have produced the same coolness by other salts which they knew, and which would have had a better effect; but this, as far as I have been able to learn, they never attempted. The above property of saltpetre was first discovered in the first half of the sixteenth century; and it was not remarked till a long period afterwards, that it belongs to other salts also.

The Italians, at any rate, were the first people

* Dictionnaire de commerce, art. *Glace*.

by whom it was employed; and about the year 1550, all the water, as well as the wine, drunk at the tables of the great and rich families at Rome, was cooled in this manner. Blasius Villafranca, a Spaniard, who practised physic in that capital, and attended many of the nobility, published, in the before-mentioned year, an account of it, in which he asserts, more than once, that he was the first person who had made the discovery publicly known.* In his opinion it was occasioned by the remark that salt water in summer was always cooler than fresh water. According to his directions, which are illustrated by a figure, the liquor must be put into a bottle or globular vessel with a long neck, that it may be held with more convenience; and this vessel must be immersed in another wide one filled with cold water. Saltpetre must then be thrown gradually into the water; and while it is disolving the bottle must be driven round with a quick motion on its axis, in one direction. Villafranca thinks that the quantity of saltpetre should be equal to a fourth or fifth part of the water;

* Methodus refrigerandi ex vocato salenitro vinum aquamque, ac potus quodvis aliud genus, cui accedunt varia naturalium rerum problemata, non minus jucunda lectu, quam necessaria cognitu. Auctore Blasio Villa-franca, Medico Hispano Romæ. Forty-six leaves small quarto. At the end stands: Romæ apud Valerium et Aloisium Doricos fratres Brixienses, anno iubilei, 1550. This edition is in the library of our university. Jöcher mentions a Venetian edition of the year 1553, 4to. The *Problemata*, however, do not form a distinct work; they make a part of the *Methodus refrigerandi*, and relate only to the described effects of the saltpetre.

and he assures us that, when again crystallized, it may be employed several times for the same use, though this, before that period, had by many been denied. Whether other salts would not produce the like effect the author did not think of trying; but he attempts to explain this of saltpetre from the principles of Aristotle; and he tells his noble patrons what rules they should observe for the preservation of their health, in regard to cooling liquors.

Towards the end of the sixteenth century this method of cooling liquors was well known, though no mention is made of it by Scappi, in his Book on cookery. Marcus Antonius Zimara, however, speaks of it in his Problems.* I do not know at what time this Appulian physician lived. In a list of the professors of Padua† his name is to be found under the year 1525, as *Explicator philosophiæ ordinariæ*; and because another is named under the year 1532, we have reason to conjecture that he died about that time. But in that case the physician Villafranca would probably have

* Problema 102: Quæsivit dominatio vestra (Joannes Castriota Ferrandinæ dux) propter quod vinum positum in vase constituto in aqua salinitro commista maxime refrigescit. The answer no one at present would read. These *Problemata* are often printed with the *Problemata Aristotelis, Alexandri Aphrodis.* and others. The collection which I have was printed at Amsterdam, by Jans. Waesberg, 1685, 12mo.

† Ant. Riccoboni Commentar. de gymnasio Patavino. Patavii 1592, 4to. p. 22. b.

been acquainted with the *Problemata* of Zimara; and would not have said that no one had spoken of this use of saltpetre before him.

Levinus Lemnius* also mentions the art of cooling wine by this method so much, that the teeth can scarcely endure it. We are informed by Bayle that the earliest edition of his work, which has been often reprinted, was published at Antwerp, in the year 1559, in octavo. It contains only the two first books; but as the above account occurs in the second book, it must be found in this edition.

Nicolaus Monardes, a Spanish physician,† who died about the year 1578, mentions this use of saltpetre likewise. It was invented, as he says, by the galley-slaves; but he condemns it as prejudicial to health. From some expressions which he uses I am inclined to think that he was not sufficiently acquainted with it; and that he imagined that the salt itself was put into the liquor.

* Æstivis mensibus ne vinum in congiis cito vapescat, aut calore perfundatur, sed inter propinandum frigescat, in labro aqua gelida oppleto collocentur urcei, aut capaciora pocula, deinde sal nitrum, vulgo *saltpeter*, insternatur; tanta frigiditate vinum imbui continget, ut eam vix dentes tolerent. *De miraculis occultis naturæ libri* iv. Coloniæ Agrippinæ, 1581, 8vo. p. 288.

† In his treatise *De nive*, which Clusius, in his *Exotica*, has translated from the Spanish: Tertius cum nitro refrigerandi modus a nautis inventus, illis præcipue qui triremibus vehuntur; nam cum aer istic non refrigeret, præsertim dum malacia est, et puteis atque nive sint destituti, necessitas hoc remedium eos docuit, licet non bonum propter annexa incommoda. P. 37.

At a later period we find some account of it in various books of receipts; such as that written by Mizaldus in 1566, and which was printed for the first time the year following.*

In the Mineralogy of Aldrovandi, first printed in 1648, this process is described after Villafranca;† but where the editor, Bartholomæus Ambrosianus, speaks of common salt,‡ he relates that it was usual in countries where fresh water was scarce to make deep pits in the earth; to throw rock-salt into them; and to place in them vessels filled with water, in order that it might be cooled. This remark proves that the latter salt was then employed for the same purpose, but it has led the editor into a very gross error. He thinks he can conclude from it that the intention

* Nostro ævo etiam inventus est modus refrigerandi aquam salnitro, quod aqua dissolutum egregie illam refrigerat, sed necesse est, lagenam, qua vinum vel aqua continetur, continuo agitare, quo potus frigidior reddatur, non secus ac si nivi vel glaciei esset imposita. *Centuriæ* ix. *memorabilium*. Francofurti 1599, 12mo. p. 67. Nonnius says, in his *Diætetica*, iv. 5, p. 442, that the first edition was printed in 1627.

† Aldrovandi Musæum metallicum, p. 327.

‡ Figuli massam, ex qua vasa fingunt ad refrigeranda potulenta, sale congruo aspergere et statim subigere debent, quia sal argillam astringit, et massam ad vasorum conservationem melius conglutinat; deinde liquores in hujusmodi vasis contenti, ope illius salis, cito frigescunt. Hanc salis vim in refrigerando mediterranei noverunt, qui in locis campestribus versantes æstivis diebus, nullis spirantibus auris, siti et calore oppressi puteos siccos effodiunt, in quibus vasa ad refrigeranda potulenta collocant, quæ ut frigidiora evadant, salem potissimum fossilem in fundo puteorum substernunt. P. 317.

of potters, when they mix common salt with their clay, is not only to render the vessel more compact, but also to make it more cooling for liquors. But the former only is true. The addition of salt produces in clay, otherwise difficult to be fused, the faintest commencement of vitrification; a cohesion by which the vessel becomes so solid that it can contain fluids, even when unglazed; but for this very reason it would be most improper for cooling, which is promoted by the evaporation of the water that oozes through.

The Jesuit Cabeus, who wrote a voluminous commentary on the *Meteorologica* of Aristotle, which was ready for the press in the year 1644, assures us that, with thirty-five pounds of saltpetre one can not only cool a hundred pounds of water, by quickly stirring it, but convert it also into solid ice; and for the truth of this assertion he refers to an experiment which he made.* Bartholin

* Notandum nos experimento didicisse, si mittamus salnitrum in aquam, et illam vehementer ac celeri motu concutiamus et agitemus, post aliquem motum, non solum frigescere illam aquam, sed congelari etiam, propria et vera congelatione; et sic delicias, quas in gelato potu quærunt delicatuli, etiam in medio mari, ubi nives non habeantur, inveniunt. Fit igitur glacies admixto salnitro competenti cum aqua, in centum lib. aquæ infundendo triginta quinque lib. salnitri, et postea celeriter et vehementer agitata aqua; ut philosophus magis laboret explicando, quomodo motus fit caussa caloris, cum hic sit caussa frigoris et congelationis. Hic autem pronuntio, quæ experientia nobis subministrat. *Nicol. Cabei Philosophia experimentalis, sive In libros meteorolog. Aristot. commentaria,* Romæ 1686. fol. i. p. 326. These *Commentaria* of Cabeus were printed

says, that for the above account he can give him full credit;* but the truth of it is denied by Duhamel, who suspects that this Jesuit took the shooting crystals of the salt to be ice.† As far as I have been able to learn, no one, in latter times, has succeeded to congeal water by saltpetre alone, without the help of snow or ice. The powder which a duke of Mantua had, in the middle of the 17th century, and by which, as the story goes, water, even in summer, could be instantaneously converted into ice, may, without doubt, have been only saltpetre.‡—Was this salt, therefore, considered formerly as the cause of the cold in the north-eastern and other countries, because it was used for cooling liquors? Even at present many farmers will say that such or such a field is cold, because it abounds with saltpetre.§

Who first conceived the idea of mixing snow or ice with saltpetre and other salts, which increases the cold so much, that a vessel filled with water, placed in that mixture, is congealed into a solid

also at Rome in 1646, as mentioned in *Fabric. Biblioth. Græca*, ii. p. 127.

* De nive, p. 38.

† Joh. Bapt. Du Hamel, Opera philosophica. Norimbergæ 1681. 4to. tom. ii. p. 50.

‡ Bartholin. De nive, p. 38.

§ When snow or ice is mixed with salt, both begin to be liquid. This process is employed in Russia to clean windows covered with frost. They are rubbed with a sponge dipped in salt, and by these means they become immediately transparent.

mass of ice that may be used on the table, I cannot with certainty determine; but I shall mention the earliest account of it that I have been able to find. Latinus Tancredus, a physician and professor at Naples, whose book *De fame et siti* was published in 1607, speaks of this experiment; and assures us that the cold was so much strengthened by saltpetre, that a glass filled with water, when quickly moved in the above mixture, became solid ice.*

In the year 1626, the well-known commentary on the works of Avicenna, by Sanct. Sanctorius, was published at Venice, in folio. The author in this work relates, that, in the presence of many

* Quod salnitrum in aquam immersum et attenuatum aquas illas ad vehemens frigus adigat; quia, motione, agitatione, cum tenui sua substantia aquæ calorem secum foras in ambiens dissipet et dispergat, inde optime cognosci poterit; quod si phialam aquæ plenam, vel mediam in aqua sale nitro eliquato circumvolveris, fiet quidem aqua in vase frigida; sed si non nitrum, sed nivem in aquam injeceris, ibique phialam celeri motu convertes, multo quidem plus frigoris illa aqua concipiet, quam ea quæ solo salisnitri frigore refrigerabatur.

At vero si nitrum nivemque una miscueris, mox phialam in salenitro et nive permixtis agitaveris, jam aqua in phiala contenta non solum frigidissima evadet, sed etiam dura glacies fiet. Unde mirabile dictu, nisi frangatur phiala, glacies sive gelu concretum a vase non separabitur.

Et ardente Sirio aquam in glaciem agere non solo nitro, nec sola nive, sed utriusque substantiæ mixtura, res est in artis naturæque operibus admirabilis: cur scilicet nix adjuncto salenitro intensius refrigeret, atque adeo aquas in gelu permutet. *Latini Tancredi De fame et siti libri tres.* Venetiis 1607. 4to. lib. iii. quæst. 27. p. 170. b.

spectators, he had converted wine into ice, not by a mixture of snow and saltpetre, but of snow and common salt.* When the salt was equal to a third part of the snow, the cold was three times as strong as when snow was used alone.

Lord Bacon, who died in 1626, says that a new method had been found out of bringing snow and ice to such a degree of cold, by means of saltpetre, as to make water freeze. This, he tells us, can be done also with common salt; by which it is probable he meant unpurified rock-salt; and he adds, that in warm countries, where snow was not to be found, people made ice with saltpetre alone; but that he himself had never tried the experiment.† Mr. Boyle who died in 1691, made

* The edition of 1626 is quoted by Haller in his *Methodus stud. med.* and in *Biblioth. med. pract.* i. p. 324. The following edition I have now before me from the library of our university. *Sanct. Sanctorii Commentaria in primam Fen primi libri Canonis Avicennæ*, Venetiis 1646. 4to. *Quæst.* 17. p. 177: Similiter nix triplo magis refrigerat, si nive permisceatur tertia pars salis communis; sal enim est vehiculum deferens frigiditatem, quod ostendimus maxima scholarium frequentia: nivem cum sale vel brevi congelasse vinum. *Quæst.* 26. p. 246: Ex nive et sale pari portione resultat qualitas adeo frigida (licet sal calidum sit), ut duplo magis refrigeret quam nix sola: tamen dum exoritur ista intensa frigiditas, non corrumpitur nix vel sal, quod patet, quia hæc possunt adhuc facile separari.—The above treatise may be found also in the Collection of all the works of this great man, printed, in four volumes, at Venice, in 1660.

† Historia vitæ et mortis, § 44: In congelatione et conglaciatione liquorum, quæ nuper cœpit esse in usu, per nivem et glaciem ad exteriora vasis apposita, immiscetur illis nitrum, atque procul dubio excitat et roborat congelationem. Verum est, etiam usurpari

experiments with various kinds of salt; and he describes how, by means of salt, a piece of ice may be frozen to another solid body.* Descartes says, that in his time this was a well-known phænomenon, but highly worthy of attention.†

Since that period the art of making ice has been spoken of in the writings of all philosophers where they treated on heat and cold, and with many other experiments has been introduced into various books of receipts. It was then employed merely for amusement;‡ and no one suspected

ad hoc salem nigrum communem, qui potius activitatem indit frigori nivali, quam per se infrigidat: sed, ut accepi, in regionibus calidioribus, ubi nix non cadit, fit congelatio a nitro solo; sed hoc mihi compertum non est. *Baconis Opera*, Lipsiæ 1694. fol. p. 528. *De augmentis scient.* v. 2. p. 131. *Silva silvarum*, cent. i. 83. p. 775.

* History of Cold, title i. 17, title v. 3, title xv. 7. The works of Rob. Boyle. London 1774. ii. p. 260, 266, 300.

† Meteora, cap. 8: Hinc etiam caussas arcani per æstatem componendæ glaciei discere possumus; quod licet cum satis vulgatum, ex optimis tamen est quod ejusmodi arcanorum studiosi habent. Salem æquali copiæ nivis aut glaciei contusæ mixtum, circa aliquod vas aqua dulci repletum disponunt; et sine alio artificio, ut illa simul solvuntur, hæc in glaciem coit. *Des Cartes Specimina philosophiæ.* Amstelodami 1650, 4to. p. 216.

‡ Von Hohberg says, in his *Adliches landleben*, Nürnberg 1716. fol. i. p. 88: The following, which serves more for amusement than use, is well known to children. If one put snow and saltpetre into a jug, and place it on a table, over which water has been poured, and stir the snow and salt well round in the jug with a stick, the jug will be soon frozen to the table." This baron, therefore, who, after he had sold his property in Austria on account of the persecution against the protestants, wrote at Regensburg

that it would ever be applied to an important purpose in luxury. In the like manner Fugger's first bills of exchange were said to be useful only for gambling; and gunpowder was called a trifling discovery.

In the beginning of the 17th century drinking-cups made of ice and iced fruit were first brought to the table; but, towards the end of that century, it appears that the French began to congeal, in this manner, all kinds of well-tasted juices, which were served up as refreshments at the tables of the great and wealthy. This was a grand invention for the art of cookery; which became common among the German cooks, both male and female, about the middle of the last century; and since that time our confectioners sell single glasses of iced articles to the ladies at our balls, and in the theatres.

I am acquainted with no older information respecting this invention than what is contained in Barclay's Argenis, which is, indeed, a romance; but the author's account makes the possibility of its being used so clear, that we may certainly conclude it was then employed; especially as he mentions it several times. Arsidas finds in the middle of summer, at the table of Juba, fresh

(Ratisbon), where he died, in 1688, at the age of seventy-six, was not acquainted with iced delicacies. Had they been known to him, he would have certainly mentioned them where, in his Book of cookery, he gives ample directions for laying out a table of the first rank.

apples, one-half of which was encrusted with transparent ice. A bason, made also of ice and filled with wine, was handed to him; and he was informed that to prepare all these things in summer was a new art. Snow was preserved the whole year through in pits lined with straw. Two cups made of copper were placed the one within the other, so as to leave a small space between them, which was filled with water; the cups were then put into a pail, amidst a mixture of snow and unpurified salt coarsely pounded, and the water, in three hours, was converted into a cup of solid ice, as well formed as if it had come from the hands of a pewterer. In the like manner apples just pulled from the tree were covered with a coat of ice.

The first edition of the Argenis was printed at Paris in 1621; and in that year the author died at the age of thirty-nine.* The book is far from being scarce; but the passage to which I allude, is so beautiful that I shall transcribe it to save my readers the trouble of searching for it.†

* Bayle, Diction. hist. *Barclai.*

† Arsidas nihil altiori intentione spectabat, quam inter promulsidaria esse varii generis poma ita glacie circumvenienti inserta, ut aliorum pars emineret extra hoc frigus, alia prorsus condita, tamen sub lucentis aquæ crusta nativo colore cernerentur.--Tum Juba, Ut magis mireris, inquit, cum in hortum intrâsti, hæc poma adhuc ex arboribus pendebant, et quæ modo est glacies, ex fontibus unda manabat.--Nova est, inquit, apud nos hæc ratio revocandi arte hiemem sub medio sole.--Aderat puer Ægyptius cum mulso, quod

After brandy, from being a medicine, came into general use as a liquor at table, and was drunk in common by the populace, the Italians, above all, endeavoured to render it weaker and more pleasant by various mixtures; and by raising its value to make it more respectable, and, at the same time, more useful to people of the first rank. That their wares might be distinguished with more certainty, they gave them the name of

in calice præferebat et ipso ex glacie facto: quo exhausto cum in terram a puero collideretur, doleretque Arsidas, fragile quidem, sed in æstatem pretiosum vas perire; Noli indignari, inquit Juba; in singulas potiones usus ejusmodi scyphorum est. Iterato eundem in mensa conspici, vile esset. Nihil amplius gustabat Arsidas, avidus cognoscendi, qua arte ad naturæ veritatem sic perveniretur; cum allata sunt variarum formarum ex ære prototypa. Orbium, poculorum, paropsidum, omnis denique convivalis instrumenti species erant. Tum Juba; Hæc sunt claustra quæ aquis infusis glaciem concipiunt. Quippe unumquodque operculo suo sic tegitur, ut oræ invicem cohæreant, excepta foraminis angustia, per quam aqua liquitur in interiora, quomodo ex stanno vel plumbo fusilis supellex conflatur. Alveolo deinde ligneo illa deponimus, cujus fundum sale primum nigro illo parumque contuso, et mox nive, contegitur, quæ nobis semper ad manum est, fulta straminibus, et in umbra antrorum toto anno inviolata. Supra ipsa deinde prototypa, in alveolum sic dimissa, pari modo nix quoque aliquoties cumulatur, sale toties interjecto. Ita hæc aqua illo in ære ad glaciem præparata accepit undique circumjectæ nivis frigus, quam sal acri mistura vetat liquescere; in locis præcipue umbrosis, qualia vini aut olei apothecis effodimus. Trium circiter horarum spatio coit aqua, et si quæ poma inseruimus, qualia nunc miraris, hærent septa in glacie. Æstu deinde languentibus grata est hæc vis nimii frigoris, quam et ipsa novitas commendat. Nuper enim nescio cujus non inepta luxuries hoc solatium invenit. *Barclaii Argenis.* Norimbergæ 1703. 12mo. lib. v. cap. 5. p. 581.

liquori; and under that appellation sold them to foreign nations. The French were the first who adopted the use of these articles; particularly after the marriage of Henry II, when duke of Orleans, with Catharine de Medici, in the year 1533. This event brought to France great numbers of Italians, who made the French acquainted with these delicacies of their native country; and who taught them to prepare and to use them. They were the first, therefore, who made and sold the fine *liqueurs* at Paris; and in order to serve those who could not bear heating liquors, or rather to serve themselves by filling their pockets with money, their successors in this business invented, about the year 1630 or 1633, that beverage called *lemonade*, because the juice of lemons or oranges was its chief component part. This liquor soon came into high repute, as it not only served for cooling and refreshing people during the sultry heats of summer, but was even recommended by physicians against putrid diseases.

The *limonadiers*, or venders of lemonade, endeavoured to increase the first property, which occasioned the far greatest consumption, by the means of ice; and one of them, Procope Couteaux, an Italian from Florence, about the year 1660, conceived the happy idea of converting such beverage entirely into ice, by a process which had been before employed only by jugglers. The ready sale which he found for his invention in-

duced others to make articles of the like kind. His example, therefore, was followed by Le Fevre and Foi; and these three, for some years, enjoyed a monopoly of this new-fashioned commodity. About the year 1676, liquors cooled by, or changed into, ice, must, however, have been the principal things sold by the *limonadiers;* for being then formed into a company, the following delicacies were mentioned in the patent which they received on that occasion :* *Eaux de gelée et glaces de fruits et de fleurs, d'anis et de canelle, franchipanne, d'aigre de cetre, du sorbec, &c.* There were at that time in Paris two hundred and fifty masters in this employment. In 1690, when De la Quintiny wrote, iced liquors were extremely common. †

People, however, long imagined that such articles could be used only during the hot months of summer. In the year 1750, Dubuisson, successor to the celebrated Procope, *au café de la rue des Fossés de S. Germain des Prés,* and author of the

* It may be found in *De la Mare, Traité de la police,* iii. p. 799.

† Instruction pour les jardins. Paris 1730, 4to. i. p. 263. The author says that ice in summer is indeed useful; but, as a gardener, he wishes that frost could be prevented; and that ice might be imported from the North, as olives and oranges are from the South. Some years ago, as no ice could be procured on account of the great mildness of the preceding winter, the merchants at Hamburgh sent ship to Greenland for a load of it, by which they acquired no small profit.

Art du distillateur,* began to keep ready prepared, the whole year through, ices of every kind for the use of those who were fond of them. At first they were little called for, except in the dog-days; but some physicians recommended them in certain disorders. Have the physicians then, by their opinion, done most service to the venders of *liqueurs* and to cooks, or the latter to the physicians? This would make a fine subject for an inaugural dissertation.—It is, however, certain, for we are told so by Dubuisson himself, that after two cures, in which ices had been of the greatest service, the *more discerning* part of the public made use of them in every season of the year. That this part of the public might never lose their conceit, the venders of *liqueurs* always employed their thoughts upon new inventions. Among the latest is that of iced butter, which acquired its name on account of some likeness to that substance. It was first known at the Parisian coffee-house (*caveau*) in 1774. The Duke de Chartres often went thither to enjoy a glass of iced liquor; and the landlord, to his great satisfaction and surprise, having one day presented him with his arms formed of eatable ice,† articles of a similar kind immediately became the mode. At present, Du-

* Der liqueurfabrikant des Demachy und Dubuisson, übersetzt und vermehrt von D. Hahnemann. Leipzig 1785, 8vo. ii. p. 165.

† Ingeniosa gula est. *Petron.*

buisson will, undoubtedly, say, that the Parisians have lost all their discernment; for where are the Dukes de Chartres?——

HYDROMETER.

This instrument, called in Latin *hydrometrum*, *hygroscopium*, *hygrobaroscopium*, *hydroscopium*, *areometrum*, and *baryllion*, serves to determine the weight or specific gravity of different fluid masses, by the depth to which it sinks in them. If I am not mistaken, it is most used in salt-works for discovering the contents of salt-water.

The laws respecting the comparative specific gravity of fluids and solid bodies immersed in them were discovered by Archimedes, when he tried the well-known experiment, by order of Hiero king of Sicily, to find the content of a golden crown, made for that sovereign. Upon these is founded the construction of the hydrometer;* and it is not improbable that Archimedes,

* Directions how to construct and use hydrometers may be found in *Karsten's Lehrbegriff der gesammten mathematik*, iii. p. 250; in the *Naturlehre* of the same author, p. 177; *Muschenbroek, Introduct. ad philosoph. natur.* ii. § 1384. *Leupold's Theatr. static.* pars ii. p. 206. § 12; and *J. Gesner, Dissert. de hygroscopiis constantis mensuræ*, Tiguri 1754. See also *De Montigny* in *Mémoires de l'Academ. des Sciences*, 1768, p. 435, and *Faggot, Verbesserung der bierproben*, in *Abhandl. der Schwedisch. Akadem.* xxv. p. 49. *Krünitz, Encyclopedie*, v. p. 272.

who was killed in the year 212 before the Christian æra, was the inventor of it, though no proofs to warrant this conjecture are to be found in the writings of that great man, or in those of any other author.

The oldest mention of the hydrometer occurs in the fifth century, and may be found in the letters of Synesius to Hypatia. Of the lives of these two persons I must here give some anecdotes, as they deserve to be known on account of the singular fate which attended them. Hypatia was the daughter of Theon, a well-known mathematician of Alexandria, some of whose writings are still extant. By her father she was instructed in the mathematics, and from other great men, who at that time abounded in Alexandria, she learned the Platonic and Aristotelian philosophy, and acquired such a complete knowledge of these sciences, that she taught them publicly with the greatest applause. She was young and beautiful, had a personable figure, was sprightly and agreeable in conversation, though at the same time modest; and she possessed the most rigid virtue, which was proof against every temptation. She conducted herself with so much propriety towards her lovers, that they never could obtain more than the pleasure of her company and of hearing her discourse; and with this, which they considered as an honour, they were contented. Those who wished to intrude farther were dismissed; and she destroyed the appetite of one who

would not suffer her to philosophise, by means of some strong preparation, which, as far as I know, was never imitated. She was not baptised, and, with all her knowledge, adopted the blind superstition of paganism. Had she been a Christian, and suffered a cruel death from heathen persecution, she would have merited a place in the martyrology of the saints: but the case was reversed; for, by the conduct of the Christians towards her, she became entitled to have her name enrolled in the martyrology of the philosophers.

The patriarch of Alexandria, at the time when she lived, was Cyrill, whose family for a hundred years before had produced bishops, who were of more service to their relations than to the church. This prelate was a proud, litigious, vindictive and intolerant man, who thought every thing lawful which he conceived to be for the glory of God; and who, as prosecutor and judge, condemned Nestorius without hearing his defence. In the city of Alexandria, which was then very flourishing on account of its commerce, the emperor allowed greater toleration than he imagined could be justified to the clergy in any other place; and it contained a great many Jews, who carried on an extensive trade, as well as a number of pagan families who were of service to the city, or at least did it no harm. This, in the eyes of Cyrill, was not proper; he would have the sheep-fold clean, and the Jews must be banished. Orestes, however,

the governor, who was a man of prudence, and better acquainted with the interests of the city, opposed a measure that was likely to be attended with mischief; and he even caused to be condemned to death a Christian profligate, who had done some injury to the Jews. This malefactor was, by the order of Cyrill, buried in the church as a martyr; and he immediately collected five hundred monks, who ill-treated Orestes in the streets, and excited an insurrection among the people, who plundered the unfortunate Jews, and expelled them from a city in which they had lived since the time of Alexander the Great.

Cyrill, observing one day a great number of horses and servants belonging to persons of the first rank, before a certain house in the city, inquired the cause of their being assembled in that manner. He was informed that the house was the habitation of the celebrated female philosopher Hypatia, who, on account of her extensive learning and eminent talents, was visited not only by people of the highest distinction, but even by the governor himself. This was sufficient to excite the bishop's jealousy against the unbelieving Hypatia, and he resolved to effect her ruin. As he had instigated the people against the Jews, he in like manner encouraged them to attack Hypatia. They seized her in the street, hurried her to the church, stripped off her clothes, tore her flesh to pieces with potsherds, dragged her mangled limbs about

through the city, and at length burned them. This bloody tragedy, which took place in the year 415, could tend only to inspire the heathens with a greater hatred to Christianity, and to make sensible Christians ashamed of the conduct of their brethren. To Cyrill however it occasioned no shame; on the contrary, he endeavoured to divert the emperor from punishing those who had been guilty of so gross a violation of the principles of justice, and in this he was assisted by his numerous adherents and friends. In some circumstances of this relation, historians are not agreed, but they all concur in bestowing praise on Hypatia, whose memory was honoured and preserved by her grateful and affectionate scholars.*

Among these was Synesius, of a noble pagan family, who cultivated philosophy and the mathematics with the utmost ardour, and who had been one of her most intimate friends and followers. On account of his learning, talents, and open disposition, he was universally esteemed, and he had been employed with great success on public occasions of importance. The church at Ptolemais at length wished to have him for their bishop. After much reluctance he accepted the office, but on condition that they should not require him to ac-

* A fuller account of Hypatia may be found in *Ægid. Menagii Histor. mulier. philosophic.* Lugduni 1690, 8vo. p. 52: *Bruckeri Hist. critica philosoph.* ii. p. 351; and *J. G. Wolfii Fragmenta mulierum Græcarum*, Gottingæ 1739, 4to. p. 368.

knowledge the resurrection of the dead, which he doubted. The people having consented to allow him this indulgence, he suffered himself to be baptised, and became their bishop. He was confirmed by the orthodox patriarch Theophilus, the predecessor of Cyrill, to whose jurisdiction Ptolemais belonged; and he afterwards renounced his errors, and declared himself convinced of the truth of the resurrection. This learned man showed his gratitude to Hypatia, by the honourable mention which he made of her in some letters that are still preserved among his writings.*

In his fifteenth letter, he tells Hypatia that he was so unfortunate, or found himself so ill, that he wished to use a *hydroscopium*, and he requests that she would cause one to be constructed for him. "It is a cylindrical tube," adds he, "of the size of a reed or pipe. A line is drawn upon it lengthwise, which is intersected by others, and these point out the weight of water. At the end of the tube is a cone, the base of which is joined to that of the tube, so that they have both only one base. This part of the instrument is called *baryllion*. If it be placed in water, it remains in a perpendicular direction, so that one can discover by it the weight of the fluid."†

* Respecting Synesius see *Bruckeri Hist. philos.* iii. p. 511; and *Fabricii Biblioth. Græca*, viii. p. 219, 221. He died in the year 431.

† That my learned readers may judge for themselves, I think it necessary to transcribe the whole letter, though it may be found entire,

Petau, who published the works of Synesius in the year 1640, acknowledges in his annotations, that this passage he did not understand. An old scholiast, he says, who had added some illegible words, seemed to think that it referred to a water-clock; but this he considers improbable, as a clepsydra was not immersed in water, but filled with it. He conjectures therefore, that it may allude to such an instrument as that called by Vitruvius *chorobates*. The latter however was employed for levelling; and it appears that Synesius, who complains of the bad state of his health, could not think of levelling. Besides, no part of the description in Vitruvius agrees with that which is given in so clear a manner by Synesius.

Petau published his edition of the works of this philosopher in the time of Peter de Fermat, *con-*

with Petau's annotations, in Wolf's *Fragmenta mulier. Græcarum.* Ουτω πανυ πεπραγα πονηρως, ὡστε ὑδροσκοπιου μοι δει. επιταξον αυτο χαλκευθηναι τε και συνωσθηναι. Σωλην εστι κυλινδρικος, αυλου και σχημα και μεγεθος εχων. ουτος επι τινος ευθειας δεχεται τας κατατομας, ἁις των ὑδατων την ροπην εξεταξομεν. Επιπωματιζει γαρ αυτον εν θατερου κωνος κατα θεσιν ισην εγκειμενος ωστ' ειναι κοινην βασιν αμφοιν του κωνου τε και του σωληνος. Αυτο δη τουτο εστι το Βαρυλλιον. Οταν ουν εις ὑδωρ καθης τον αυλον, ορθος εστηξει και παρεξει σοι τας κατατομας αριθμειν. αι δε της ροπης εισι γνωρισματα. Eo sum infortunii redactus, ut hydroscopio opus habeam; jube mihi fabricari ac coemi. Tubulus est cylindri figuram habens, tibiæ magnitudine forma. Hic in una recta linea incisiones habet, quibus aquarum libramentum cognoscimus. Obturat enim illum altera ex parte conus, æquabili positu insertus, ita ut communis sit amborum basis, coni videlicet atque tubuli. Hoc ipsum est, quod Baryllium appellant. Jam cum tubulum in aquam deposueris, erectus subit, ut in eo incisiones facile numerare possis, ex quibus libramentum cognoscitur.

seiller au parlement de Toulouse, a man of great learning, who was an excellent mathematician, and well acquainted with antiquities and the works of the ancients. We have by the latter a commentary upon some obscure passages of Athenæus, annotations on the writings of Theon of Smyrna, and emendations from a manuscript to the *Stratagemata* of Polyænus, which may be found also in his Miscellanies.* Mursinna, in his edition of the same author, has added them to the end of the preface. As Fermat was often consulted respecting difficult passages of the ancients, he could not be unacquainted with that in the new edition of Synesius. He drew up an explanation of it, and gave it to a friend who was then about to publish a French translation of Bened. Castelli's book *Della misura dell' acque correnti*, and who caused it to be printed along with that work. Fermat died in the year 1665, which I remark because it has not been mentioned in the Dictionary of learned men.† After his death his son published some of his writings under the title of *Varia opera mathematica*;‡ and in this collection is in-

* Opera varia, p. 205.

† I know the year from his *Eloge* in the *Journal des Sçavans*, 1665, Fevr. to which the son prefixed a list of his father's works which he published.

‡ Varia opera mathematica D. Petri de Fermat, senatoris Tolosani. Accesserunt quædam ejusdem epistolæ. Tolosæ 1679, 210 pages folio.

serted his short treatise on the *hydroscopium*,* from which I have extracted the following explanation.

It is impossible, says he, that the *hydroscopium* could be the level or *chorobates* of Vitruvius, for the lines on the latter were perpendicular to the horizon, whereas the lines on the former were parallel to it. The *hydroscopium* was undoubtedly a hydrometer of the simplest construction. The tube may be made of copper, and open at the top; but at the other end, which, when used, is the lowest, it must terminate with a cone, the base of which is soldered to that of the tube. Lengthwise, along the tube, are drawn two lines, which are intersected by others, and the more numerous these divisions are, the instrument will be so much more correct. When placed in water, it sinks to a certain depth, which will be marked by the cross lines, and which will be greater in proportion to the lightness of the water.† A figure, which is added,‡ illustrates this explanation more than was necessary. When a common friend of Fermat and Petau showed it to the latter, he considered it to be so

* It was made known by an extract also in the *Journal des Sçavans*, 1679, Jan.

† Fermat here remarks, that ῥοπη, which the editor wished to change, ought to be retained, but that it should not be translated by *libramentum* but *momèntum*. In a mechanical sense it signifies the weight; and on this account the books of Archimedes de *æquiponderantibus* are called ισορροπικων.

‡ This may be found also in the *Journal des Sçavans*.

just that he wished to have an opportunity of introducing it in a new edition.

Mersenne, on the other hand, entertains some doubt* respecting this instrument, though he does not mention Fermat, with whom he was well acquainted; for in the dispute which the latter had with Descartes, Mersenne was the bearer of the letters that passed between them, as we learn from the Life of Descartes, by Baillet.† His objections however are of little weight. Why should Synesius, asks Mersenne, consider himself unfortunate, because he had not a hydrometer?—It may be here replied, that he was in an infirm state, and that the physicians seem to have ordered him to drink no water but what was pure and light. We know that in former times, when so many artificial liquors were not in use, people were accustomed, more than at present, to good water. We read in the works of the ancient physicians, such as Galen and Celsus,‡ directions how to examine the lightness and purity of water. He might have tried it, says Mersenne, with a common balance. He indeed might, but not so conveniently. That Synesius was in a bad state of health is apparent from several of his letters; otherwise one might say that in a

* In cogitata physico-mathematica. Paris 1644, 4to. and in *Phænomena hydraulica*, p. 209.

† La vie de M. Des Cartes. Reduit en abregé. Paris 1693, 8vo. p. 112.

‡ Lib. ii. cap. 18. p. 100.

letter many expressions may be only jocular, respecting some circumstance known to the friend to whom one writes; and that every expression is not to be taken according to its literal meaning. One might confess also, without weakening a received explanation, that one does not know to what Synesius alludes in the first line of his letter. But even if we allow that the instrument was not a hydrometer, but a water-clock, or a level; it may be asked how the want of these could make him unfortunate. Mersenne thinks farther, that the cone, added to the end of the tube, would have been unnecessary in an hydrometer; but it serves to keep the instrument with more ease in a perpendicular direction in the water.* Such is the opinion of H. Klugel, whom I shall soon have occasion to quote.

For the explanation of Fermat one may produce a still stronger testimony, with which he seems not to have been acquainted. It can be proved that this instrument was used in the next or at least in the sixth century. Of that period we have a Latin poem on weights and measures, which contains a very just description of an hydrometer. The author, in manuscripts, is called

* As I do not know whether I understand this objection perfectly, I shall here add his own words: Non video, cur baryllii superficiem superiorem cono voluerit obturari, cum basis cylindri superior ex eadem ac cylindrus ipse materia sufficiat, nisi forsan in coni vertice pinnula quædam ad aquæ libramentum addita fuerit.

sometimes *Priscianus*, and sometimes *Rhemnius Fannius Palæmon;* but we know, from grounds which do not belong to this subject, that the former was his real name. Two persons of that name are known at present. The one, Theodore Priscian,* was a physician, and lived in the time of the emperor Valentinian, towards the end of the fourth century. As more physicians have written on weights and measures, with which it is indispensably necessary they should be acquainted, one might conjecture that this Priscian was the author of the above poem. The rest of his writings, however, still preserved, are in so coarse and heavy a style, that one can scarcely ascribe to him a work which is far from being ill written; especially as it is no where said that he was a poet. With much more probability may we consider as the author the well-known grammarian Priscian, who died about the year 528.

This poem has been often printed, and not unfrequently at the end of *Q. Sereni Samonici De medicina præcepta.* The best edition is that inserted by Wernsdorf in the fifth part of the first volume of his *Poetæ minores,*† where an account may be found of the other editions.

Be the author who he may, this much is evident, that he was acquainted with the hydrometer of

* Haller, Biblioth. botan. i. p. 151.

† Page 238 and p. 248.

Synesius, and has described it in a very clear manner.*

" Fluids" says he, " are different in weight, as may be proved by the specific gravity of oil and

* I shall here insert the whole passage:

Illud præterea tecum cohibere memento,
Finitum pondus varios servare liquores.
Nam libræ, ut memorant, bessem sextarius addet,
Seu puros pendas latices, seu dona Lyæi.
Addunt semissem libræ labentis olivi,
Selibramque ferunt mellis superesse bilibri.
Hæc tamen assensu facili sunt credita nobis;
Namque nec errantes undis labentibus amnes,
Nec mersi puteis latices, aut fonte perenni
Manantes, par pondus habent: non denique vina,
Quæ campi aut colles nuperve aut ante tulere;
Quod tibi mechanica promptum est deprendere Musa.
Ducitur argenti, tenuive ex ære, cylindrus
Quantum inter nodos fragilis producit arundo,
Cui cono interius modico pars ima gravatur,
Ne totus sedeat, totusve supernatet undis;
Lineaque a summo tenuis descendit ad ima,
Ducta superficie: tot quæque in frusta secatur,
Quot scriplis gravis est argenti ærisve cylindrus.
Hoc cujusque potes pondus spectare liquoris;
Nam si tenuis erit, majori mergitur unda;
Sin gravior, plures modulos superesse notabis.
Aut si tantundem laticis sumatur utrimque,
Pondere præstabit gravior; si pondera secum
Conveniunt, tunc major erit, quæ tenuior unda est.
Quod si ter septem numeros texisse cylindri
Hos videas latices, illos cepisse ter octo,
His drachma gravius fatearis pondus inesse;
Sed refert æqui tantum conferre liquoris,
Ut gravior superet drachma, quantum expulit undæ
Illius aut hujus, teretis pars mersa cylindri.

Wernsdorf, p. 510.

honey compared with that of pure water;" and the given proportion agrees almost with that found by modern experiments. "This," adds he, "may be discovered by an instrument," which he thus describes: "It consists of a thin metallic cylinder made of silver or copper, about as large as the joint of a reed between two knots, to the end of which is added a cone. This cone makes the lower end so heavy, that the instrument, without sinking or floating on the surface, remains suspended perpendicularly in the water. Lengthwise, upon the cylinder, is drawn a line, which is divided by cross lines into as many parts as are equal to the weight of the instrument in *scripla*. If placed in light fluids, more of the divisions will be covered than when put into heavy fluids; or it sinks deeper into those which are light than into those which are heavy. This difference of gravity may be found also," continues he, "by filling vessels of equal size with the fluids and weighing them; for the heavier must then weigh most; but when one takes an equal weight of two fluids, the lighter will occupy more space than the heavier. If twenty-one divisions of the instrument are covered in water, and twenty-four in oil, and if one take twenty-four *scripla* of water, twenty-one *scripla* of oil only can be contained in the space occupied by the water." Such is the manner in which professor Klugel has conjectured the meaning of the author from hydrostatical principles; though nei-

ther he nor Wernsdorf has ventured to give a literal translation of the words which ought to convey this explanation. But, however obscure they may be, it evidently appears that they allude to a hydrometer.

This poem was once published together with *Celsus De re medica*, in 1566,* by Robert Constantin, who died, at an advanced age, in 1605, and who added a few, but excellent, notes, which have been inserted by Wernsdorf in his edition. This Constantin seems to have known that the instrument of Priscian and the *hydroscopium* of Synesius were the same; and that they were used for determining the weight of fluids. He explains the use of them very properly; but is mistaken in supposing the cone to have been of wood, though it served to render the lower part of the instrument heavier, as the poet himself says: *cui cono interius modico pars ima gravatur.* I am almost induced to think that *interius* implies that additional weight was given to the cone by throwing some small heavy bodies into it, through the opening above; and at present grains of leaden shot are employed for that purpose. It appears therefore that the honour of having first given a good explanation of the before-quoted passage of Synesius belongs rather to Constantin than to Fermat; but I can readily believe that the latter was not ac-

* Lugduni, 1566. 8vo.

quainted with the observations made on it by the former.* Before I conclude the history of this instrument among the ancients, I shall add two remarks further. It is evidently wrong when one, with Muschenbroek and others, whose opinion I adopted before I engaged in this research,† considers Hypatia as the inventress of the hydrometer. It was known at her time, and was made at Alexandria; but it seems not to have been very common, as Synesius wrote to Hypatia to procure him

* Constantin refers to the word βαρυλλιον in his Dictionary, and, as I expected to find there further elucidation, I consulted it. The first edition of his Greek Dictionary was, as Conr. Gesner says, printed at Geneva in 1562. This I could not procure, but the other, enlarged by Francis Portus and others, Geneva 1592, I have now before me. The word βαρυλλιον, to which the author refers, I cannot meet with, and the explanation given under ὑδροσκοπιον, which is entirely different from that of the editor of Priscian, is as follows: *clepsydræ genus qua horæ discernuntur, descriptum a Synesio.* I suspect therefore that Constantin in 1566 was first led to a right comprehension of Synesius by the account of Priscian; and that he referred to his Dictionary, printed four years before, without examining whether the word had been there introduced. That reference is consequently of no use. In the well-known Dictionary of Basle, however, printed in 1572 and 1577, in which that of Constantin and other dictionaries are inserted entire, I find the word βαρυλλιον, hydroscopii pars apud Synesium, and under ὑδροσκοπιον the explanation before mentioned. Besides these two editions, I am acquainted with one of 1558 and another of 1565. All the four are *ex officina Henricpetrina;* but in the last two the word βαρυλλιον does not occur. I have remarked this occasionally respecting a dictionary printed so often in the course of a few years. See *Morhofii Polyhist.* tom. i. p. 808.

† In the fourth edition of my Technology, just published, p. 174. § 15, 1.

one, and even thought it necessary to give her a description of it.

Those are mistaken likewise, who say that this instrument was called also *baryllium*. That word, as far as I have been able to learn, occurs only in Synesius, who expessly tells us that the small heavy cone alone was meant by it. In the same manner has it been understood by Constantin. In the Dictionary of Basle it is said to be *hydroscopii pars;* and in Stephen's Dictionary it is explained by *ponducsulum*, as well as in that of Ernest, where it is given as the diminutive of *baros*. It signified therefore the heavy part of the hydrometer only.

It is equally erroneous when one says, with Muschenbroek and others, that those who among the Romans made it their employment to examine the quality of water with the hydrometer, were called *baryllistæ* or *barynilæ*. These words do not occur in the works of the ancient Latin authors, nor in any of the completest dictionaries. We read only the following passage in some editions of the Commentary of Servius upon Virgil: *Scrutatores et repertores aquarum (aquilices dicuntur) barinulas diverunt.** If these words were really

* On Georg. I. 109. These words are quoted by Emmenessius and Ægid. Menage in *Juris civilis amœnitat*. Francof. et Lips. 1680. 8vo. p. 412: but in the edition of Servius, Venetiis 1562, fol. p. 51. a. which I have in my possession, they are not to be found. The Commentary of Servius may, at present, be no further necessary for explaining Virgil; but it deserves to be printed once more as

written by Servius, who lived in the fifth century, he either confounded the water-searchers, *aquilices*, those who sought for springs, with those who examined the nature of water when found, as the hydrometer was of no service to the former in their business, or both employments must at that time have been followed by the same people, and these must have acquired their name from a part only of one instrument they used, which is not at all probable.

I think we may with certainty believe that the hydrometer was not known to Seneca, Pliny, or Galen, who died about the end of the second century. Were not this the case, it would certainly have been mentioned by the first, where he speaks so minutely of the specific gravity of hard and fluid bodies;* by the second, where he says that the weight of water was ascertained by a common balance;† and by the last, where he gives directions how to discover its lightness. Galen adds, that in his time, a method had been invented of determining the quality of salt-lye by placing an egg in it, and observing whether it floated.‡ Have

completely and accurately as possible. It contains much useful information, as well as many fragments of works now lost; and on this account cannot well be entirely dispensed with.

* Quæst. nat. iii. 25. p. 726.

† Hist. nat. xxxi. 3. sect. 23. p. 552: Quidam statera judicant de salubritate, frustrante diligentia, quando perrarum est, ut levior sit aliqua. *Athen.* ii. p. 46. *Plutarchi Quæst. nat.* 7.

‡ De simplic. med. facultatibus, iv. 20. p. 61. ed. Gesneri.

we not reason to think that, on this occasion, the hydrometer must have occurred to him had it been then used?

But however well known it may have been in the fifth century, it seems that it was afterwards entirely forgotten, and that, towards the end of the sixteenth, it was again, for the first time, revived or invented anew. To George Agricola it was scarcely known; for where he speaks of the weight of different kinds of water, and particularly of that of salt springs,* he does not mention it. Constantin, however, who lived at the same time, must have been acquainted with it, else he could not have explained the before-mentioned passages of Synesius and Priscian.

I am inclined to think that the first account of the hydrometer being again brought into use, must be found in the oldest German books on salt-works. It is, at any rate, certain that from these the modern philosophers became first acquainted with it. One of the earliest who has described it is the Jesuit Cabeus, who wrote about the year

Quin et modum jam invenerunt, moderatam ad saliendum conficiendi salsuginem, si ovum in ea videatur natare. Nam ubi etiamnum sidit, ac nondum super salsuginis superficiem innatat, aquosa magis est et dulcis; graviter vero salsa, ubi tanta est salis copia indita, ut amplius liquari qui postea adjicitur nequeat. Αλλα και μετζον ηδη τι πεποιηνται του την ακμην ευκρατον ὑπαρχειν εις τας ταριχειας, ει φαινοιτο κατ' αυτην επιπλεον ωον. This passage occurs in the Greek edition of Basle, part ii. p. 52. 49.

* De natura eorum quæ effluunt ex terra, lib. ii. p. 124.

1644;* but he confesses that he acquired his information from a German treatise by Tholden, whom Kircher † calls a German artist. He was, however, not properly an artist. He was a native of Hesse; a good chemist for his time; and resided about the year 1600 or 1614 as overseer of the salt-works at Frankenhausen in Thuringia. His treatise, which Cabeus had in his possession, was entitled *Tholden's Haligraphia*, printed at Leipsic in 1603. Another edition, printed at the same place in 1613, is mentioned by Draudius; but at present I have not been able to find it; and can say only from Cabeus and Leupold, that Tholden's hydrometer had a weight suspended to it; and that he speaks of the instrument not as a new but a well-known invention, and on that account has described it only imperfectly.

Kircher, whose works were generally read, seems to have principally contributed towards making it publicly known; and Schott, ‡ Sturm § and others, in their account of it, refer to his writings.

* Philosophia experimentalis, sive Commentaria in Aristotelis Meteorolog. lib. ii. textus 26. quæst. 2, tom. ii. p. 158, b. Inveni hoc instrumentum positum a quodam Jo. Tholden, in libello Germanice scripto de sale; sed aut auctor ille non intellexit causam et formam instrumenti, aut certe occultare voluit, non vulgare, nec publicum facere.

† Mundus subterraneus, vol. i. p. 254; and also *Physiologia Kircheriana*, Amstelod. 1680. fol. tom. i. p. 29.

‡ Cursus mathemat. p. 455. icon. 20. f. 469.

§ Collegii experimentalis pars secunda. Norimbergæ 1715. 4to. p. 58.

The artists at Nuremberg, who worked in glass, and who constructed a great many hydrometers which were every where sold, assisted in this likewise. One, above all, made by Michael Sigismund Hack, was highly valued about the beginning of the last century, as we are told by J. Henry Muller,* professor at Altorf. Of this artist, often mentioned by Sturm and other philosophers, an account has been given by Doppelmayr.† He died in 1724.

Many improvements, or perhaps only alterations, have been made in this instrument in latter times by a variety of artists. The task of collecting these completely, in chronological order, with explanations, I shall leave to others; and only mention a few of them. One of the first who endeavoured to adapt the hydrometer for determining the specific gravity and purity of metals was Monconys.‡ Almost about the same period Cornelius Meyer and Mr. Boyle seem to have conceived the idea of facilitating the weighing of solid bodies by a weighing-scale added to the instrument. The former affirms that this improvement was invented by him so early as the year

* Dissertat. de hydrometro. Altorfi 1723, 4to. p. 9.

† Page 275.

‡ In the third part, p. 3. of the letters printed with his Travels, which addition seems to have been made in the year 1664. I quote the edition printed at Lyons 1665 and 1666 three volumes in quarto, *Journal des voyages de Monconys.*

1668;* whereas Boyle did not make his known till 1675.† Besides these the following also are worthy of notice: Feuille,‡ Fahrenheit, Clarke,§ and Leutmann,‖ whose improvements have been described by Wolf,¶ Leupold,** Gesner,†† Weigel,‡‡ and others.

LIGHTING OF STREETS.

THE lighting of streets while it greatly contributes to ornament our principal cities, adds considerably also to the convenience and security of the inhabitants. But, of whatever benefit it may be,

* Nuovi ritrovamenti divisi in due parte. Roma 1696, fol. I shall take this opportunity of observing that a good account of Meyer and of his works, which are scarce, may be found in *Scheibels Mathematische bücherkunde*, ii. p. 443.

† Hydrostatica medica, and in the Philosoph. transact. 1675. No. cxv. p. 329, where an engraving is given of all the parts, p. 340.

‡ Journal des observations physiques et mathematiques. Paris 1714, 4to. i p. 16.

§ Philosoph. transact. No. ccclxxxiv. p. 140; and Numb. ccccxiii. p. 277.

‖ Commentarii Acad. Petropolit. v. p. 274.

¶ In his Versuchen. Halle 1737, 8vo. i. p. 556.

** Pars ii. Theatri statici universalis, sive Theatrum hydrostaticum.

†† In his Dissertation mentioned in the first note to this article.

‡‡ C. E. Weigel, Programma de historiæ barylliorum rudimentis. Gryphiæ 1785, 4to.

it is generally considered as a modern invention. Mr. St. Evremond says, "The invention of lighting the streets of Paris, during the night, by a multitude of lamps, deserves that the most distant nations should go to see what neither the Greeks nor the Romans ever thought of for the police of their republics." This opinion appears to be well founded; for I have never yet met with any information which proves that the streets of Rome were lighted. Some passages, indeed, in ancient authors rather indicate the contrary; and, according to my ideas, the Romans would not have considered the use of flambeaux and lanterns so necessary, on their return from their nocturnal visits, as they seem to have done, had their streets been lighted; though I will allow that the public lighting of the streets, in our cities, does not render links or lanterns altogether superfluous. Whoever walked the streets of Rome, at night, without a lantern, was under the necessity of creeping home in perfect darkness, and in great danger,* like Alexis in Athenæus. Meursius endeavours to make it appear that the streets of Rome were lighted; and in support of this opinion quotes Ammianus Marcellinus, and the Life of Julius Cæsar in Suetonius; but his argu-

* Non multum edens, bibensque multum, protinus
Discedo, lucernam puer nec fert mihi;
Serpo cadens persæpe per nigras tenebras.
Athen. Deipn. vi. 8. p. 236.

ments to me are far from being convincing.* That Naples was not lighted, appears from the return of Gito in the night-time, mentioned by Petronius.† Some circumstances, however, related by ancient authors make it probable that Antioch, Rome and a few other cities had public lanterns, if not in all the streets, at least in those which were most frequented.

Libanius, who lived in the beginning of the fourth century, says in his Panegyric,‡ where he

* Joh. Meursii Opera, ex recensione Joannis Lami. Florentiæ 1745. fol. v. p. 634.—The passages on which Meursius founds this idea are as follow: Adhibitis paucis clam ferro succinctis, vesperi per tabernas palabatur et compita, quæritando Græco sermone, cujus erat impendio gnarus, quid de Cæsare quisque sentiret; et confidenter agebat in urbe, ubi pernoctantium luminum claritudo dierum solet imitari fulgorem. *Ammian. Marcell.* edit. Gronov. Leyden 1693, fol. p. 5. Dein post solis occasum, mulis e proximo pistrino ad vehiculum junctis, occultissimum iter modico comitatu ingressus est; et cum luminibus extinctis decesisset via, diu errabundus tandem ad lucem duce reperto per angustissimos tramites pedibus evasit. *Suet. in Vit. Jul. Cæs.* cap. xxxi.

† Neque fax ulla in præsidio erat, quæ iter aperiret errantibus, nec silentium noctis jam mediæ promittebat occurrentium lumen. Accedebat huc ebrietas et imprudentia locorum, etiam interdiu obscura. Itaque cum hora pene tota per omnes scrupos gastrorumque eminentium fragmenta traxissemus cruentos pedes, tandem expliciti acumine Gitonis sumus. *Pet.* cap. lxxix. That the author here speaks of Naples I conclude from cap. lxxxi. where the city is called *Græca urbs*. Others, however, with less probability, are of opinion that *Capua* is meant.

‡ Solis porro facem aliæ faces excipiunt, quæ illam Ægyptiorum (in Minervæ Saiticæ festo) lucernarum accensionem longe superant. Hac una re tantum differt nox a die apud nos, nimirum specie lucis: quod ad opificia, certe, et structuras spectat, ex æquo procedit.

praises his native city Antioch, "the light of the sun is succeeded by other lights, which are far superior to the lamps lighted by the Egyptians on the festival of Minerva of Sais. The night with us differs from the day only in the appearance of the light: with regard to labour and employment every thing goes on well. Some work continually; but others laugh and amuse themselves with singing." I cannot allow myself to imagine that the sophist here considers it as a subject of praise to his native city, that the inhabitants, after sun-set, did not sit in darkness, but used lights to work by. It appears, therefore, that he alludes to the lighting of the streets.

In another passage, in the oration to Ellebichus,* the same author tells us, that the ropes from which the lamps that ornamented the city were suspended, had been cut by some riotous soldiers, not far from a bath. "Proceeding," says he, "to a bath, not far off, they cut with their swords the ropes from which were suspended

Quidam assidue et jugiter operantur manibus; alii vero molle rident et canticum laxantur. Και την ήλιου λαμπαδα λαμπτηρες έτεροι διαδεχονται την Αιγυπτιων λυχνοκαιαν παριοντες (so reads Gronovius instead of περιοντες), και διενηνοχεν ένι μονῳ παρ' ήμιν νυξ ήμερας, τῳ του φωτος ειδει. Libanii Opera, Lutetiæ apud Morellum 1627, fol. ii. p. 387.

* Ελθοντες επι το πλησιαζον βαλανειον, καλωα ων εξηρτηντο τα το φως εν νυκτι παρεχοντα μαχαιραις απεκοπτον, δεικνευντες ότι δει τον εν τῃ πολει κοσμον ταις αυτων βουλησεσι ύποχωρειν. Profecti ad vicinum balneum, funes a quibus appendebant ea quæ lumen noctu præbebant, gladiis resciderunt, quoniam oporteret ornatum qui in civitate est suis conciliabulis cedere. *In Ellebichum*, p. 526.

the lamps that afforded light in the night-time, to show that the ornaments of the city ought to give way to them." This quotation indicates, at any rate, that there were lamps suspended from ropes near the baths and places of greatest resort. The following passage of Jerome, however, seems to make it probable, or rather certain, that the streets of Antioch were lighted. In the altercation between a Luciferan and an Orthodox, he relates that an adherent of the schismatic Lucifer disputed, in the street, with a true believer, till the streets were lighted, when the listening crowd departed; and that they then spat in each other's face, and retired.*

In the elegant edition of the works of that father, by Dominicus Vallarsius, we have a short dissertation on the time when this unmannerly dispute took place; and the editor shows that it happened, at Antioch, in the year 378. †

Basilius the Great, in a letter to Martinianus, giving an account of the miserable situation of his native city Cæsarea, in Cappadocia, in the year 371, says they had nights without lights (*noctes non illustratas*).‡ Most commentators explain this

* Dum audientium circulum lumina jam in plateis accensa solverent, et inconditam disputationem nox interrumperet, consputa invicem facie recesserunt.

† See the works of Jerome, *studio et labore Dominici Vallarsii*, Veronæ 1735, fol. vol. ii. p. 170.

‡ Νυκτας αλαμπεις.

passage as if it meant that the lamps in the streets had not been lighted. *

That the streets not only of Antioch, but also of Edessa, in Syria, were lighted, in the fifth century, seems proved by a passage in the History of Jesue Stylites. It is there expressly said, that Eulogius, governor of Edessa, about the year 505, ordered lamps to be kept burning in the streets during the night; and that he employed, for that purpose, a part of the oil which was before given to the churches and monasteries. †

With regard to the public lighting of whole cities on festivals, and particularly on joyful oc-

* Valesius informs us, in his observations on Ammianus Marcellinus, that to denote public sorrow, on occasions of great misfortune, it was customary not to light the streets; and in proof of this assertion, he quotes a passage of Libanius, where it is said that the people of Antioch, in order to mitigate the anger of the emperor, bethought themselves of lighting either no lamps or a very small number. This passage of Libanius I cannot find; but the words of Basilius are in vol. iii. p. 169 of the excellent edition of that father published by the Benedictines at Paris, in 1730, in folio.

† Eulogius Edessæ præfectus, acceptis ab Anastasio libris auri bis centum, extima urbis propugnacula restaurat. Aquæ ductus præterea duos extruit. - - - - Collapsas quoque balneas et prætoris ædes ædificat; aliisque præterea ædificiis Edessam exornat. Petro etiam urbis episcopo libras auri viginti Anastasius mittit ad mæniorum instaurationem. Urbicius eunuchus decem libras auri adjecit ad excitandum B. Mariæ templum. Solebant Edessæ præfecti mensuras olei sex mille et octingentas templis et monasteriis distribuere. Eulogius vix ducentas singulis templis erogari jussit, reliquas ad publicum urbis usum recondi; instituitque, ut in porticibus noctu lampades arderent. *Assemani Bibliotheca orientalis.* Romæ 1719, fol. i. p. 281.

casions, which we call illuminations, that practice seems to be of great antiquity. Of this kind was a particular festival of the Egyptians,* during which lamps were placed before all the houses throughout the country, and kept burning the whole night.† During that festival of the Jews, called *festum encæniorum*, the feast of the Dedication of the Temple, which, according to common opinion, was celebrated in December, and continued eight days, a number of lamps were lighted before each of their houses.‡ A passage in Æschylus shows that such illuminations were used also in Greece. At Rome, the forum was lighted when games were exhibited in the night-time;§ and Caligula, on a like occasion, caused the whole city to be lighted.‖ As Cicero was returning home late at night, after Catiline's conspiracy had been defeated, lamps and torches were lighted in all the streets, in honour of that great orator.¶ The emperor Constantine caused the whole city of Constantinople to be illuminated with lamps and

* It was called by the Greeks λυχνοκαια.

† Herodot. lib. ii. cap. 62.

‡ Et accendere mos est in eis lumina tempore vespertino, ad ostium domorum. *Gemara Babylonica*, ad tit. *Sabbath.* c. ii. p. 21.

§ Romanis ludis forum olim ornatum lucernis. *Nonius*, p. 206.

‖ Scenicos ludos et assidue et varii generis multifariam fecit; quondam etiam et nocturnos accensis tota urbe luminibus. *Suet. Vita Calig.* c. 18.

¶ Plut. in Vita Ciceronis.

wax candles on Easter eve.* The fathers of the first century frequently inveigh against the Christians because, to please the heathens, they often illuminated their houses, on idolatrous festivals, in a more elegant manner than they. This they considered as a species of idolatry. † That the houses of the ancients were illuminated on birth-days, by suspending lamps from chains, is too well known to require any proof. ‡

* Sacram autem vigiliam in diurnum splendorem convertebat, accensis tota urbe cereorum quibusdam columnis per eos quibus id operis erat injunctum. Lampades quoque accensæ cuncta passim loca illustrabant, adeo ut hæc mystica vigilia quovis vel splendidissimo die splendidior redderetur. *Euseb. Pamphili Lib.* iv. *de vita Constantini*, cap. 22. Cant. 1720. fol. p. 637. Compare with the above *Greg. Nazianzeni Orat.* 19, and *Orat.* 2. p. 676, where the author alludes to the festival of Easter. I imagined that I should meet with some orders respecting illuminations in Constantine's book *De ceremoniis aulæ Byzantinæ*; but I was not so fortunate as to find any. Reiske says, in his Annotations, p. 93, a: De illuminationibus et ignibus artificialibus veterum annotavi quædam ad p. 351, ubi de hilariis triumphalibus egi; but these notes were unfortunately never printed.

† Plures jam invenies ethnicorum fores sine lucernis et laureis quam Christianorum. *Tertullian. de idololatria*, cap. xv. p. 523. See also his *Apologet.* cap. 35. p. 178. In both places La Cerda quotes similar passages from other writers. In *Concilio Eliberitano*, cap. 37, it was decreed *prohibendum etiam ne lucernas publice accendant*. See also *Joh. Ciampini Vetera monumenta, in quibus musiva opera illustrantur*. Romæ 1690. 2 vol. fol. i. p. 90. where, on a piece of mosaic work, said to be of the fifth century, some lamps are represented hanging over a door.

‡ *J. Lipsii Electa*, lib. ii. cap. 3, in the edition of his works, Antwerp 1637, 3 vol. fol. p. 234. *Kippingii Antiquit. Rom.* Lugd. Bat. 1713. 8vo. p. 189.

Of modern cities, Paris, as far as I have been able to learn, was the first that followed the example of the ancients by lighting its streets. As this city, in the beginning of the sixteenth century, was much infested with street robbers and incendiaries, the inhabitants were, from time to time, ordered to keep lights burning, after nine in the evening, before the windows of all the houses which fronted the street. This order was issued in the year 1524, and renewed in 1526 and 1553;* but in the month of October 1558, *fallots* were erected at the corners of the streets, or, when the street was so long that it could not be lighted by one, three were erected in three different parts of it. These lights had, in a certain measure, a resemblance to those used in some mines; for we are told, in the *Grand Vocabulaire, François,*† that *Falot* is a large vase filled with pitch, rosin, and other combustibles, employed in the king's palace and houses of princes to light the courts. At that period there were in Paris 912 streets; so that the number of lights then used must have been less than 2736.‡

In the month of November, the same year,

* This order may be seen in that large and elegant work, entitled, *Histoire de la Ville de Paris, composée par D. Michel Felibien, reveue, augmentée et mise à jour par D. Guy-Alexis Lobineau,* Paris 1725. Five large volumes in folio, with many plates. See vol. ii. pp. 951, 977, and vol. iv. pp. 648, 676, 764.

† Paris 1770. x. p. 265.

‡ Felibien, iv. p. 785.

these lights were changed for lanterns of the like kind as those used at present.* The lighting of the streets of Paris continued, however, for a long time to be very imperfect, till the abbé Laudati, an Italian of the Caraffa family, conceived the idea of letting out torches and lanterns for hire. In the month of March 1662, he obtained an exclusive privilege to this establishment for twenty years; and he undertook to erect, at certain places, not only in Paris, but also in other cities of the kingdom, booths or posts where any person might hire a link or lantern, or, on paying a certain sum, might be attended through the streets by a man bearing a light. He was authorised to receive from every one who hired a lantern to a coach, five sous, for a quarter of an hour; and from every foot-passenger three sous. To prevent all disputes in regard to time, it was ordered that a regulated hour-glass should be carried along with each lantern.†

In 1667, however, the lighting of the city of Paris was put on that footing on which it is at present. At the same time the police was greatly improved, and it afterwards served as a pattern to most of the other cities in Europe. Affairs of judicature and those respecting the public police,

* Felibien, iv. p. 786. The order says: que au lieu des fallots ardens seront mises lanternes ardentes et allumantes.---

† Felibien, v. p. 191. where the order may be seen in which *porte-lanternes* and *porte-flambeaux à louage* are mentioned.

instead of being committed, as before, to one magistrate, called the *Lieutenant civil du prevost de Paris*, were, by a royal edict of the month of March in the above year, divided between two persons. One of them, who had the management of judicial affairs, retained the old title; and the other, who superintended the police, had that of *Lieutenant du prevost de Paris pour la police*, or *Lieutenant général de police*. The first lieutenant of police was Nicholas de Reynie, a man who, according to the praises bestowed on him by French writers, formed an epoch in the history of modern police. In the History of Paris, so often already quoted, he is called an enlightened, upright, and vigilant magistrate, as zealous for the service of the king as for the good of the public, and who succeeded so well in this new office that we may say, adds the author, it is to him, more than to any other, that we are indebted for the good order which prevails at present in Paris. The first useful regulation by which La Reynie rendered a service to the police, was that for improving the (*guet*) night watch, and the lighting of the streets.* I can find no complete account of the changes he introduced; but four years after, that is, on the 23d of May, 1671,† an order was made that the lanterns every year should be lighted from the

* See Code de la Police, par M. D., troisieme edit. Paris 1761, 8vo. t. i. p. 228.

† Felibien, t. v. p. 213.

20th of October till the end of March in the year following, and even during moon-light; because the latter was of little use in bad weather, and even in fine weather was not sufficient to light some of the most dangerous streets.

Before this period the streets were lighted only during the four winter months; and on account of the numberless atrocities committed in the night-time, when there were no lights, the Parisians offered to contribute as much money as should be sufficient to defray the expense of keeping the lamps lighted throughout the whole winter. The lamps employed by La Reynie were, on account of their likeness to a bucket, called *lanternes à seau*,* and succeeded those invented by one Herault, called *lanternes à cul-de-lampe*.

When De Sartines held the office of *Lieutenant de police*, a premium was offered to whoever should discover the most advantageous means of improving the lighting of the streets; and the Academy of Sciences were to decide on the different plans that might be proposed. In consequence of this offer, a journeyman glazier, named Goujon, received a premium of 200 livres, and Messrs. Bailly, Le Roy, and Bourgeois de Chateaublanc 2000 livres. To the last-mentioned gentleman is ascribed the invention of the present re-

* Die kunst auf glas zu malen und glasarbeiten zu verfertigen; von Le Vieil. Aus dem Französ. übersetzt. Nürnberg 1780, 4to. iii. p. 77.

verberating lamps, described by La Vieil, which were introduced in 1766.*

In a small work, called an Essay on Lanterns, by a society of literary men,† which, though written to ridicule antiquarian researches, and certain persons at Paris, contains some authentic information respecting the lighting of the streets, we are told that reverberating lamps were invented by an abbé P. who, therefore, says the author humorously, is the second abbé who can boast of having enlightened the first city in the world. The superiority of these lamps cannot be denied; but, besides their expense, they are attended with this disadvantage when they hang in the middle of the street, that they throw a shade over it, so that one cannot be known by those who pass. In cities also where people walk principally in the middle of the streets, or where the streets are broad, they are not very convenient, and they occasion a stoppage when it is necessary to clean them.

In the year 1721, the lamps in Paris are said to have amounted to 5772; but in the *Tableau de Paris*, printed in 1760, the number is reckoned to be only 5694, and in the *Curiosités de Paris*, 1771, they are stated to be 6232.

In 1777 the road between Paris and Versailles,

* Dictionnaire des origines, vi. p. 34.

† Essai sur les Lanternes, par une societé de gens de lettres. A Dole 1755, 12mo.

which is about nine miles in length, was lighted at the yearly expense of 15000 livres by the same contractors who lighted Paris. The city of Nantes was lighted the same year; and in 1780 had 500 lamps. Strasburgh began to be lighted in 1779.

If what Maitland says in his history* be true, that in the year 1414 an order was issued for hanging out lanterns to light the streets, and if that regulation was continued after the above period, which I very much doubt, then must it be allowed that London preceded Paris in this useful establishment. Maitland refers for his authority to Stow's Survey of London; but in the edition of that work published in 1633, I find only, where a list of the magistrates is given, the following information: "1417 Major, Sir Henry Barton, skinner. This Henry Barton ordained lanthorns with lights, to be hanged out on the winter evenings, betwixt Hallontide and Candlemasse." Nothing more occurs in the new edition of Strype, published in 1720.

In the year 1668, when several regulations were made for improving the streets, the Londoners were reminded that they should hang out lanterns duly at the accustomed time.† In the year 1690 this order was renewed, and every housekeeper

* History of London. London 1756, 2 vol. fol. i. p. 186.

† New History of London, by John Noorthouck. Lond. 1773, 4to. p. 233: For the safety and peace of the city, all inhabitants were ordered to hang out candles duly at the accustomed hour.

was required to hang out a light or lamp, every night, as soon as it was dark, between Michaelmas and Lady-day; and to keep it burning till the hour of twelve at night. In the year 1716 it was ordained by an act of common council, that all house-keepers, whose houses fronted any street, lane, or public passage, should, in every dark night, that is, every night between the second night after every full moon till the seventh night after every new moon, set or hang out one or more lights, with sufficient cotton wicks that should continue to burn from six o'clock at night till eleven o'clock of the same night, under the penalty of one shilling. All these regulations, however, seem to have been ineffectual, owing to bad management. The city was lighted by contract, and the contractors for liberty to light it were obliged to pay annually to the city the sum of six hundred pounds. Besides, the contractors received only six shillings per annum from every house-keeper whose rent exceeded ten pounds; and all persons who hung out a lantern and candle before their houses were exempted from paying towards the public lamps. The streets were lighted no more than one hundred and seventeen nights; and as this gave great opportunity to thieves and robbers to commit depredations in the night-time, the lord mayor and common council judged it proper, in the year 1736, to apply to parliament for power to enable them to light the streets of the city in a

better manner; and an act was accordingly passed, by which they were empowered to erect a sufficient number of such sort of glass lamps as they should judge proper, and to keep them burning from the setting to the rising of the sun throughout the year.* Instead, therefore, of a thousand lamps, the number was now increased to 4679; but as these even were not sufficient, several of the wards made a considerable augmentation, so that the whole could amount to no less than 5000. This, however, was not the amount of all the lamps in London, but of those in what is properly called the city and liberties. As this division forms only a fifth part of London, Maitland reckons the whole number of public and private lamps to have been, even at that period, upwards of fifteen thousand. The time of lighting also, which before had been only 750 hours annually, was increased to five thousand. In our cities of Lower Saxony, the streets of which are not so dark as those of London, the lighting continues 1519 hours.

In the year 1744, owing to the great number of robberies committed in the streets during the night, it was found necessary to apply for another act of parliament to regulate still farther the lighting of the city;† and at that period this establishment was placed upon that footing on which it now stands.

* Maitland, i. p. 566.

† Ibid. i. p. 640.

The lamps of London, at present, are all of crystal glass; each is furnished with three wicks; and they are affixed to posts placed at the distance of a certain number of paces from each other. They are lighted every day in the year at sun-set. Oxford-street alone is said to contain more lamps than all Paris. The roads, even, seven or eight miles round London are lighted by such lamps; and as these roads from the city to different parts are very numerous, the lamps seen from a little distance, particularly in the county of Surrey, where a great many roads cross each other, have a beautiful and noble effect.* Birmingham was lighted, for the first time, in 1733, with 700 lamps.†

It appears that the streets of Amsterdam were lighted by lanterns so early as 1669; for in the month of February that year, the magistrates, who in 1665 had forbidden the use of torches, issued an order against destroying the lamp-posts, to which it was customary to fasten horses.‡ This order, as well as the instructions given to the lamp-lighters in 1669, may be found in a work called the Privi-

* The above account is taken from Mr. Archenholz (*England und Italien.* Leipzig 1785, 8vo. i. p. 141); but the information of this author, on account of his partiality for England, is very doubtful. Compare *Nouvelles observations sur l'Angleterre, par un voyageur;* Paris 1779: though the author of this work also is not considered as altogether free from the same fault.

† Hutton's History of Birmingham, 1781, 8vo. p. 99.

‡ Handvesten of te privilegien end octroyen de Stad Amstelredam. Te Amstelredam 1748, fol. ii. p. 1047.

leges of the city of Amsterdam. The lanterns were not of glass, but of horn; for the lamplighters were ordered, in their instructions, to wipe off every day the smoke of the train-oil which adhered to the horn of the lanterns.

At the Hague an order was issued in the month of October 1552, that the inhabitants should place lights before their doors during dark nights; and afterwards small stone buildings were erected at the corners of the principal streets, in which lights were kept burning; but in the year 1678 lamps were fixed up in all the streets.*

The streets of Copenhagen were first lighted by lamps in 1681; and on the 16th of July 1683, new regulations were made, by which the plan was much improved, as well as that of the night-watch.†

The streets of Rome are not yet lighted. Sixtus V was desirous to introduce this improvement in the police, but he met with insurmountable obstacles. In order however that the benefit of lighting might be enjoyed in some measure, he ordered the number of the lights placed before the images of saints to be augmented.‡ De la Lande says, in his Travels, that Venice had been lighted for some

* Beschryving van s'Graven-Hage; door Jacob de Riemer. In s'Graven-Hage 1739, fol. ii. p. 265.

† Mr. Gebhardi in Algemeine welthistorie, xxxiii. p. 596.

‡ Lettres écrites de Suisse, d'Italie, de Sicile, et de Malthe; en 1776—78.

years before that period when he wrote, by 3000 lamps.* Messina,† and Palermo,‡ in Sicily, are both lighted.

Madrid, which till lately was the dirtiest of all the capital cities of Europe, is at present as well lighted as London.§ Valencia in Spain was some years ago indebted for this improvement to Joachim Manuel Fos, then inspector of the manufactories.‖ Barcelona is lighted also.¶ Lisbon however has no lights.

The streets of Philadelphia are lighted, and on each side there is a foot-pavement.**

In the year 1672, the council of Hamburgh made a proposal to the citizens for lighting the streets. The year following this proposal was accepted, but the lamps were not fixed up till two years after, that is to say in 1675.††

* Voyage d'un François par Italie, tom. viii. p. 187.

† Lettere del signor abate Domenico Sestini, scritte dalla Sicilia e dalla Turchia. In Firenze. Four vol. 12mo. vol. i. 216.

‡ Riedesels Reise durch Sicilien und Griechenland. Zurich 1771, 8vo.

§ See Twiss and Dalrymple's Travels.

‖ Ueber Sitten, temperament, alterthümer und die gerichtshöfe Spaniens. Aus dem Französischen. Leipz. 1781, 2 vol. 8vo. i. p. 86.

¶ Travels through Spain, by Henry Swinburne. London 1779, 4to.

** Burnaby's Travels through North America.

†† Von Griesheims Anmerkungen über den tractat, die Stadt Hamburg, p. 223. *Nucleus recessuum et conventuum Hamburgensium*; Altona 1705, fol. art. *Lighting*. *Sammlung der Hamburgischen mandate, befehle u. s. w.* vol. i. p. 321, and ii. p. 584; where

In the year 1679, Berlin had advanced so far towards this improvement, that the inhabitants were obliged in turns to hang out a lantern with a light at every third house. In 1682, the elector Frederick William caused lamp-posts with lamps to be erected, notwithstanding the opposition made by the inhabitants on account of the expense. In a petition which they presented in 1680, they stated that the lamps cost 5000 dollars, and that 3000 were required yearly to keep them lighted. At present Berlin has 2354 lamps, which are kept lighted from September till May, and at the king's expense. Potsdam has 590.*

Vienna began to be lighted in the year 1687. The lights were hung out in the evening on a signal given by the fire-bell.† In 1704, lamps were introduced; but at first the light which they afforded was very imperfect, as the lamps burned badly, and because, to save the expense of lamp-lighters, every housekeeper was obliged daily to remove the empty lamps, to carry them to the lamp-office to be filled, and to light them again on a signal given with a bell. In 1776, the lamps, which before amounted to 2000, were increased to 3000, and a contract was entered into for lighting them at the

may be found the rigid instructions given to the lamp-lighters and those who had the care of the lamps.

* Nicolai Beschreibung von Berlin und Potsdam, p. 308, 971.

† Codex Austriacus. Vienna 1704, fol. p. 514; and Supplement, i. p. 993.

rate of 30,000 florins. These lamps were invented by counsellor Sonnenfels, and amount now to 3445.* They are made of white glass, in a globular form, and have a covering of tin plate, painted red on the outside and polished within. They are supported by lamp-irons, fixed in the houses at the height of fifteen feet from the earth. Each lantern is only sixteen paces distant from the other, so that the streets are completely illuminated. They are kept lighted both summer and winter, whether the moon shines or not; and this is more necessary at Vienna than any where else, on account of the height of the houses and the narrowness and crookedness of the streets. The lamplighters wear an uniform, and are under military discipline. In 1783, the yearly expense of the lamps was estimated at only 17,000 florins.†

Leipzig was lighted in 1702, and Dresden in 1705.‡ In 1766, the number of lamps at the latter amounted only to 728, for the lighting of which oil of rape-seed was employed.

In Cassel the streets began to be lighted under the landgrave Charles, in 1721; but as regulations were not made sufficient to support this improvement, it was at length dropped. It was however

* Neueste beschreibung aller merkwürdigkeiten Wiens. Wien 1779, 8vo. p. 14.

† Nicolai Beschreibung einer reise, iii. p. 212, 214.

‡ The regulations may be found in *Codex Augusteus*, i. p. 1721, 1727. See also *Schmieders Policey von Sachsen*, p. 315.

revived in 1748,* and in 1778 the number of the lamps was increased to 1013, besides those at the landgrave's palace.

Hanover was lighted in 1696,† Halle in 1728,‡ and Gottingen in 1735. Brunswick since 1765 has had 1565 lamps.§ Zurich has been lighted since 1778, but the lamps are very few in number.‖

NIGHT-WATCH.

The establishment of those people who are obliged to keep watch in the streets of cities during the night, belongs to the oldest regulations of police. Such watchmen are mentioned in the Song of Solomon, and they occur also in the book of Psalms.§

* Schminke, Beschreibung der residenz-stadt Cassel, 1767, 8vo. p. 329.

† Du Plat, Situations-risse der chausseen der Churfürstenth. Brunschw. Luneb. Hannover 1780, 4to. i. p. 71.

‡ Von Dreyhaupts Beschreibung des Saalkreises, ii. p. 379.

§ Brunschw. Intelligenz-Blatt, 1785. *Handbuch fur kaufleute*, 1784, p. 18.

‖ Anth. Werdmuller, Memorabilia Tigurina, oder Merkwürdigkeiten der Stadt Zürich. 1780, 4to. i. p. 350.

§ The watchmen that go about the city found me: to whom I said, Saw ye him whom my soul loveth? *Song of Solomon*, chap. iii. ver. 3. The watchmen that went about the city found me, they smote me, they wounded me; the keepers of the walls took away my veil. *Ibid.* chap. v. ver. 7. Except the Lord build the house, they labour in vain that build it: except the Lord keep the city, the watchman watcheth but in vain. *Psalm* cxxvii. ver. 1.

Athens, and other cities of Greece, had at least sentinels posted in various parts; and some of the *thesmothetæ* were obliged to visit them from time to time, in order to keep them to their duty.* At Rome there were *triumviri nocturni, cohortes vigilum*, &c.†

The object of all these institutions seems to have been rather the prevention of fires than the guarding against nocturnal alarms or danger; though in the course of time attention was paid to these also. When Augustus wished to strengthen the night-watch, for the purpose of suppressing nocturnal commotions, he used as a pretext the apprehension of fires only.‡ The regulations respecting these

* They were called κωδωνοφοροι, bell-bearers, or bellmen, because, while going the rounds, they gave a signal with their bells, which the sentinels were obliged immediately to answer. See the Scholiasts on the *Aves* of Aristophanes, ver. 841, whose words have been inserted by Varinus in his Dictionary, p. 461. To the same class belong the περιπολοι την πολιν φυλαττοντες in Pollux, viii. cap. 9, 105, where some however read χωραν. Dio Cassius, lib. liv. 4, p. 733, says: The watchmen in the different quarters of the city have small bells, that they may make signals to each other when they think proper. Οι τας συνοικιας νυκτωρ φυλασσοντες, κωδωνοφορουσιν, ὁπως σημαινειν σφισιν ὁποταν βουληθωσι δυνωνται. The bells therefore did not serve for announcing the hours, as some have imagined.

† See *Crusii Comment. de nocte*, cap. 5, in *Sallengre Thesaur. antiq.* ii. p. 836, and *C. Ch. Heubach, Comment. de politia Romanorum.* Gottingæ 1791, 4to. p. 54, 72.

‡ We read in Cassiodorus the orders given to a *præfectus vigilum* on his appointment. It was said to him: Eris securitas soporantium, munimen domorum, tutela claustrorum, discussor obscurus, arbiter silentiosus, cui fallere insidiantes fas est, et decipere gloria. *Var.* vii. 7.

watchmen, and the discipline to which they were subjected, were almost the same as those for night-sentinels in camps during the time of war; but it does not appear that the night-watchmen in cities were obliged to prove their presence and vigilance by singing, calling out, or by any other means. Signals were made by the patroles alone, with bells, when the watchmen wished to say any thing to each other. Singing by sentinels, in time of war, was customary, at least among some nations; but in all probability that practice was not common in the time of peace.*

Calling out the hours seems to have been first practised after the erection of city gates, and, in my opinion, to have taken its rise in Germany; though indeed it must be allowed that such a regulation would have been very useful in ancient Rome, where there were no clocks, and where people had nothing in their houses to announce the hours in the night-time. During the day, people could know the hours after water-clocks had been constructed at the public expense, and placed in open buildings erected in various parts of the city. The case seems to have been the same in Greece; and rich families kept particular servants both male and female, whose business it was

* The Persian sentinels sung in this manner when they were surprised in the city by the Romans. *Ammianus Marcell.* xxiv. 15: Obtruncarunt vigiles omnes, ex usu moris gentici justitiam felicitatemque regis sui canoris vocibus extollentes.—We read the same account in *Zosimus*, iii. 22, p. 308.

to announce to their masters and mistresses certain periods of the day, as pointed out by the city clocks. These servants consisted principally of boys and young girls, the latter being destined to attend on the ladies. It appears however, that in the course of time water-clocks were kept also in the palaces of the great; at any rate Trimalchio, the celebrated voluptuary, mentioned in Petronius, had one in his dining-room, and a servant stationed near it to proclaim the progress of the hours, that his master might know how much of his lifetime was spent; for he did not wish to lose a single moment without enjoying pleasure.*

I have not read every thing that has been written by others on the division of time among the ancients; but after the researches I have made, I must confess that I do not know whether the hours were announced in the night-time to those who wished and had occasion to know them. There were then no clocks which struck the hours, as has been already said; and as water-clocks were both scarce and expensive, they could not be procured by labouring people, to whom it was of most importance to be acquainted with the progress of time.† It would therefore have been

* Trimalchio, lautissimus homo, horologium in triclinio, et buccinatorem habet subornatum, uti subinde sciat, quantum de vita perdiderit. *Cap.* xxvi. p. 62.

† That the servants in many houses were wakened by the ringing of a bell, appears from what Lucian says in his treatise, *De iis qui mercede conducti in divitum familiis vivunt*, cap. xxiv. p. 245, and

an useful and necessary regulation to have caused the watchmen in the streets to proclaim the hours, which they could have known from the public water-clocks, by blowing a horn, or by calling out.

It appears however, that people must have been soon led to such an institution, because the above methods had been long practised in war. The periods for mounting guard were determined by water-clocks; at each watch a horn was blown, and every one could by this signal know the hour of the night;* but I have met with no proof that

cap. xxxi. p. 254, edition of Deux-Ponts, vol. iii. ὑπο κωδωνι εξαναστας, ad tintinnabuli sonum surgens. It does not however follow, that there were then striking or alarm-clocks, as some have thence concluded. See *Magius De tintinnabulis*, cap. 6, in *Sallengre, Thesaurus antiquit.* ii. p. 1177.

* Vegetius De re milit. iii. 8: In quatuor partes ad clepsydram sunt divisæ vigiliæ, ut non amplius quam tribus horis nocturnis necesse sit vigilare. That Cæsar had such clocks, may be concluded from the observation which he makes in his Commentaries, on the length of the day in the islands near Ireland: Nos nihil de eo percunctationibus reperiebamus, nisi certis ex aqua mensuris, breviores esse noctes, quam in continente, videbamus. Maternus, in *Römische alterthümer*, iii. p. 47, endeavours to prove by what Suetonius relates of Domitian, cap. 16, that this prince had in his palace neither a sun-dial nor a water-clock. But what kind of a proof! Domitian asked what the hour was, and some one answered, the sixth. Such insignificant *dicta probantia* have been banished from philophy by the moderns, and ought they not to be banished from antiquities likewise? The often-quoted passage also of *Valerius Maximus*, viii. 7, 5, proves nothing, unless we first adopt the amendment of Green. Carneades, it is said, was so engaged in the study of philosophy, that he would have forgot his meals had not Melissa put him in mind of them. Green reads *monitrix domestica:* but Va-

these regulations were established in cities during the time of peace, though many modern writers have not hesitated to refer to the night-watch in cities what alludes only to nocturnal guards in the time of war.* On the contrary, I am still more strongly inclined to think, that ancient Rome was entirely destitute of such a police establishment. The bells borne by the night-watchmen were used only by the patroles, as we are expressly told, or to give signals upon extraordinary occasions, such

lerius says, *Melissa, quam uxoris loco habebat.* See *Greenii Lib. de rusticat. Roman.* cap. 9, in *Sallengre, Thesaurus antiq. Rom.* i. p. 721. A passage likewise in Pliny's Epistles, iii. 1. p. 181: *Ubi hora balinei nunciata est,* does not properly prove that it alludes to one of those boys who announced the hours. That such servants however were kept, is evident from the undoubted testimony of various authors. *Martial,* viii. ep. 67: Horas quinque puer nondum tibi nunciat. *Juven. Sat.* x. 216. *Seneca De brevit. vitæ, c.* 12. *Alciphron, Epist.* lib. iii. p. 282: Theocares non prius occupat torum, nisi ei servus accurrens indicat sextam esse. Still stronger is a passage of *Sidon. Apollin.* ii. ep. 9. p. 120: Ecce et ab archimagiro adventans, qui tempus instare curandi corpora commoneret. Quem quidem nuncium per spatia clepsydrarum horarum incrementa servantem probabat competenter. A passage in the thirteenth epistle of the same book, p. 138, belongs also to this subject: Cujus spatia vitæ sic custodiebantur, ut per horarum dispositas clepsydras explicarentur. That there were maid-servants for announcing the hours is proved by Hesychius: περητζια ἡ παραγγελλουσα την ὡραν ταις κεκτημεναις.

* To night-watching in the time of war the following passages allude: *Propert.* iv. 4. 62: Et jam quarta canit venturam buccina lucem. *Silius Ital.* vii. 155: Mediam somni cum buccina noctem divideret. *Livius.* vii. 35. p. 609: Ubi secundæ vigiliæ buccina datum signum esset. *Seneca, Thyest.* v. 798: Tertia misit buccina signum.

as that of a fire, or when any violence had been committed. Cicero, comparing the life of a civil with that of a military officer, says, "The former is awaked by the crowing of the cock, and the latter by the sound of the trumpet." The former therefore had no other means of knowing the hours of the night but by attending to the noise made by that animal.* An ancient poet says, that the cock is the trumpeter which awakens people in the time of peace.† The ancients indeed understood much better than the vulgar at present, who are already too much accustomed to clocks, how to determine the periods of the night by observing the stars; but here I am speaking of capital cities, and in these people are not very fond of quitting their beds to look at the stars, which are not always to be seen.

Without entering into further researches respecting watchmen among the ancient Greeks and Romans, I shall prove, by such testimonies as I am acquainted with, that the police establishment of which I speak, is more modern in our cities than one might suppose. But I must except Paris; for

* Vigilas tu de nocte, ut tuis consultoribus respondeas; ille ut eo, quo intendit, mature cum exercitu perveniat. Te gallorum, illum buccinarum cantus exsuscitat. *Cic. Orat. pro Muræna*, cap. 22.

† Heinsius says in his annotations to *Sil. Ital.* vii. 155: Hanc tubam (gallicinium) intelligit in Fragmentis Lyricorum poeta ille, qui pacis tempore gallum solam tubam esse ait. That passage however I have not been able to find.

it appears that night-watching was established there, as at Rome, in the commencement of its monarchy. De la Mare* quotes the ordinances on this subject of Clothaire II, in the year 595, of Charlemagne, and of the following periods. At first the citizens were obliged to keep watch in turns, under the command of a *miles gueti*, who was called also *chevalier*. The French writers remark on this circumstance, that the term *guet*, which occurs in the oldest ordinances, was formed from the German words *wache*, *wacht*, the guard, or watch; and in like manner several other ancient German military terms, such as *bivouac*, *landsquenet*, &c.† have been retained in the French language. In the course of time, when general tranquillity prevailed, a custom was gradually introduced of avoiding the duty of watching by paying a certain sum of money, until at length permanent *compagnies de guet* were established in Paris, Lyons, Orleans, and afterwards in other cities.

If I am not mistaken, the establishment of single watchmen, who go through the streets and call out the hours, is peculiar to Germany, and was copied only in modern times by our neighbours. The antiquity of it however I will not venture to deter-

* Traité de la police, vol. i. in the Index under the word *Guet*.

† *Bivouac*, from the German *beiwacht*, is an additional night-guard during a siege, or when an army is encamped near the enemy. *Lansquenets* were German soldiers added by Charles VIII of France to his infantry, and who were continued in the French army till Francis I introduced his legions. TRANS.

mine. At Berlin, the elector John George appointed watchmen in the year 1588;* but in 1677 there were none in that capital, and the city officers were obliged to call out the hours.† Montagne, during his travels in 1580, thought the calling out of the night-watch in the German cities a very singular custom. "The watchmen," says he, "went about the houses in the night-time, not so much on account of thieves as on account of fires and other alarms. When the clocks struck, the one was obliged to call out aloud to the other, and to ask what it was o'clock, and then to wish him a good night."‡ This circumstance he remarks also when speaking of Inspruck. Mabillon likewise, who made a literary tour through Germany, describes calling out the hours as a practice altogether peculiar to that country.§

The horn of our watchmen seems to be the *buccina* of the ancients, which, as we know, was at

* Nicolai Beschreibung von Berlin, i. p. 38.

† Ibid. p. 49.

‡ Reisen. Halle 1777, 2 vol. 8vo. i. p. 172 and 237.

§ Muræ primum observavimus, quod in omnibus ferme Germaniæ locis observatur, ut unus famulorum propter incendii periculum noctu excubias agat, et singulis ab ignitegio horis, id est ab hora octava in hyeme, nona in æstate, quædam verba variis in locis proclamet, ut se vigilem probet. Audite quid dicturus sim, inquit ille in æstate hora nona, insonat hora nona, extinguite lumen et ignem, ut nos Deus cum Maria tutetur. In aliis horis significat, talem insonuisse horam. Id fit, inquam, propter incendii periculum, quod in Germaniæ partibus maximum est, quoniam abietinis lignis fere omnia constant, ut etiam in plerisque locis pro tegulis sunt asseres abiegni. *Iter Germanicum.* Hamburgi 1717, 8vo. p. 26.

first an ox's horn, though it was afterwards made of metal.* Rattles, which are most proper for cities, as horns are for villages, seem to be of later invention.† The common form, "Hear, my masters, and let me tell you," is very old. I am not the only person to whom this question has occurred, why it should not rather be "Ye people or citizens." The chancellor von Ludwig deduces it from the Romans, who, as he says, were more liberal with the word Master, like our neighbours with Messieurs, than the old Germans;‡ but the Roman watchmen did not call out, nor yet do the French at present. If I may be allowed a conjecture on so trifling an object, I should say that the city servants or beadles were the first persons appointed to call out the hours, as was the case at Berlin. These therefore called out to their masters, and "Our masters" is still the usual appellation given to the magistrates in old cities, particularly in the Empire, and in Swisserland. At Gottingen the ancient form was abolished in the year 1791, and

* Lipsius De milit. Rom. iv. 10. p. 198. *Bochart. Hierozoic.* i. p. 317 and 426.

† From the name of this instrument, called in some places of Germany a *ratel*, arose the appellation of *ratelwache*, which was established at Hamburg in 1671. In the Dutch language the words *ratel, ratelaar, ratelen, ratelmann, ratelwagter* (a night-watchman) are quite common.

‡ Gelehrte anzeigen. Halle 1743, 4to. i. p. 488. The author refers to Seneca, epist. 3: Quem nos obvium, si nomen non succurrit, dominum vocamus.

the watchmen call out now, "The clock has struck ten, it is ten o'clock"

Watchmen who were stationed on steeples by day as well as by night, and who, every time the clock struck, were obliged to give a proof of their vigilance by blowing a horn, seem to have been established on a permanent footing, first in Germany, and perhaps before watchmen in the streets. In England, there are none of these watchmen;* and in general they are very rare beyond the boundaries of Germany. That watchmen were posted on the tops of towers, in the earliest ages, to look out for the approach of an enemy, is well known, and has been sufficiently proved by Faber, my friend and former pupil.† In the times of feudal dissension, when one chief, if he called in any assistance, could often do a great deal of hurt to a large city, either by plundering and burning the suburbs and neighbouring villages, or by driving away the cattle of the citizens, and attacking single travellers,‡ such precaution was more necessary than at present. The nobility therefore kept in their strong castles watchmen, stationed on towers; and this practice prevailed in other countries besides

* Physikal œconom. biblioth. v. p. 294.

† Archæologie der Hebräer. Halle 1773, 8vo. i. p. 181.

‡ Those who have read ancient annalists must recollect many instances of this kind; but at all events they may be found by recurring to *Von Falkenstein's Historie von Erfurt.*

Ireland and Burgundy.* It appears by the laws of Wales, that a watchman with a horn was kept in the king's palace.† The German princes had in their castles, at any rate in the sixteenth century, tower-watchmen, who were obliged to blow a horn every morning and evening.‡

At first, the citizens themselves were obliged to keep watch in turns on the church-steeples, as well as at the town-gates; as may be seen in a police-ordinance of the city of Einbeck§ in the year 1573. It was the duty of these watchmen, especially where there were no town clocks, to announce certain periods, such as those of opening and shutting the city-gates.‖ The idea of giving orders

* This is proved by professor Fischer in *Sitten der Europäer im fünften jahrhunderte.* Frankf. 1784, 8vo. p. 96. from the testimony of Richard Stanihurst in *De rebus in Hibernia gestis,* lib. i. p. 33, and from other works.

† Leges Walliæ. Lond. 1730, fol.

‡ In *Meiners* and *Spittlers Historisches magazin,* i. p. 45, mention is made, in a letter of a landgrave, dated 1561, of a tower-watchman, who was obliged to blow his horn in the castle morning and evening.

§ It may be found in *Dasselische und Eimbeckische Chronica, durch Letznerum.* Erfurt 1596, fol. vol. vi. p. 106. The person whose turn it was to watch at the gates, was obliged to perform the duty himself, or to cause it to be performed by a sufficient young citizen. Those who attended to trade, and neglected the watch, paid for every omission one mark to the council. The case was the same with the watch on the tower in the market-place.

‖ Historisch-diplomatische abhandlung vom ursprung der stadt Rostock, p. 25, 62.

to these watchmen to attend not only to danger from the enemy but from fire also, and, after the introduction of public clocks, to prove their vigilance by making a signal with their horn, must have naturally occurred; and the utility of this regulation was so important that watchmen on steeples were retained even when cities, by the prevalence of peace, had no occasion to be apprehensive of hostile incursions.

After this period persons were appointed for the particular purpose of watching; and small apartments were constructed for them in the steeples. At first they were allowed to have their wives with them; but this was sometimes prohibited, because a profanation of the church was apprehended. In most, if not in all, cities, the town-piper, or, as we say at present, town-musician was appointed steeple-watchman; and lodgings were assigned to him in the steeple; but in the course of time, as these were too high and too inconvenient, a house was given him near the church, and he was allowed to send one of his servants or domestics to keep watch in his stead. This is the case still at Gottingen. The city musician was called formerly the *hausmann*, which name is still retained here as well as at the Hartz, in Halle, and several other places; and the steeple in which he used to dwell and keep watch was called the *hausmann's thurm*.* These

* Stiebritz Auszug aus Von Dreyhaupts Beschreibung des Saal-

establishments, however, were not general; and were not every where formed at a period equally early, as will be shown by the proofs which I shall here adduce.

If we can credit an Arabian author, whose Travels were published by Renaudot, the Chinese were accustomed, so early as the ninth century, to have watchmen posted on towers, who announced the hours of the day as well as of the night, by striking or beating upon a suspended board.* Marcus Paulus, who, in the thirteenth century, travelled through Tartary and China, confirms this account; at least in regard to a city which he calls Quinsai, though he says that signals were given only in cases of fire and disturbance.† Such

Creyses. Halle 1773, 8vo. ii. p. 44. *Frisch, Teutsches-Wörterbuch. Zeitfuchs, Stolbergische historie*; Frankf. 1717, 4to. p. 59. *Vulpius, Magdeburgische geschichte*, 1702, 4to. p. 300. *Vulpius, Märseburg* 1700, 4to. p. 33 and 37. In the Berlin police ordinance of the year 1580, which may be found in *Küsters Alte u. n. Berlin*, iii. p. 353, it was ordered that the *raths-thurn oder hausmann*, steeple-watchman or city-musician, should attend at weddings with music for the accustomed pay, but only till the hour of nine at night, in order that he might then blow his horn on the steeple, and place the night-watch.

* Anciennes relations des Indes et de la Chine. Paris 1718, 8vo. p. 25, 192. The credibility of these travels, which are highly worthy of attention, has been of late much confirmed in *Notices des manuscrits du Roi*, i. p. 157, as they were formerly in *Memoires de l'Académie des Inscriptions*, xxxvii. p. 477. See also *Meusel's Biblioth. hist.* ii. 2. p. 117.

† De regionibus oriental. edit. Mulleri 1671, 4to. p. 120. *Allgemeine historie der reisen*, vii. p. 100.

boards are used in China even at present;* and in Petersburg the watchmen who are stationed at single houses or in certain parts of the city, are accustomed to announce the hours by beating on a suspended plate of iron. Such boards are still used by the Christians in the Levant to assemble people to divine service, either because they dare not ring bells or are unable to purchase them. The former is related by Tournefort of the inhabitants of the Grecian islands,† and the latter by Chardin of the Mingrelians.‡ The like means were employed in monasteries, at the earliest periods, to give notice of the hours of prayer, and to

* Martini Atlas Sinens. p. 17. Matches or links, to which alarums are sometimes added, are employed in China to point out the hours; and these are announced by watchmen placed on towers, who beat a drum. See *Algemeine historie der reisen*, vi. p. 289, 290. *Kœmpfer's Geschichte und beschreibung von Japan*, ii. p. 28, or the French translation *Histoire de Japon*, Amsterdam 1732. 12mo. ii. p. 115, where the mention of matches is omitted. *Thunberg's Resa uti Europa, Africa, Asia*, iii. p. 99: "Time is measured here not by clocks or hour-glasses, but by burning matches, which are plaited like ropes, and have knots on them. When the match burns to a knot, which marks a particular lapse of time, the hour is announced, during the day, by a certain number of strokes on the bells in the temples; and in the night by watchmen who go round and give a like signal with two pieces of board, which they knock against each other."

† Voyage du Levant, i. p. 45, where a figure is given of the instrument, which still retains the ancient names explained by Reiske σημαντρον and σημαντηριον.

‡ Voyages, edition of Rouen, 12mo. i. p. 180.

awaken the monks.* Mahomet, who in his form of worship borrowed many things from the Christians of Syria and Arabia, adopted the same method of assembling the people to prayers; but when he remarked that it appeared to his followers to savour too much of Christianity, he again introduced the practice of calling out.

The steeple-watchmen in Germany are often mentioned in the fourteenth and fifteenth century. In the year 1351, when the council of Erfurt renewed that police ordinance which was called the *zuchtbrief*, letter of discipline, because it kept the people in proper subjection, it was ordered, besides other regulations in regard to fire, that two watchmen should be posted on every steeple.† A watchman of this kind was appointed at Merseburg‡ and Leisnig so early as the year 1400.§ In the beginning of the seventeenth century the town-piper of Leisnig lived still in apartments in the steeple. In the year 1563, a church-steeple was erected in that place, and an apartment built in it

* A great deal of important information, which is as yet too little known, has been collected on this subject by Reiske, on *Constantini Lib. de ceremoniis aulæ Byzant.* ii. p. 74.

† Von Falkensteins Historie von Erfurt. Erfurt 1739, 2 vol. 4to. i. p. 249.

‡ Vulpius, Geschichte der Stadt Märseburg. Quedlinburg, 1700, 4to. p. 37.

§ Kamprads Leisnigker chronika. Leisnig 1753, 4to. p. 390.

for a permanent watchman, who was obliged to announce the hours every time the clock struck.*

In the fifteenth century the city of Ulm kept permanent watchmen in many of the steeples.† In the year 1452 a bell was suspended in the tower of the cathedral of Franckfort on the Mayn, which was to be rung in times of feudal alarm, and all the watchmen on the steeples were then to blow their horns and hoist their banners.‡ In the year 1476, a room for the watchman was constructed in the steeple of the church of St. Nicholas.§ In the year 1509, watchmen were kept both on the watch-towers and steeples, who gave notice by firing a musket when strangers approached. The watchman on the tower of the cathedral immediately announced, by blowing a trumpet, whether the strangers were on foot or on horseback; and at the same time hung out a red flag towards the quarter in which he observed them advancing. The same watchman was obliged, likewise, to blow his horn on an alarm of fire; and that these people might be vigilant day and night, both in winter and summer, the council supplied them with fur-cloaks,

* Kamprads Leisnigker chronica, p. 550, 582.

† In turri Beatæ Virginis sunt semper duo custodes, qui mane et vespere tubis concrepant. Ante paucos annos habebant uxores secum superius; sed Plebanus modernus ejecit feminas propter ecclesiæ emunitatem servandam. *Felix Faber* in *Rerum Suevic. scriptor.* Ulmæ 1727, fol. p. 79. a. p. 82. b.

‡ Von Lersners Chronica von Frankf. i. p. 369.

§ Ibid. i. p. 20.

seven of which, in the above-mentioned year, were purchased for ten florins and a half.*

In the year 1496, the large clock was put up in the steeple of Oettingen, and a person appointed to keep watch on it.† In 1580, Montagne was much surprised to find on the steeple at Constance a man who kept watch there continually; and who, on no account, was permitted to come down from his station.‡

LEAF-SKELETONS.

Plants, as well as animals, are organised bodies, and like them their parts may be dissected, and decomposed by art; but the anatomy of the former has not been cultivated so long and with so much zeal and success as that of animals. Some naturalists, about the beginning of the last century, first began to make it an object of attention, to compare the structure of plants with that of animals; and for that purpose to employ the microscope. Among these, two distinguished themselves

* Von Lersners Chronica von Frankf. i. p. 374.

† This is related in the *Oettingisches Geschichts-almanach*, p. 7, on the authority of an account in the parish-books of Oettingen, said to be extracted from an ancient chronicle of that town. The author of this almanack, which is now little known, was, I have been told, Schablen, superintendant at Oettingen. I have the edition of 1783, with the calendar. It consists of 232 pages in octavo.

‡ Reise, i. p. 180.

in a particular manner: Marcellus Malpighi,* an Italian; and Nehemiah Grew, † an Englishman; who both undertook almost the same experiments and made them known at the same time; so that it is impossible to determine which of them was the earliest. It appears, however, that Grew published some of his observations a little sooner; but Malpighi was prior in making his known in a complete manner. But even allowing that the one had received hints of the processes of the other, they are both entitled to praise that each made experiments of his own, and from these prepared figures, which are always more correct the nearer they correspond with each other.

Among the various helps towards acquiring a knowledge of the anatomy of plants, one of the principal is the art of reducing to skeletons leaves, fruit, and roots; that is, of freeing them from their soft, tender, and pulpy substance, in such a manner, that one can survey alone their internal, harder vessels in their entire connexion. This may be done by exposing the leaves to decay for some time soaked in water, by which means the softer parts will be dissolved, or at least separated from the internal harder parts, so that one, by carefully wiping, pressing, and rinsing them, can obtain the latter alone perfectly entire. One will possess then

* Haller's Biblioth. botan. i. p. 582.

† Ibid. p. 562.

a tissue composed of innumerable woody threads or filaments, which, in a multiplicity of ways, run through and intersect each other. By sufficient practice and caution one may detach, from each side of a leaf, a very thin covering, between which lies a delicate web of exceedingly tender vessels. These form a woody net, between the meshes of which fine glandules are distributed. This net is double, or, at least, can be divided lengthwise into halves, between which may be observed a substance that appears as it were to be the marrow of the plant. Persons who are expert often succeed so far, with many leaves, as to separate the external covering, on both sides, from the woody net, and to split the latter into two, so that the whole leaf seems to be divided into four.

One might conjecture that this method of reducing leaves into skeletons must have been long known, as one frequently finds in ponds leaves which have dropped from the neighbouring trees, and which by decomposition, without the assistance of art, have been converted into such a woody net, quite perfect and entire. It is however certain, that a naturalist about the year 1645 first conceived the idea of employing decomposition for the purpose of making leaf-skeletons, and of assisting it by ingenious operations of art.

This naturalist, Marcus Aurelius Severinus, professor of anatomy and surgery at Naples, was born

in 1580, and died of the plague in 1656.* In his *Zootomia Democritæa*, printed in 1645, he gave the figure, with a description of a leaf of the *ficus opuntia* reduced to a skeleton. Of the particular process employed to prepare this leaf, the figure of which is very coarse and indistinct, he gives no account. He says only that the soft substance was so dissolved that the vessels or nerves alone remained; and that he had been equally successful with a leaf of the palm-tree.† A piece of a leaf of the like kind he sent, by Thomas Bartholin, to Olaus Wormius, who caused it to be engraved on copper, in a much neater manner, without saying any thing of the method in which it had been prepared.‡ The process Severin kept secret; but he communicated it to Bartholin, in a letter, on the 25th of February, 1645, on condition that

* Haller's Biblioth. anatom. i. p. 367, where he is called, improperly, professor of anatomy and botany.

† This book was printed at Nuremberg, in quarto, under the inspection of J. George Volkamer, who became acquainted with the author during his travels, and had obtained from him the manuscript, in order that it might be published. The following passage occurs, p. 63: E foliis mihi, quod admiratione dignissimum obtigit, est folium ficus opuntiæ, resolutum parte carnosa, residuis tantummodo venis aut nervis, si sic vocandi sunt. In p. 65, the author says: Ita non dissimilis venarum vegetabilium, et sentientium omnium usus est et fabricatio, post hanc plantam secunda est opificio folium, quod primoribus interest foliis palmæ. Carne enim sua resolutum rectis secundum corpus fibris ac transversis contexum est sic, ut stamina duplicia linteorum pannorum referat.

‡ Museum Wormianum. Lugd. Bat. 1655, fol. p. 149.

he would not disclose it to any one.* At that period, however, it excited very little attention; and was soon forgotten, though in the year 1685 one Gabriel Clauder made known that he had reduced vine-leaves, the calyx of the winter cherry, and a root of hemlock, to a net or tissue by burying them in sand during the heat of summer, and hanging them up some months in the open air till they were completely dried.†

This art was considered to be of much more importance when it was again revived by the well-known Dutchman, Frederick Ruysch. That naturalist found means to conduct all his undertakings and labours in such a manner, as to excite great wonder; but we must allow him the merit of having brought the greater part of them to a degree of perfection which no one had attained before. By the anatomy of animals, in which he was eminently skilled, he was led to the dissection of plants; and as it seemed impossible to fill their tender vessels,

* Bartholini Epistolarum medicinal. centuria i. Hagæ Com. 1740, 8vo. p. 269. The following are the words of Severin, who seems, indeed, not to have been able to express himself in a very clear manner: Verum me ineptum! quid præterieram opuntii folii resolutionem artificiosam? Parabitur hæc porro simplici tabefactu per affusam uberem aquam, tamdiu complexuram, dum fibris lignea duritie vestibilibus omnis exsolvatur carnea portio. Quæ tibi ars ad analyses plerasque felici soli servatur, nulli præterquam Achati revelanda. Fuit huic fabricæ opificium divinum in Dendranatome mea parva, apud Zootomiam, enarratum.

† Ephemerid. Nat. Curios. dec. 2. an. 4, p. 285.

like those of animals, with a coloured solid substance,* he fell upon a method of separating the hard parts from the soft, and of preserving them in that manner.

For this purpose, he first tried a method which he had employed, with uncommon success, in regard to the parts of animals. He covered the leaves and fruit with insects, which ate up the soft or pulpy parts, and left only those that were hard. But however well these insects, which he called his little assistants, may have executed their task, they did not abstain altogether from the solid parts, so that they never produced a complete skeleton. He dismissed them, therefore, and endeavoured to execute with his own fingers what he had before caused the insects to perform, after he had separated the soft parts from the hard by decomposition.

* The well-known Sir John Hill, an Englishman, has proved, however, in latter times, the possibility of injecting a substance into the vessels of plants also. He dissolved sugar of lead in water, suspended in it bits of the finest wood, so that one half of them was under water and the other above it, and covered the vessel in which they were placed with an inverted glass. At the end of two days he took the bits of wood out, cut off the part which had been immersed in the water, dipped them in a warm lye made of unslaked lime and orpiment, like what was used formerly for proving wine: and by these means the finest vessels, which had been before filled with sugar of lead, acquired a dark colour, and their apertures became much more distinct. This process he describes himself in *The Construction of Timber*, two editions of which were published in the year 1770, one in folio and the other in octavo. The whole account may be found in the latter, p. 33.

In this he succeeded so perfectly, that all who saw his skeletons of leaves or fruit were astonished at the fineness of the work, and wished to imitate them.

I cannot exactly determine the year in which Ruysch began to prepare these skeletons. Trew thinks that it must have been when he was in a very advanced age, or at any rate after the year 1718; for when he was admitted to Ruysch's collection in that year, he observed none of these curiosities. Rundmann, however, saw some of them in his possession in the year 1708.* At first Ruysch endeavoured to keep the process a secret, and to evade giving direct answers to the questions of the curious. We are informed by Rundmann, that he attempted to imitate his art by burying leaves at the end of harvest in the earth, and leaving them there till the spring, by which their soft parts became so tender that he could strip them off with the greatest ease. He produced also the same effect by boiling them.

The first account which Ruysch himself published of his process, was, as far as I know, in the year 1723. After he had sufficiently excited the general curiosity, he gave figures of some of his vegetable skeletons, related the whole method of preparing them, and acknowledged that he had accidentally met with an imperfect engraving of a leaf-

* Rariora naturæ et artis. Breslau and Leipsic 1737, fol. p. 421.

skeleton in the *Museum* of Wormius, which had at one time occasioned much wonder.* It is not improbable that he knew how the Italian, whom he does not mention, though he is mentioned by Wormius, and though he must certainly have been acquainted with his *Zootomia*, prepared his skeletons. I must however observe, that it is remarked by those who knew Ruysch, that he had read few books, and was very little versed in the literature of his profession.

In the year following, Ruysch described more articles of the like kind, and gave figures of some

* Adversariorum decas tertia. Amstelod. 1723, 4to. In the preface, and p. 8, 9, 11. Neque latere velim artem, qua arcanum hoc detegitur. Impono illos explorandos fructus aquæ, donec incipiunt putrescere, deinde vero eos vasi figulino immitto, cujus fundus planus est, sicque positos deglubo lente; excorticatos dein diu agito hinc inde per aquam, ut hoc concussu solvantur a mutuis complexibus vasa, simul autem blande lenteque comprimo inter digitos, donec incipiat dissolutio fieri. - - - In Musæo Wormiano incidi in imperfectam imaginem partis sceleti opuntiæ, quod doctissimi etiam viri tunc temporis valde mirati sunt, cujusque meminerunt in scriptis suis. The many small treatises written by Ruysch, which are mentioned in Haller's *Biblioth. anat.* i. p. 530, have, in part, been printed more than once in quarto, but they are known under the following general title, which Haller forgot to give: *Ruyschii Opera omnia anatomico-medico-chirurgica.* Amstelod. apud Jansonio-Waesbergios 1721, 4to. Then follow his various treatises with distinct title-pages, and the different dates when published. To this collection, which may very conveniently be divided into two volumes, is prefixed *Historia vitæ et meritorum F. Ruyschii*, auctore J. F. Schreibero. Amstel. 1732. At the end there is a complete index to all his writings. *Operum index locupletissimus, concinnatus ab Ysbr. Gysberto, Arlebout.* Amstel. 1725.

pears prepared in this manner.* In 1726, when Vater, professor at Wittenberg, expressed great astonishment at the fineness of his works, he replied, in a letter written in 1727, that he had at first caused them to be executed by insects, but that he then made them himself with his fingers.† He repeated the same thing also in 1728, when he described and gave engravings of more of these curious objects.‡ The progress of this invention is related in the same manner by Schreiber, in his Life of Ruysch.

When the method of producing these skeletons became publicly known, they were soon prepared by others; some of whom made observations, which

* Curæ posteriores, seu Thesaurus anatom. omnium præcedentium maximus, 1724, n. 27, 41, 183, 200, and p. 31, B. tab. 1.

† Abrahami Vateri Epist. gratulat. ad Ruyschium de musculo orbiculari, 1727. In the answer printed along with this letter, Ruysch says, p. 16: I have hitherto replied, when asked how it was possible to make such fine works: me non esse hujus opificii auctorem, sed satellites meos, puta animalcula, quæ tunc temporis in usum revocaveram. Nunc vero illud longe nitidius et exquisitius ipsemet perago, idque propriis satellitibus, nempe propriis digitis. Of employing different kinds of insects, particularly the *dermestes*, as they are called, for reducing animal and vegetable bodies to skeletons, Hebenstreit has treated in *Program. de vermibus anatomicorum administris* to the *Disputat. de adjumentis sanguinis ad cor regressus*, by Qualmaltz von Troppaneger; Lips. 1741. Figures of the insects and of some of their preparations are added.

‡ Curæ renovatæ, seu Thesaurus anat. post curas posteriores novus, 1728; in the preface, and also No. 40, 60, 72, 81, 89, 115, 127, 133, 138, and p. 21, No. 4. tab. 1, 2, 3. Some of these figures, with an account of the book, were inserted in *Acta Eruditorum*, 1729, Febr. p. 63.

were contrary to those of Ruysch. Among these in particular, were J. Bapt. Du Hamel, who so early as the year 1727 described and illustrated with elegant engravings the interior construction of a pear;* Trew,† in whose possession Keysler saw such skeletons in 1730;‡ P. H. G. Mohring;§ Seba;‖ Francis Nicholls,¶ an Englishman; professor Hollmann** at Gottingen, Ludwig,†† Walther,‡‡ Gesner, §§ and others. Nicholls seems to have been the first who split the net of an apple or a pear-tree leaf into two equal parts, though Ruysch split a leaf of the opuntia into three, four, and even five layers, as he himself says.

* Memoires de l'Academ. des Sciences, année 1730, 1731, 1732; and translated into Latin in *Commercium litter. Norimberg.* 1735, p. 308; 1736, p. 349; and 1738, p. 6.

† Commerc. litter. Norimb. 1732, p. 73.

‡ Reise, p. 1197.

§ Commerc. Norimb. 1733, p. 37.

‖ Philosoph. transact. 1730, No. ccccxvi. p. 441; and in the first part of his *Thesaurus.*

¶ Philosoph. trans. 1730, No. ccccxiv. p. 371.

** Ibid. No. ccccl xi. p. 789, and No. ccccl xiii. p. 796. *Commerc. litter. Norimb.* 1735, p. 353. *Hollmanni Commentat. sylloge.* Gottingæ 1765, 4to. p. 109. In p. 120, the year 1727 must undoubtedly be read instead of 1734. The papers of Seba and Hollmann may be found translated into Italian in *Scelta d'opuscoli interessanti,* vol. ix. p. 79.

†† Institutiones regni vegetabil. In the part on Leaves.

‡‡ Programma de plantarum structura. Lips. 1740, 4to. § 5, 6.

§§ Dissertationes physicæ de vegetabilibus, 1740, 1741. Both were reprinted at the same time with *Linnæi Orat. de necessitate peregrinationum intra patriam.* Lugd. Bat. 1743, 8vo.

In the year 1748, Seligmann, an engraver, began to publish, in folio plates, figures of several leaves which he had reduced to skeletons.* As he thought it impossible to make drawings sufficiently correct, he took impressions from the leaves or nets themselves, with red ink, and in a manner which may be seen described in various books on the arts. Of the greater part he gave two figures, one of the upper and another of the under side. He promised also to give figures of the objects as magnified by a solar microscope; and two plates were to be delivered monthly. Seligmann however died soon after, if I am not mistaken; and a lawsuit took place between his heirs, by which the whole of the copies printed were arrested, and for this reason the work was never completed, and is to be found only in a very few libraries.

Cobres says, that eight pages of text, with two black, and twenty-nine red copper-plates, were completed. The copy which is in the library of our university, has only eight pages of text, consisting partly of a preface by C. Trew, and partly of an account of the author, printed in Latin

* Die nahrungs-gefässe in den blättern der bäume, nach ihrer unterschiedlichen austheilung und zusammenfügung, so wie solche die Natur selbst bildet, abgedruckt von Johann Michael Seligmann, kupferstecher in Nürnberg. Nurnberg 1748. See *Gottingische Zeitungen von gelehrten sachen*, 1748, p. 1091. *Haller, Biblioth. botan.* ii. p. 374. *Hamburg. Magazin*, iv. p. 93. *Deliciæ Cobresianæ*, p. 653, 4.

and German opposite to each other. Trew gives a history of the physiology of plants and of leaf-skeletons; and Seligmann treats on the methods of preparing the latter. The number of the plates however is greater than that assigned by Cobres. The copy which is now before me contains thirty-three plates, printed in red; and, besides these, two plates in black, with figures of the objects magnified. Of the second plate in red, there is a duplicate with this title, "Leaves of a bergamot pear-tree, the fruit of which are mild;" but the figures in both are not the same; and it appears that the author considered one of the plates as defective, and therefore gave another. The leaves represented in the plates are those of the orange-tree, lemon-tree, shaddock-tree, butcher's-broom, walnut-tree, pear-tree, laurel, lime-tree, ivy, bastard-quince or mespilus, chesnut-tree, maple-tree, holly, willow, white hawthorn, &c.

I shall take this opportunity of inserting here the history of the art of raising trees from leaves. The first who made this art known was Agostino Mandirola, doctor of theology, an Italian minorite of the Franciscan order. In a small work upon Gardening, which, as I think, was printed for the first time at Vicenza, in duodecimo, in the year 1652, and which was reprinted afterwards in various places, he gave an account of his having produced trees from the leaves of the cedar and

lemon-tree;* but he does not relate this circumstance as if he considered it to be a great discovery. On the contrary, he appears rather to think it a matter of very little importance. His book

* Many editions of this book may be found mentioned in *Lastri Bibliotheca georgica*, p. 79; *Halleri Biblioth. botan.* i. p. 484; *Böhmeri Biblioth. hist. nat.* iii. 1. p. 679. That in the library of our university has the following title: *Manuale de' Giardinieri, diviso in tre libri---di F. Agostino Mandirola. Aggiuntovi il quarto libro, che dimostra la qualita e virtu---de' fiori descritti in questo volume.* Venetia 1684, 12mo. The account to which I allude occurs lib. iii. cap. 5, p. 133. I shall transcribe it entirely, as the original in Germany is exceedingly scarce: Con un artificio simile per via di stillicidio hò provato piantar le foglie di cedri, di limoni, c di simili in questo modo: hò preso un vaso pieno di buonissima terra sottile e grassa, poi intorno all' orificio vi hò posto le foglie con il gambo sotto terra tanto che resti meza la foglia sopra; poscia hò fatto un' orcioletto d'acqua che a stilla inaffiasse esse foglie, al modo detto di sopra, aggiongendovi sempre terra nel scavo dell acqua, et in tal modo hanno fatto presa, e gettato fuora le vergelette in breve tempo.—According to Lastri, the latest edition was printed at Rovoredo in 1733, 12mo. In the year 1665 a French translation appeared, at Paris, under the title of *Manuel du Jardinier---par le Sieur Mandirola, traduit sur l'original Italien par* M. C. L. F. Randi, 455 pages, large duodecimo. To this edition is prefixed a letter from Mandirola, at Florence, in the year 1764, to the translator, in which it is said that the former had sent him large additions. An evident imposture! The first book is a literal translation from the Manuale of Mandirola. What follows is taken, as I think, from *Instruction pour la culture des fleurs*, which is printed at the end of *Quintiny's Jardinier parfait;* but which, however, was not written by him. The French translator has entirely omitted the ingenious account of raising trees from leaves. In Haller and Böhmer the French translator is improperly called *Fraudi.* I must remark also that Agricola, Munchhausen and others call the Italian author, erroneously, Mirandola.

was soon translated into German;* and the above account was copied by other writers, such as Böckler† and Hohberg,‡ who were at that time much read. A gardener of Augsburg, as we are told by Agricola, was the first who imitated this experiment, and proved the possibility of it to others. He is said to have tried it with good success in the garden of count de Wratislau, ambassador at Ratisbon from the elector of Bohemia.

But never was this experiment so often and so successfully repeated as in the garden of baron de Munchhausen, at Swobber. A young tree was obtained there from a leaf of the *Limon a Rivo*, which produced fruit the second year. It was sent to Mr. Volkamer, at Nuremberg, who caused a drawing to be made from it, which was afterwards engraved, in order that it might be published in the third volume of his *Hesperides;* but as the author died too early, it was not printed. The exact drawing, as it was then executed at Nuremberg, and an account of the whole process employed in the experiment at Swobber, have been published by the baron de Munchhausen himself,

* Mandirola, Italienischer baum- blumen- und pomeranzen-gärtner. Nurnberg 1670, 12mo; and at the same place 1679, 12mo. The first edition is inferior, as the other contains some notes by the editor.

† Georg. Andr. Boeklers Haus-und feld-schule, i. 26.

‡ Georgica curiosa, i. p. 778.

from authentic papers in his grandfather's own writing.*

No one, however, excited so much attention to this circumstance as the well-known George Andrew Agricola, physician at Regensburg (Ratisbon), who, with that confidence and prolixity which were peculiar to him, ventured to assert, that trees could be propagated in the speediest manner by planting the leaves, after being steeped in a liquor which he had invented; and for the truth of his assertion he referred to his own experiments.† Among the naturalists of that period none took more trouble to examine the possibility of this effect than Thummig,‡ who endeavoured to prove that not only leaves with eyes left to them, could, in well moistened earth, throw out roots which would produce a stem, but that leaves also without eyes would grow up to be trees. Baron Munchhausen, on the other hand, assures us, that according to the many experiments made in his garden, one can expect young plants from the leaves of those trees only which do not bring forth buds; that experiments made

* Hausvater, vol. v. p. 662.

† Versuch der universal-vermehrung aller bäume. Regensb. 1716, fol. p. 107, 157; or in the newest edition by Brauser. Regensb. 1772, fol. i. p. 97; and ii. p. 41.

‡ Thummigii Meletemata. Brunsw. et Lips. 1727, 8vo. p. 5. *Thummigs Erläuterung der begebenheiten in der natur.* Marburg 1735, 8vo. p. 101.

with the leaves of the lemon-tree had alone succeeded, but never those made with the leaves of the orange or lime-tree; and that Agricola and Thummig had erroneously imagined that the leaves themselves shot up into trees, their middle fibre (*rachis*) becoming the stem, and the collateral fibres the branches. But the leaf decays as soon as it has resigned all its sap to the young tree, which is springing up below it.

To conclude: It is probable that the well-known multiplication of the Indian fig, or *opuntia*, gave the first idea of this experiment; for every joint of that plant, struck into the earth, and properly nurtured, throws out roots and grows. As these joints were commonly considered to be leaves, people tried whether other leaves would not grow in the like manner. Luckily, those of the lemon-tree were chosen for this purpose; and what was expected took place. Thus from a false hypothesis have new truths often been derived; and thus was Kepler, by a false and even improbable opinion, led to an assertion, afterwards confirmed, that the periodical revolutions of the planets were in proportion to their distance from the sun. But the raising of trees from leaves was too rashly declared to be a method that might be generally employed; for it is certain that it now seldom succeeds.

BILLS OF EXCHANGE.

I SHALL not here repeat what has been collected by many learned men respecting the important history of this noble invention, but only lay before my readers an ordinance of the year 1394, concerning the acceptance of bills of exchange, and also two bills of the year 1404, as they may serve to illustrate further what has been before said on the subject by others. These documents are, indeed, more modern than those found by Raphael de Turre* in the writings of the jurist Baldus,† which are dated March the 9th 1328; but they are attended with such circumstances as sufficiently prove, that the method of transacting business by bills of exchange was fully established so early as the fourteenth century; and that the present form and terms were even then used. For this important information I am indebted to Mr. Von Martens, who found it in a book which, as far as I know, has never been noticed in any Literary Journal, though it is much more deserving of attention than many others better known. It is a History, written in Spanish, of the maritime trade and other branches of commerce at Barcelona, taken entirely from the archives of that city, and accompanied with documents from

* Disp. i. quæst. 4, n. 23. † Consil. 348.

the same source, which abound with matter highly interesting.*

Among these is an ordinance issued by the city of Barcelona in the year 1394, that bills of exchange should be accepted within twenty-four hours after they were presented; and that the acceptance should be written on the back of the bill.†

In the year 1404, the magistrates of Bruges, in Flanders, requested the magistrates of Barcelona to inform them what was the common practice, in regard to bills of exchange, when the person who presented a bill raised money on it in an unusual manner, in the case of its not being paid, and by these means increased the expenses so much that the drawer would not consent to sustain the loss.

* Memorias historicas sobre la marina commercio y artes de la antigua ciudad de Barcelona, por D. Antonio de Capmany y de Montpalau. Madrid 1779, 2 vol. 4to. As a proof of what I have said above, I shall mention the following important articles, which may be found in this work. A custom-house tariff, written in Latin, of the year 1221, in which occur a great number of remarkable names and articles of merchandise not explained. Another of the like kind, of the year 1252. Letters of power to appoint consuls in distant countries, such as Syria, Egypt, &c. dated in the years 1266, 1268, and 1321. An ordinance of the year 1458, respecting Insurance, which required that under-writing should be done in the presence of a notary, and declared *polices o scriptures privades* to be null and void. A *privilegium* of the emperor Andronicus II. to the merchants of Barcelona, written in Greek and Spanish, 1290. Account of the oldest Spanish trade with wool, silk, salt, and saffron; and of the oldest guilds or incorporated societies of tradesmen at Barcelona, &c.

† Vol. ii. p. 382.

The bill which gave occasion to this question is inserted in the memorial. It is written in the short form still used; which certainly seems to imply great antiquity. It speaks of usance; and it appears that first and second bills were at that time drawn, and that when bills were not accepted, it was customary to protest them.*

* As this article is of great importance, I shall here transcribe it, from vol. ii. p. 203: Cum de mensibus Aprilis et Maii ultimo elapsis Antonius Quarti, mercator Lucanus residens in villa Brugensi, a Joanne Colom, mercatore civitatis Barchinonae, etiam residente in praedicta villa Brugensi, duo millia scutorum Philippi, quolibet scuto pro xxii grossis computato, solvendi per Franciscum de Prato mercatorem Florentiae, more solito, in Barchinona, mediatim Petro Gilberto et Petro Olivo, et mediatim Petro Scorp, et supradicto Petro Gilberto, mercatoribus Cardonae: prout de dictis cambiis apparet quatnor litteris papireis, quarum tenores subsequuntur.

Superscriptio autem primae litterae fuit talis: *Franc. de Prato & comp. à Barselona.* Tenor vero eiusdem ad intra fuit talis: *Al nome di Dio, Amen. à di* xxviii. *Aprile* 1404. *Pagate per questa prima di camb. a usanza à Piero Gilberto, è Picro Olivò scuti mille à sold.* x. *Barselonesi per scuto, i quali scuti mille sono per cambio che con Giovanni Colombo à grossi* xxii. *di g. scuto: & pag. à nostro conto, & Christo vi guardi.* Subtus vero erat scriptum: *Antonio Quarti Sal. de Bruggias.*

Superscriptio vero secundae litterae fuit talis: *Francisco de Prato & comp. à Barsalona.* Et ab intra sic habebatur: *Al nome dc Dio, Amen. à di* xviii. *di Magio* 1404. *Pagate per questa prima di camb. à usanza à Piero Gilberto & à P. de Scorpo scuti mille de Felippo à sold.* x. *Barselonesi per scuto: i quali scuti mille sono per camb. che con Giov. Colombo à grossi* xxii. *di g. scuto: & pag. à nostro conto: & Christo vi guardi.* Subtus vero erat sic scriptum: *Ant. Quadri Sal. de Bruggias.*

Et ita sit, quod supra dicta cambia, per supra dictum Franc. de Prato, aut aliquem alium suo nomine, soluta minime fuerint, et ex

My learned readers will here, no doubt, express a wish of seeing a complete translation of this curious and important work, though with

illius defectu, et praecipue ex eo quod Guilh. Colom, vt procurator supradictorum P. Gilberti, P. Olivo et P. Scorp. emit supratacta duo millia scutorum in praedicta civitate Barchinonae in promptis et paratis denariis, expensis vt praetendit ipsius Ant. Quarti; certa coram nobis orta sit questio inter supradictos Jo. Colum ex vna parte, et Ant. Quarti ex altera, dicente eodem Antonio, quod ipse Guil. Colom, vt procurator praedictus, praedicta insolutione non obstante, non debebat, sumptibus et expensis ipsius Antonii, supradictas pecuniarum sumas emere in ipsa civitate Barchinonae in promptis et paratis pecuniis, sed solum debuisset illas cepisse ibidem in Tabulis, prout hoc dicit in tali casu moris et consuetudinis esse, et ab antiquo fuisse in ipsa civitate Barchinonae. Et ipsi custus et expensae, pro illis duobus millibus scutorum modo praedicto factae, in multo excedunt custus dictorum cambiorum, si eadem capta fuissent ibidem in Tabulis: asserit saepe dictus Antonius, se illa praecisse dampna Tabularum et non ampliora debere portare, supradicto Jo. Colom dicente contrarium, et quod iuxta protestationum litteras super hoc suo tempore factas, praedictus Antonius tolerare debet et solvere omnes expensas et interesse, quod ex defectu dictae solutionis, per emptionem dictarum pecuniarum vel alias factae sunt, et de illis eundem Johannem reddere indempnem. - - - The *Tabula* here mentioned was established in 1401, and seems to have been the commencement of banks for paper-money, the first imitation of which was that formed at Genoa in 1407. I hope I shall merit thanks from my readers for adding the following information taken from the before-mentioned work, vol. i. p. 213. Este banco del cambio ò tabla, que al principio se llammò *Taula de cambi*, y estaba asegurado con el credito y las rentas publicas de la ciudad, fuè establecido primeramente en la casa de la Lonja, y era administrado por commerciantes, cuyos oficios de administradores, tenedores de libros, y otros elegia y tenia dotados la ciudad de su erario proprio. Este util establecimiento fuè adquiriendo cada dia mayor solidez en virtud

the less hope of its being gratified, as such labour must require not only a knowledge of the Spanish language, but also of the history of trade, and of maritime and commercial laws. I find the greater pleasure, therefore, in informing them that Mr. Von Martens has resolved to undertake this task.

GUNS. GUN-LOCKS.

The first portable fire-arms were discharged by means of a match, which in the course of time was fastened to a cock, for the greater security of the hand while shooting. Afterwards a fire-stone was screwed into the cock, and a steel plate or small wheel, which could be cocked or wound up by a particular kind of key, was applied to the barrel. This fire-stone was not at first of a vitreous na-

de los varios reglamentos desde su fundacion hasta principios de este siglo, que fuè quando céso el giro del cambio y la circulacion mercantil que tenian sus fondos. --- Esta tabla, segun la primitiva forma y metodo de su institucion, se custodian y aseguran sin premio todos los caudales de communidades y particulares en qualquiera especie de moneda corriente, abonandola con las debidas circunstancias de su valor intrinseco. En ella se hacen pagos y depositos por toda especie de personas: de modo que por los medios autorizados y autenticos que dimanan de las formalidades de dicha tabla quedan afianzadas la verdad y legitimidad de los creditos, y asegurada la confianza de los particulares.

ture, like that used at present for striking fire, but a compact pyrites or marcasite, which was long distinguished by that name. But as an instrument of this kind often missed fire, a match, till a late period, was retained along with the wheel; and it was not till a considerable time after that men, instead of a friable pyrites, so much exposed to effloresce, affixed a vitreous stone to the improved cock or present lock. On each new improvement, the piece, the caliber and length of which were sometimes enlarged and sometimes lessened, obtained various new names; such, for example, as *Büchse, Hakenbüchse, Arquebuse;* Musket, Pistol, *flinte,* &c. But I shall leave it to those who are able to write a history of artillery, to determine the difference between these kinds; and shall here add only what follows.

The first name undoubtedly arose from the oldest portable kind of fire-arms having some similarity to a box. There were long and short *büchse,* the latter of which, as Hortleder says, were peculiar to the cavalry. The long kind also, on account of their similarity to a pipe, were called *rohr.* Large pieces, which were conveyed on cars or carriages, were called *Karrenbüchse,* but soon after also *canna,* cannon. Instead of artillery-man, artillery, and arsenal, people used the terms *büchsenmeister, büchsenmeistery, büchsenhaus,* &c. The *hakenbüchsen* were so large and heavy that

they could not be carried in the hand; it was necessary therefore to support them with a prop, called *bock*, because it had two horns, between which the piece was fixed with a hook that projected from the stock.* Hence arose the name *hakenbüchse*, *hakenbüsse*, which the French and different nations, along with many other German words, adopted, and corrupted till they at length became *arquebuse*, *archibugio*, *archibuso*, &c.† From the passages of ancient writers collected by Daniel, it may be concluded that these *hakenbüchsen* with a wheel were invented in Germany, in the beginning of the sixteenth century;‡ and

* A figure and description of the *Hakenbüchse*, the *bock*, the wheels, and key, may be found in *Histoire de la milice Francois par Daniel*, Amst. 1724, 2 vol. 4to. i. p. 334. At Dresden there is still preserved an old *Büchse*, on which, instead of a lock, there is a cock with a flint stone placed opposite to the touch-hole, and this flint was rubbed with a file till it emitted a spark.

† Kaisers Leo Strategie und Taktik. Wien. 1777, 2 parts 8vo. ii. p. 160. A derivation undoubtedly false is given in *Polydori Vergilii lib. de rerum inventoribus*. Lugd. Bat. 1644, 12mo. p. 123. Alio nomine appellatur Arcusbusius, a foramine opinor, quo ignis in pulverem fistula contentum immittitur; nam Itali *busium* vulgo foramen dicunt, et arcus, quod instar arcus pugnantibus sit; quippe hodie hujusmodi tormenti usus in primo statim pugnæ loco est quem olim sagittariis dabant.

‡ As I have no opportunity of consulting the books quoted by Daniel, I shall here insert his own words. *Fabrice Colonne* dans les Dialogues de Machiavel sur l'art de la guerre, parle de cette arme comme d'une invention nouvelle et de son tems. L'arquebuse, dit il, qui est un bâton inventé de nouveau, comme vous sçavez, est bien

this is confirmed by the testimony of Martin Bellay. Speaking of the league formed between the emperor Charles V and pope Leo X against France, and the siege of Parma undertaken in the year 1521, he says: *de ceste heure là furent inventées les harcquebouzes qu'on tiroit sur une fourchette.* *

Pistols also, which at first had a wheel, seem to have been used at an earlier period by the Germans than by the French. Bellay mentions them in the year 1544, in the time of Francis I; and under Henry II the German horsemen, *des reiters*, were called *pistoliers*. De la Noue, who served under both these kings, says, in his *Discours politiques et militaires*, that the Germans first employed pistols. I know no probable derivation of this term. Frisch conjectures that it may have arisen from *Pistillo*, or *Stiopo*, because pistols used to have large knobs on the handle. Daniel and others think that the name comes from Pistoia in Tuscany, because they

nécessaire pour le tems qui court. L'auteur de la Discipline militaire, attribué au seigneur de *Langei*, en parle de même; la harquebuse, dit il, a été trouvée de peu d'ans en çà, et est très-bonne. Il écrivoit sous le regne de François I. Si nous en croyons *Luigi-Collado* dans son Traité de l'artillerie, imprimé à Venise l'an 1586, on ne commença que de son tems à se servir des arquebuses à roüet en Allemagne. Nell' Alemagna etiandio fu ritrovata l'inventione de gl' Archibugi da ruoto.

* Les mémoires de mess. Martin du Bellay. Paris 1588, fol. p. 55.

were there first made. He says he saw an old pistol which, except the ramrod, was entirely of iron.

Muskets received their name from the French *mouchet*, or the Latin *muschetus*, which signifies a male sparrow-hawk. This derivation is the less improbable, as it is certain that various kinds of fire-arms were named after ravenous animals, such, for example, as *falconet*. Daniel proves that they were known so early in France as the time of Francis I. Brantome, however, asserts * that they were first introduced by the Duke of Alva, in the year 1567, when he exercised his cruelty in the Netherlands, in order to overawe and keep in subjection the people of that country; and that they were not then known in France. In another place he says, that they were first made general in France by M. de Strozzi, under Charles XI.

That the lock was invented in Germany, and in the city of Nuremberg, in 1517, has been asserted

* Il fut le prémier qui leur donna en main des gros mousquets, et que l'ont vit les premiers en la guerre et parmy les compagnies; et n'en avions point veu encore parmy leurs bandes, lorsque nous allasmes pour le secours de Malthe, dont depuis nous en avons pris l'usage parmy nos bandes, mais avec de grandes difficultez à y accoutumer nos soldats. Et ces mousquets éstonnèrent fort les Flammands, quand ils les sentirent sonner a leurs oreilles; car ils n'en avoient veu non plus que nous; et ceux, qui les portoient, on les nommoit Mousquetaires. *Ouvres du seign. de Brantome*, à la Haye 1740, 15 vol. 12mo. iv. p. 89.

by many, and not without probability; but I do not know whether it can be proved that we are here to understand a lock of the present construction. In my opinion, the principal proof rests on a passage made known by Wagenseil,* from an unprinted Nuremberg Chronicle, the antiquity of which he has not determined. The same year is given by J. Guler von Weineck,† Walser,‡ Mr. von Murr, and others. It is also certain that in the sixteenth century there were very expert makers of muskets and fire-locks; for example, George Kühfuss, who died in 1600, and also others, whose names may be seen in Doppelmayer. I must not omit here to remark, that many call the fire-lock the French lock, and ascribe the invention to these people; yet as, according even to Daniel's account, the far more inconvenient wheels on pistols were used in France in 1658, it is probable that our neighbours, as is commonly the case, may have made some improvement in the German invention.

* J. C. Wagenseilii de civitate Noribergensi commentatio, Altorfi 1697, 4to. p. 150: In chronico quodam MS. legitur: the fire-locks belonging to the shooting tubes were first found out at Nuremberg in 1517.

† Raetia das ist Beschreibung der dreyen loblichen Grawen Bündlen und anderer Rætischen Völker, Zurich 1616, fol. p. 152: The ingenious fire-lock was invented, after the year 1517, at Augsburg and Nuremberg.

‡ Gabriel Walser Neue Appenzeller Chronik oder Beschreibung des Cantons Appenzell. St. Gall 1740, 8vo. p. 194, where the same account is given as by Guler.

In the History of the Brunswick regiments, it is stated that the soldiers of that duchy first obtained, in 1687, flint-locks instead of match-locks. It has often been asserted that fire-tubes, which took fire of themselves, were forbidden first in Bohemia and Moravia, and afterwards in the whole German empire, under a severe penalty, by the emperor Maximilian I; but I have not found any allusion to this circumstance in the different police laws of that emperor.

That the first fire-stones were pyrites, appears from various accounts;* and as a vitreous kind of stone was introduced in its stead, this circumstance gave often rise to confusion, some instances of which are related by Henkel, so that many applied to the stone what was related by our forefathers of pyrites. In the greater part of Europe, † people use at present that *hornstein* called by Wallerius *Silex igniarius*, and by Linnæus *S. cretaceus*. In Germany it was formerly called *Flins* or *Vlins*, which some consider as more proper; and in the Swedish, Danish, and English *Flinta* and *Flint*. This appellation is of great antiquity;

* A good number of them may be found in the second part of *Samlung der Reichsabschiede*, Frankfort on the Maine, 1747, fol.

† This kind of stone is not every where used for this purpose. In the Tyrol, for example, the hardest ferruginous granite, which consists of corneous, partly irregular and partly polyedral pieces, is employed as flints, which therefore are called Tyrol flints. In other places jasper, such as that found in great abundance in Turkey, is formed by grinding, and used in the same manner.

for the Wends had a pagan deity of that name, which they erected on a stone called *Flynstein.** In some districts of Germany this word has been still retained; for example, white or grey ferruginous spar, *Minera ferri alba* WALL. is called in Stiria *Flins*, or, as it is often improperly written *Pflinz;* and in Bayreuth that fire-stone is still called flint-stone.† In our neighbourhood the same name is still used by the stone-cutters. It cannot be doubted that the weapon which is fired by the help of this stone, obtained from it, in German, the names of *Flintgewehr*, *Flint*, or *Flinte;* but since the old name of the stone has been forgotten, it is, in general, named from the weapon flint-stone. Those acquainted with the German and northern antiquities, know that the knives employed at the ancient sacrifices, and other articles, were made of this kind of stone, as appears by the

* Of this deity an account may be found in *Eliæ Schedii Syntagma de diis Germanis*, Halæ 1728, 8vo. p. 726. also in *Albinus Meisnische Landchronica*, Dresden 1589, fol. p. 149. and in *Scriptor. Brunsvic* iii. p. 336: De Wenden de hatten weder up ören olden Afgot, de het Flyns, wente he stod upp eynen Flynsteine.

† Esper Nachricht von neu entdeckten zoolithen, Nurnberg, 1774, fol. of which expensive work I gave an account in my *Biblioth.* vi. p. 349. Mr. Esper says, those fire-stones only which contain fossils or petrifactions are called *flins*, flint; and it is possible that the singular formation may be the cause why they have retained longest the name of the pagan deity: *Omne eximium diis dicatum*, says Pliny. Fulda also, in *Samlung und Abstammung Germanischer Wurzel Worter*, Halle 1776, 4to. p. 337, translates *Flint, silex petra*, and *Flintern, fulgere*.

remains still found in old barrows and between urns.* This proves that these stones were much used by the ancients. In England and France old buildings constructed of them are still to be seen, and the stones appear to have been cut with the greatest care.† The above articles, which have lain in the earth more than a thousand years, and these edfices, among which some at Norwich were inhabited in 1403, shew the wonderful durability of this kind of stone. Some imagine that the art of working it has been lost; but though our artists prefer employing their talents and dexterity on stones which have a more beautiful appearance and less brittleness, they are able to cut also the fire-stone. Enamel painters, for the most part, rub their glass enamel on plates made of it; but they are obliged to purchase them at a very dear rate.‡

Many of my readers will perhaps be desirous to know in what manner our gun-flints are prepared. Considering the great use made of them, it will hardly be believed how much trouble I had to obtain information on this subject. One would

* Figures of such instruments, may be found in *Beckmann's Beschreibung der Mark*, and in the fifth volume of the *Archaeologia Britannica*.

† Philosoph. Transactions, No. 474. *Hamb. Magazin*, ii. p. 487.

‡ A polished plate a foot square is sold at the Vienna porcelain manufactory for five hundred florins. See *Beschäftigungen der Berliner Naturf. Gesellsch.* ii. p. 213.

laugh were I to repeat the various answers which I obtained to my inquiries. Many thought that the stones were cut down by grinding them; some conceived that they were formed by means of red-hot pincers; and many asserted that they were made in mills. On the least reflection it may be readily conjectured, that the double cuneiform shape is given to these stones without much labour, because they are so cheap; and as every country, at all times, with whatever other it may be engaged in war, can obtain them in sufficient quantity, no nation can have an exclusive trade in them. It is nevertheless difficult to discover the places whence they are procured; and in works which give an account of the different articles of merchandise they are not named. The best account with which I am acquainted, is that collected by my brother, and published in the Hanoverian magazine for the year 1772. Shepherds, and other persons who gain little by their service, break the flint-stone merely by manual labour, and chiefly in Champagne and Picardy. Some years ago Gilbert de Montmeau, a merchant at Troye, carried on the greatest trade with them, and sold them at the rate of five livres six sous per thousand. The Dutch always buy up large quantities of them, which they keep in reserve, in order to sell them when the exportation of them is forbidden by France, in the time of war. Savary, however, relates that the largest quantity and best

stones come from Berry, and particularly the neighbourhood of St. Agnau and Meusne. I know also that a great many are made at Stevensklint in Zealand,* and exported from that country. In the year 1727, the chancery of war at Hanover sent some persons to learn the art of breaking flints; but after their return, it was given out that our horn-stone was unfit for that purpose. It is possible that those stones which occur in continued veins, may be split easier in any required direction than those found in single pieces, as it appears to me that the latter are harder and more compact than the former. Perhaps the case is the same with flints as with vermilion, the preparation of which we endeavoured to learn from the English and Dutch, though from the earliest periods it had been made better in the very centre of Germany than any where else.

Long after the wheel with pyrites and fire-stone was invented for discharging fire-arms, many connoisseurs in the art of war preferred matches. Among these may be mentioned John Jacobi, named in general, from his native place, von Wallhausen, who in the year 1621 was a lieutenant-co-

* No account, however, of this use of flints is given in *Abildgaard's Beschreibung von Stevens Klint*, Copenhagen and Leipsic 1764, 8vo. though they are mentioned p. 32. Chemnitz regrets, in the before quoted *Berliner Beschäftigungen*, p. 213. that the largest and most beautiful pieces are broken in many thousand fragments, and afterwards sold for a trifle as gun-flints.

lonel in the service of the elector of Mentz, and afterwards town-major of Dantzic. In nocturnal attacks, however, which required to be made speedily and without noise, and in which three or four discharges only were necessary, he thought Netherlandish or well made fire-locks might be employed without any detriment.*

That stones were used at least in the middle of the sixteenth century, is confirmed by the account of an ingenious Italian, named Francis Angelerius. This artist had constructed a short piece of wood, to which he applied a wheel, and instead of a cock a dog, which held the stone in its mouth, the whole so ingeniously made, that a person who appeared with it at a masquerade was arrested by the guard, because it was considered to be a real pistol.† I have thought it proper to mention this circumstance, because it proves that the wheel was then invented and known under the appellation of pistol. In old arsenals and armouries, large collections of arms with the wheel are

* Defensio patriæ oder Landrettung durch Johann. Jacobi von Wallhausen. Franckfort on the Mayn, 1621 fol. p. 54 and 55.

† Hippolytus Angelerius, in a work entitled *de antiquitate Atestinæ*, p. 14, in the seventh volume of *Thesaurus Antiquitat. Italiæ:* Franciscus Angelerius finxit aliquando ex ligno et foliis auri sclopum quam brevissimum una cum rota et cane silicem in ore habente ita exacte et ingeniose, ut quidam personatus, qui in bacchanalibus illum circumferebat, in carcerem fuerit detrusus a lictoribus putantibus illum esse æneum et verum sclopum et ejus generis quod pistola vocatur.

still to be seen. Major-general von Trew and Mr. Owenus had the goodness to show me those still preserved in the arsenal at Hanover. Those which I consider as the oldest, had on the barrel the figure of a hen with a musket in its mouth, because perhaps they were made at Henneberg. A pistol of this kind was entirely of brass without any part of wood, and therefore exceedingly heavy. On the lower part of the handle were the letters J. H. Z. S. perhaps John duke of Saxony. A piece with a wheel, which seemed to be one of the most modern, had on the barrel the date 1606.

Together with fire-stones, properly so called, pyrites, which is sometimes named fire-stone, continued long in use. In the year 1586, under duke Julius of Brunswick, when abundance of sulphureous pyrites was found near Seefen, the duke caused it to be collected and formed it himself into the necessary shape, though in doing so he often bruised his fingers, and was advised by the physicians not to expose himself to the sulphureous vapour emitted by that substance.* G. E.

* Rehtmeiers Braunschw. Lüneburg. Chronica, p. 1070. Damit nichts zu spilde sondern alles zu Nutz käme, liess er solche Nieren und Steine alle Tage durch die Edel-Knaben und Trabanten herein holen und schlug die selber klein, etzliche Tönnichen voll und zog den Schwefel ins Gehirn, das ohn Zweifel derselbe, vorerzählter Maassen, die weisse phlegmatische Materie rege gemacht und zum Fluss gebracht. Er wolte sich aber davon night abreden lassen, ungeachtet er oftmals die Finger entzwey schlug, dass das Blut darnach folgete so er doch nicht achtete.

Stahl, in a dissertation published in 1716, mentioned an observation he had made in regard to that pyrites, which, as he says, was then used for fire-locks, under the name of *Feuer-Büchsen* stone.

SEIGNETTE'S SALT. SAL POLYCHREST.

This neutral salt, which consists of the mineral alkali, soda, and the acid of winestone, was prepared and made known, about the end of the seventeenth century, by a Frenchman named Seignette. The confidence with which he recommended it, and the care he employed to keep the process for making it a secret, produced, as in general, so much effect, that it was used in preference to other medicines long known, which had been of no less service; so that the inventor was enabled to acquire a fortune without much trouble. It must, however, be confessed, that he was an expert chemist, who had before gained the

* Joh. Stretz Dissertat. de vitrioli elogiis, Halæ 1716. p. 13: Minera illa sulphureo-martialis, in Variscis fodi solita e qua pyritæ pro bombardis Germanici ignitabuli formantur vulgo *Feuer-Büchsen-Steine*.

esteem of naturalists and physicians by some learned dissertations, and by various medicines which he had invented. Peter Seignette was an apothecary at Rochelle. He wrote an account of some remarkable natural productions in that neighbourhood, in the Transactions of the Academy of Sciences at Paris, or in other works, and died on the 11th of March, 1719.* This salt, by which he acquired celebrity as well as riches, he recommended in some papers printed separately, and particularly in the year 1672. He called it sometimes alkaline salt, sometimes *sal polychrest*, and sometimes Rochelle salt; and after his death it continued to be sold by his son for a long time, with the best advantage.

The mechanics have often been reproached with a want of confidence in the learned; but, in my opinion, the latter give too much cause for it. To the great mortification of human pride it must be confessed, that the most useful inventions occur to the former amidst their continual labours; and their merit consists chiefly in this, that they prosecute the discovery, seize it, and turn it to advantage. If they succeed, their interest requires that they should keep it a secret, in order to gain

* In Bibliotheque historique de la France par Le Long, augmentée par Fevret de Fontelte, Paris 1778, 5 vol. fol some of Seignette's writings are quoted; such, for example, as a paper in Memoirs de l'Acad. 1707, p. 115, also in Histoire de la Rochelle, par M. Arcére, ii. p. 424.

by a monopoly. No sooner has the literary man heard of a new art, than he wishes to become the second discoverer; and with the greater anxiety the more important the invention is, and the more it has been concealed. If he discovers it, he hastens to communicate it to the public; because, in general, he gains only by making his exertions known. The man of letters, therefore, has a great advantage over the mechanic. He acquires the character of a patriot and friend to mankind, who endeavoured to render the important advantage public; and his exertions being more applauded, he is thus enabled to throw a shade over the merit of the mechanic. These contending interests, however, are of great advantage to the whole society of which both parties are members, I mean to the public good. When the mechanic invents any thing new, the man of letters diffuses a knowledge of it, and makes it generally useful; takes care that no injury arises from it by a monopoly; that it does not die with the inventor; and, by examining the causes and defining the laws of the invention, he renders the application of it more certain, and shows how it may be employed for purposes of which the inventor never perhaps entertained an idea.* If in this manner he lessens

* Nam invenire præclare, enuntiare magnifice, interdum etiam barbari solent; disponere apte, figurare varie, nisi eruditis, negatum est. *Plin. epist.* iii. 13.

the merit of one, he, on the other hand, creates employment to many, and gives rise to researches in which thousands participate with advantage.

In this manner, Seignette the apothecary discovered sal polychrest, while engaged in making soluble tartar. Having employed salt of soda instead of winestone, under the old idea that there was only one kind of fixed alkali, he unexpectedly saw produced a salt different from the common soluble tartar which he wished to make, and from every other known saline substance. On examination he found it to be a new laxative, recommended it as such, and by the sale of it acquired a fortune. Scientific men examined this secret salt; found out the component parts of it; made them publicly known; and caused the difference between the mineral and vegetable alkalies, before overlooked, to be more accurately examined,* by which means much light was thrown on chemistry, and many of the arts were improved.

Among those who contributed to bring the new salt into vogue was Nicholas Lemery who received a large quantity of it from Seignette, and distributed it at Paris, but without making known its

* Who first discovered the difference between the vegetable and mineral alkali? To this question professor Gmelin returned the following answer: That, at any rate, it had been accurately defined by Stahl. See *G. E. Stahlii fundamenta chymiæ dogmaticæ et experimentalis.* Norimbergæ 1746, 3 vol. 4to. iii. p. 268 and 304.

component parts.* These, in the year 1731, were discovered at the same time by two French chemists, Boulduc and Geoffroi. The former announced his discovery in the Memoirs of the Academy of Sciences,† and the latter communicated his to Sir Hans Sloane, who caused it to be published in the Philosophical Transactions.‡ What therefore has been said by J. H. Schulz, in his Chemical Experiments, that Neuman in his Treatise on Saltpetre made known Seignette's salt, is entirely false; for Neuman's sal polychrest is essentially different; and he himself acknowledges§ that he was not acquainted with Rochelle salt.‖ After this, the properties of salt of soda were examined by Grosse, Duhamel, Brande, a Swedish chemist, and others.¶

* Lemery vollkommene chymist. Dresden and Leipsic 1734, 2 parts, 8vo. i. p. 521.

† Memoires de l'Academ. des Sciences. Année 1731, p. 124.

‡ Philos. Transactions, N° 436, p. 37.

§ Neumann's Chymie nach Kessels Ausgabe, i. 3, p. 160.

‖ The principal works in regard to Seignette's salt are mentioned in *Weigel's Chemistry*, Greifswald 1777, 2 parts, 8vo. ii. p. 225: To which, however, may be added *Georgii Ludov. Enckelmann Diss. de Sale alkali de Seignette ejusque natura et usu.* Argentorati 1756, 4to.

¶ Weigel ut supra, ii. p. 144, 147.

PLANT IMPRESSIONS.

If it be true that the extreme boundaries of all things approach or touch each other, one might almost believe that the arts of drawing and engraving on copper must have attained nearly to the highest degree of perfection. At present, while we have among us a Tischbein, a Haid, and other great artists, whose portraits of the persons whom they honour with their pencil or graver are such striking likenesses that they appear to live, we return again to the commencement of the art of drawing, the paltry outline of a shadow, like the love-sick daughter of Dibutades,* and think we ornament our apartments and books with these dark and dismal profiles, and that we can discover by them the talents and disposition of the

* A young woman, who was obliged to separate some time from her lover, endeavoured to discover some means by which the pain occasioned by his absence could be rendered more supportable. While engaged in these thoughts, she observed the shadow of her lover formed by the light of a lamp on the wall. Love, which is fertile in invention, suggested to her the idea of obtaining this likeness of her beloved object, by drawing a line round it on the wall, following exactly the circumference. We are further told by history, that the father of this maid, to whom the Greeks trace back their art of drawing, was a potter at Sicyon, and named Dibutades. Having considered the drawing of his daughter, he conceived the idea of applying clay to these traces. He thus made a profile of clay, which he burnt in a furnace; and this was the origin of portraits in relief in Greece. *Plin.* lib. xxxv. ii. p. 710. *Goguet*, ii. p. 194.

persons they are supposed to represent. Instead of imitating the great masters, our young gentlemen and ladies are satisfied if they can draw as well as the Grecian potter's daughter; and this they may easily do if they have not lost the use of their hands. While Ehret, Miller, and others have given us the most perfect representation of plants in engravings elegantly coloured, we daub over with lamp-black the dried plants themselves; take impressions of them on paper, and place a collection of such shadows by the side of these productions of the arts. I call them shadows, because indeed they are nothing else. They, however, exceed the former in this respect, that they express better some of the internal prominent parts, fibres, veins, &c.; on the other hand, they exhibit only the contour of dead and bruised plants, whereas the former present the living image.

I am ready, however, to acknowledge the utility of these impressions; they are cheap, and preserve so well what botanists call the appearance, *habitus*, of the plant, that they afford no small assistance towards acquiring a knowledge of many vegetable productions. I do not blame mankind for returning sometimes to the commencement of an art, from which those have deviated who carried it to the summit of perfection; for people, overjoyed at a new discovery, reject the first idea, though it very often possesses peculiar advantages,

which might be increased by new improvements. In the course of time, occasions also occur when the oldest inventions can be employed with more advantage than the new, by which they have been thrown into oblivion. Thus artists forgot the preparation of metallic mirrors, which had been long used; and, after the invention of the telescope, found themselves obliged to make numerous experiments in order to re-discover it. But these plant impressions cannot be considered as a new invention; they may rather be called the precursor of engraving.

Directions for making these impressions may be found in the oldest books on the arts. The writer meant under the name Alexius Pedemontanus* spoke of such works in the beginning of the sixteenth century; and his account was afterwards copied by Wecker† and others, who believed that very beautiful tapestry might be made in this manner, and of various colours for ornamenting rooms. At that time, however, such impressions had been used to assist persons fond of botany in the study of that science; for professor Baier had a collection of this kind formed in the above century.‡ Cardan also learned this art;

* Kunstbuch des Alexii Pedemontani—in Teutsch gebracht durch Wecker 1570, 8vo. p. 423.

† De Secretis, p. m. 829.

‡ Buchneri miscellanea physico-medico-mathematica, 1730, p. 1358.

and that it was never forgotten is proved by its being mentioned from time to time in various works.* In the year 1664 it was described by Monconys,† and in 1687 by Geyer,‡ but it was not till the beginning of the last century that it was employed in a serious manner. Omitting those who made plant impressions of this kind for their own use, among whom Linnæus § mentions Hessel, I shall here notice those only who formed

* Ejusdem argumenti est herbas ad vivum, ut dicunt, in chartis pingere. Herba virens ærugine carbonibusque tritis, imbuta pro coloris ratione alterutrum augentes chartæ imprimitur, ut vestigium quasi ichnographiæ remaneat. *De Subtilitate*, lib. xiii. See *Cardani Opera*. Lugd. 1663, 10 vol. fol. iii. p. 581.

† Journal des voyages de M. de Monconys. A Lyon 1665, 1666, 3 vol. in 4to. ii. p. 450.

‡ Si accuratissime quis velit dictamnum ejusque species depingere, tali modo poterit excellentissimum pictorem superare, nimirum si sumat atramentum impressorium (printer's ink) opeque pilæ (printer's balls) superillinat folio plantæ, ac illa vel manu, vel trochlea, vel sucula leviter imprimat chartæ nonnihil madefactæ, egregie depictam habebit plantam, adeo ut uno in momento vix accuratior effigies exhiberi poterit. In hoc tamen adest difficultas, quod in striatis aliisque floribus major requiratur labor ratione colorum, qui subtilissimo penecillo debent distribui, insuperque notandum, in omnibus coloribus vernice appropriata opus esse, quemadmodum illi norunt, qui Almanach imprimunt. Egregium certe artificium et perquam utile illis botanophilis, qui nullam artis pictoriæ notitiam habent, hocque modo egregium poterunt sibi comparare herbarium. *J. Dan. Geyer Thargelus Apollini sacer diss.* iii. *de Dictamno.* Francof. 1687, pag. ultima.

§ Linnæus says in his *Philosophia Botanica*, p. 9, that Hessel made similar impressions in America in 1707; but in regard to that man I know nothing farther.

whole collections of them, in the same manner as of engravings, for the purpose of illustrating botany.

The first printing establishment of this kind was formed by J. H. Kniphof, in 1728, with the assistance of J. Michael Funke, a printer and bookseller at Erfurt. The whole work, delivered at that time, consisted of twelve hundred impressions; but few complete copies now exist. One of them is preserved in the library of the *Academia naturæ curiosorum* at Erfurt.*

In 1727, this art was improved, and so far extended by Trampe, a bookseller at Halle, under the patronage of Mr. Büchner, a privy-counsellor, with the assistance of professor Ludwig, at Leipsic, that any number of copies required could be taken. Hence was produced that large work consisting of twelve centuries, the first of which is entitled, *J. H. Kniphofii Botanica in originali seu herbarium vivum, in quo plantarum tam indigenarum quam exoticarum, peculiari quadam operosaque enchiresi atramento impressorio obductarum, nominibusque suis ad methodum Linnei et Ludwigii insignitarum elegantissima ectypa exhibentur, opera et studio* Joannis Godofredi Trampe *typographi Halensis.*† The succeeding centuries seem to

* See Buchneri Catalogus bibliothecæ academiæ naturæ curiosorum, p. 71.

† Halæ Magdeburgicæ, 1758, fol.

have been printed at different times.* The figures are not numbered, but arranged alphabetically according to the names placed beneath them. Each century has prefixed a catalogue of all the plants contained in it.

In the year 1741, Henning, printer to the court at Berlin, began to publish such impressions, under the title, *Specimen floræ Berolinensis.* These were afterwards edited, but anonymously, by J. J. Hekker, counsellor of the consistory and director of the royal school at Berlin. I have seen two centuries with black impressions. The title is, *Flora Berolinensis,* that is, Impressions of Plants and Flowers, published by the royal school at Berlin, for the purpose of promoting a knowledge of the vegetable kingdom, 1757, fol. Each leaf has the Linnæan name imprinted on it, and at the end of each century there is an index of the impressions.

Between the years 1760 and 1764 Trampe, with the assistance of professor Ludwig, published, in folio, coloured impressions of two hundred medicinal plants, entitled *Ectypa vegetabilium—ad naturæ similitudinem expressa*—Natural Impressions of Plants destined for medicinal purposes—together with a short account of the method of cultivating them, executed by J. G. Trampe, under the inspection of C. G. Ludwig, of Halle. This

* The other centuries have, on the title pages, the dates 1759, 60, 61, 62, 63, 64.

collection consists of eight fasciculi, to each of which is prefixed an account of the plants both in Latin and German. The copy I now have before me exceeds in beauty all preceding works of the same kind, yet it is much inferior to one published at Hamburgh in 1777, with this title: *Icones plantarum: partes, colorem, magnitudinem, habitum earum examussim exhibentes, adjectis nominibus Linneanis, ediderunt* P. D. Gieseke, J. D. Schultze, A. A. Abendroth, et J. N. Buck, *opera et sumptibus* J. von Dohren.* It appears that, in this work, much assistance has been given with the pencil: but I do not know whether it was continued.† It is to be regretted, that those who exercised this art on a large scale, did not publicly make known the means they employed, and the advantages attending them.‡

* A similar work, in small folio, without a title, and consisting of three *fasciculi*, each containing twenty-five impressions, is mentioned in *von Cobers Büchersamlung zur Naturgeschichte*, 1782, 8vo. p. 491. The first plant is *Boerhavia hirsuta*, and the last *Fucus siliquosus*.

† I have given an account of all the parts of it with which I am acquainted in *Physikalisch. œkonom. Bibliothek.* viii. p. 121.

‡ Some further account of this art may be found in the following works: *F. E. Brückman Sendschreiben von der Art, Krauter nach dem Leben abzudrucken. Kniphof Sendschreiben die Krauter abzudrucken betreffend.* Both these are printed separately, but they are inserted also in *Büchner's Miscellanea physico-medico-mathematica*, 1730, p. 1346, 1353. *Observations sur la physique, sur l'histoire naturelle*—par Rozier. Tom. ii. part 2, in 8vo. 1771, Octob. p. 146. *Oekonomische Nachrichten der patriotischen Gesellschaft in Schlesien. Erster Band.* 1773, 4to. p. 84, 91.

Professor Blumenbach showed me a folio book, lent him from the library of our friend C. W. Büttner, of Jena, which consisted of coloured figures of many plants and animals, executed in the sixteenth century, partly by John Kentman and partly by his son Theophilus. Among these, is a numerous collection of the impressions of various green leaves, with the following title: *Icones stirpium impress a Theophilo Kentmanno, medico, anno* 1583. These impressions evidently belong to the infancy of the art; and it is not improbable that those of the sixteenth century, which Baier, as above stated, had in his possession, were executed by Kentman also.

That the art, however, at that time was new, or at any rate little known, is proved by two commendatory poems prefixed to Kentman's collection before mentioned, and subscribed M. Michael Bojemus, Pirnensis. In one of these, the utility, but at the same time the inconvenience and perishableness of dried plants, are mentioned; after which come the following lines, alluding to Theophilus Kentman:

Ille igitur pingui tingens fuligine plantas,
Cum fibris omnes exprimit articulos.
Ista nova est ratio plantarum discere vires,
Ignota aut certe pluribus ante fuit.

The same thing nearly occurs in the other poem:

Sed pingui inducens virides fuligine plantas,
Cum fibris oculis objicit articulos.*

I shall here remark, that the celebrated botanist Paul Herman took impressions in this manner, and left behind him a collection of them, which Von Uffenbach† saw in the possession of J. Aymon, at the Hague; also, that the book quoted from the catalogue of the library of Cobres, is the same which was edited by Gieseke and others at Hamburgh, and that, in general, it contains only seventy-five plates.

Those who wish to examine the history of silhouettes, above mentioned, should compare what has been said on the subject by Athenagoras.‡

* It is to be hoped that professor Blumenbach will publish a fuller account of this important codex, which contains many things relating to the history of botany and some of its kindred branches of science. I shall, therefore, transcribe only the following lines from an account given by Theophilus of himself, in order to rectify what has been said in the *Gelehrt. Lexicon.* Joan. Kentmanus Dresdæ natus an. Christi 1518 die 21 Aprilis hora 2. m. 30. p. m. Medicinam in urbe Misna fecit 1551, deinde Torgam se conferens, ibi mortuus est an. Chr. 1574, die 14 Junii, cujus anima requiescat in pace —Theophilus Kentmanus Joannes F. natus est anno Chr. 1552, die 21 Januarii hora 1. m. 15. p. m. qui Torgæ atque Halæ Saxonum medicinam fecit.

† Von Uffenbach Reisen, iii. p. 488; where much information in regard to Herman's family may be found.

‡ Athenagoræ legatio pro Christianis, p. 141, in the Wirzburg edition of the *Opera Patrum,* vol. iii.

CALIBRE-ROD.

CALIBRE-ROD, or artillery measuring-rod, is a rod on which the diameters of iron, stone, or leaden balls of different weights are marked, so that the calibre or diameter of a gun or cannon being known, one can discover the weight of the iron, stone, or leaden ball which it will carry. The weight of the ball also being given, it serves to determine the calibre of the piece.* It might naturally be supposed that this simple and convenient instrument must have been invented soon after the invention of heavy artillery. But, according to Hulsius,† Vossius,‡ Doppelmayer,§

* Instructions for making this calibre-rod may be found in *C. A. Struensee Anfangs-gründen der Artillerie*, Leipzig und Liegnitz 1760, 8vo. p. 65, and in many other works.

† Ander Tractat der mechanischen Instrumente Levini Hulsii. Franck. 1603, 4to. p. 5. "This measuring-rod is commonly made according to the Nuremberg foot and pound, because it was invented and arranged so by that experienced mathematician George Hartman, who lived about the year 1540."

‡ G. J. Vossii de universæ mathesios natura et constitutione liber. Amst. 1650, 4to. p. 424: Anno 1540 vixit Georgius Hartmannus, qui primus reperit baculum bombardicum, quo adhibito, scire possumus pondus globi ferrei, aliave materia constantis, pondere eo ignorato, aberrabitur in pulvere tormentario, quo onerandum est tormentum. Ejusdem baculi beneficio metiinur orificium tormenti, ut constet, quot librarum globum ex eo possimus jaculari.

§ Historische Nachricht von den Nürnbergischen Mathematicis und Künstlern. Nurnb. 1730, fol. p. 56. *G. A. Will. Nurnbergisches Gelehrten-Lexicon*, ibid. 1755, 4 Theile. 4to. ii. p. 40.

and others, it was first announced, in the year 1540, by George Hartman, at Nuremberg. This Hartman was born at Ekkoltsheim, a market village in the bishopric of Bamberg, in 1489, as is proved by the still legible epitaph made known by Doppelmayer. It is therefore a mistake in Jöcher's Dictionary, when he is called a native of Nuremberg. He studied theology at Cologne in 1510; but directed his chief attention to mathematics; and for his improvement made a tour through Italy. On his return, he settled, in 1518, at Nuremberg, where he employed himself in the construction of mathematical and astronomical instruments, such as globes, astrolabes, sun-dials, compasses, &c. He published also, in 1542, *Johannis Pisani perspectiva communis*, with proofs and illustrations; and in 1554, an astrological work entitled *Directorium*. He was afterwards vicar of the church of St. Sebald at Nuremberg, and died there in the month of April 1564. The calibre-rods which he prepared were adapted to the Nuremberg foot and pound; and for a long time all the calibre-rods in Germany were constructed according to this standard.

Since the above was written, professor Meister has shown me that Fronsperger makes it doubtful whether Hartman was really the inventor of this instrument. The passage in his book on war* re-

* Kriegsbuch. Andrer Theil. Frankfurth 1596, fol. p. lxxxi. a.

lating to it I shall here transcribe. "Among the ingenious gauges and gauging-rods for measuring many bodily things by geometrical means, the gauging-rod for great guns, first brought into use at Nuremberg in Germany, as I understand, by that well-experienced mathematician M. George Hartman, as he asserts, but first properly described in the Italian language by Nicholas Tartaleo, of Brixen, near Venice, is not the least important." Fronsperger then gives an accurate account of the method of constructing and using the calibre-rod, and shows how it may be made to agree with the weights of different nations. He gives also a figure of one constructed according to the Bavarian or Austrian standard, and says, that one corresponding to the Nuremberg weights had been made by Dr. Walter Reyffen, and given to him as a keep-sake. From these two also the proportion between the different weights could be determined.

Nicholas Tartaglia, for so the name ought to be written, was not a native of Brixen in the Tyrol, as Fronsperger says, but of Brescia, a town in the Venetian territories. He is styled in the title to some of his works *Brisciano*, and in that to Gosselin's French translation of his Algebra, *Brescian.* Some account of the life and services of this mathematician may be found in Bayle's Dictionary, and a list of his works is given in *Teissier Eloges des Hommes savans.* In one of them, called *Que-*

siti et inventioni diverse, the second book has the following title: *Sopra la differentia, che occorre nelli tiri & effetti fatti con balla di piombo, over di ferro, over di pietra, & altre varie particolarità, circa la proportione, peso & misura nelle dette balle,* where the principles on which the calibre-rod must be made are explained. I do not know in what year the above work was printed; the first book has the date 1538. I shall leave others to examine whether more particular directions for constructing this instrument may not be found in other works of the same mathematician, and shall only observe, that the *Quesiti & inventioni* were several times printed separately; but I find them also in a collection entitled: *Opere del famosissimo Nicolo Tartaglia, cioé Quesiti; Travalgliata inventione; Nuova scientia; Ragionamenti sopra Archimede.* In Venetia, 1606, 4to.

WILD CHESNUT-TREE,

Of all the exotic trees which have become indigenous amongst us, none is more beautiful than the wild chesnut. In a short time and without care, it shoots up into a high tree, the branches of which, together with their majestic leaves, form a crown, covered in spring above all, with pyramidal bunches of reddish and white flowers. It affords a most pleasant shade; withstands the cold; bears

the loss of those boughs which are inconvenient to the possessor, and attains often to the age of above a hundred years. It is a pity however, that this tree should not be of more utility: its wood is bad, and not proper even for firing; the fruit, which grow in abundance, and on which various experiments have been made in order to procure something useful from them, serve no other purpose than that of being food to goats and wild animals;* and I do not know whether what the Turks believe, that they are a medicine for short-winded horses, has been ever confirmed by the experience of the Europeans. From that idea, however, the Turks have formed the name which we retain under that of *Hippocastanum* the horse-chesnut.

The earliest account I have found of this tree, which was certainly brought to us from Turkey, about the middle of the sixteenth century, is in the letters of Mathioli, first printed in 1561; but which appear for the most part to have been written about the year 1559. The letter to which I allude is addressed to Aldrovandi at Prague, but without any date. To this letter Mathioli refers in his commentary on Dioscorides,† in which he has

* See Count Von Mellin's, *Anweisung zu anlegung der wildbahnen*. Berlin 1779, 4to.

† The oldest Latin edition of the above commentary, that of 1553, does not contain the least information respecting this tree. I found an account of it in *Commentarii in Dioscoridem, jam denuo ab ipso auctore recogniti et locis plus mille aucti; adjectis plantarum iconibus supra priores editiones longe pluribus.* Venetiis 1570, fol.

given the first figure of a branch with the fruit, but without any flowers. At that time he had received a branch with some leaves, and likewise some of the dried fruit, by order of the imperial ambassador at the Turkish court, whom he calls Augericus of Flanders, from his physician William Guaccelbenus, who was also from Flanders; but he does not say that attempts had been made to introduce the tree into Europe.

In *Lobelii Adversaria*, printed at Antwerp in 1576, there is only a very short account of this tree. The author, Matthias de l'Obel or Pena, says that Rondelet had some of the fruit which he tasted; but that he had procured, by means of a friend, some of the same, together with other rarities from Baruth in Egypt.

The earliest account of this tree in the writings of Charles de l'Ecluse, to whom the introduction of it into Europe is generally ascribed, is to be found in a work,* the preface to which was written at Vienna in 1582. It was then considered as a botanical rarity; and this diligent botanist had seen neither its flowers nor its fruit fresh; but he describes the latter from fruit which were brought

p. 163; and in *Matthioli opera omnia edita a Casp. Bauhino.* Basilliæ 1674, fol. p. 183. The figure in Bauhin's edition is different from that in the Venetian: it has flowers and fruit, but is however very indifferent. The letter above quoted is to be found in Bauhin, p. 125.

* Clusii rariorum stirpium per Pannoniam Austriam et vicinas provincias observatarum historia, Antverpiæ 1583, 8. p. 5.

from Constantinople to Vienna in 1581. He gives a new figure, but without blossom, and the fruit are delineated without the shell.

In a later work of the same author, the preface of which is dated at Leyden in 1601,* he says, that he first procured fruit with the shell in 1587, from Christopher Wexius, who had returned from Syria and Egypt; and that he had left behind him at Vienna, in 1588, a large tree twelve years old, which however had not then produced bloom. It would appear that this tree was not planted at Vienna, at least by Clusius, else mention of it would have been made by him in his old works.

Though it is certain that the first knowledge of this tree was brought to Europe from Constantinople, it appears to me however improbable that it grew originally in that neighbourhood. Had it always grown there, it would hardly have remained so long unknown; but the smallest trace of it is not to be found in the ancients; and I do not recollect that any of the modern travellers, who have enumerated all the plants that grow wild in the Levant, make the least mention of it.

This tree must have been introduced into France, at a much later period than among us, if what Tournefort,† and Duhamel‡ say be true, that it

* Rariorum Plantarum Historia. Antverpiæ, 1601, fol. p. 7.

† Voyage, ii. p. 16.

‡ Abhandlung von Bäumen, Stauden und Sträuchen Nürnberg 1762, 4to. i. p. 208.

was first raised from seed, procured from the Levant in 1615, by one Bachelier, whose flower gardens at Paris were much celebrated. At the time when Sauval wrote there was shown in one of the public gardens there a horse chesnut-tree, which was not only the largest and most beautiful of its kind, but was considered also as the stock from which all the other trees in the kingdom had been propagated.*

ALMANACKS. COURT CALENDAR.

WHERE and at what time did people begin to print almanacks similar to those used at present, in which the year is divided into months, weeks, and days, and the time of the different festivals pointed out? It is not very probable that this question can be fully answered; for it appears, that the old almanacks were always torn up as waste paper; and those, who have described the productions of the earliest printing-houses, seem either to have found no works of this kind, or to have considered them as unworthy of their notice.

The first printed almanacks were not annual,

* In the temple there is a horse chesnut-tree, which is not only the largest and finest in the kingdom, but the father, as they say, of all those we have in France, and one of the most beautiful trees that can be seen. *Histoire de Paris*, iii. p. 45.

that is to say, calculated, for one year, but rather for several years, like those which are prefixed to the oldest Breviaries. They had a resemblance to the so called perpetual almanacks. One could find in them, for some years to come, the golden number, the saints-days, and the changes of the moon, with as much accuracy as was necessary in the common affairs of life; and in most of them instructions were given for that purpose. From time to time, new editions were published under the title of "Almanach or new Calendar." It is not improbable that for some time after the invention of printing, those calculated only for one year were found to be too expensive.

In the fifteenth and sixteenth centuries, astrology was every where in high repute; and astrologers published their predictions, under the title of *Practica*, sometimes for several years together, and sometimes for one year. These *practica* in the course of time were combined, with the almanacks calculated for several years, and at length when annual almanacks began to be printed, these *practica* were considered as an indispensable part of them, of which remains are still to be found in the almanacks published for the use of the common people. The *practica*, which were printed separately, might be considered as almanacks, if one knew nothing more of them than the title. A particular account of a great many of them may be found in *Information collected by the Economical*

*Society in Franconia.** This work which contains a great deal respecting the history of astrology as well as the history of literature, was edited, according to professor Baldinger, by Mr. Rabe, diaconus at Anspach.

Two old almanacks, calculated for several years and bound up with the *practica*, I have now before me; and I shall here give a short account of them, as all the other copies, perhaps, are lost: however little the loss of them is to be regretted, they might, however, have been of considerable use to those who wish to write a history of almanacks. The first has the following title. "An Epitome of the Natural Art of Astronomy, by the far famed M. John Künigsperger. Of the natural influence of the Stars, Planets, and twelve Signs, &c.; what is useful for every one to know on that subject; and what is to be observed in regard to the natural exercises; to which is added an almanack, and every thing necessary for the use of it, as pointed out in the index." It consists of forty leaves in quarto, and has several astrological figures cut in wood. At the end stands: "printed at Strassburgh by Christian Egenophen, for the heirs of Paul Götz, citizen of Strassburg, MDXXIX."†

* Gesamleter Nachrichten der Ökonomischen Gesellschaft in Franken, herausgegeben von Hirsch. Zweyter Jahrgang. Anspach, 1776, 4to. p. 201—225.

† The title in the original is: Naturlicher Kunst der Astronomei, Des weitberumpten M. Johannen Künigspergers kurzer Begriff. Von natürlichem influss der Gestirn, Planeten und XII.

The other has a much greater resemblance to our almanacks. The title is: "A new Calendar of all kinds of medicine, as directed by the seven planets - - - by the far famed John Künigsperger, carefully compiled from the most excellent astronomers and physicians. Newly revised and improved. - - - Printed at Strassburgh, by Jacob Kammerlandern, Anno MDXXXVII."* It makes almost a whole alphabet in quarto. The calendar prefixed is printed in Roman characters, and in the explanation, is the following passage: "After this there are two eclipses of the sun and moon, with an account of the year, month, and day, when they will take place, and how long they will continue, calculated from the year thirty-six to the last. And one can also easily remark other accidental phenomena of the heavens." It may be here readily seen, that the object in these publications, was not so much to furnish the purchaser

Zeychen, &c. Was einem jeden dabey zu wissen förderlich sey, Sich also darnach in der Natur nötigen Uebungen zu halten hab, Mit enim beigelegten Kalender, und was dazu dienlich, nach anzeyg Regïsters dem Kalender nachgesetzt. - - Getrukt zu Strassburg bei Christian Egenohphen, Für den Ersamen Paulum Götzen, bürger zu Strassburg. Im MDXXIX. jar.

* Eyn newer Kalender, von allerhandt artznei, durch anzeygung der sieben Planeten - - - von dem weitberhümten Joanne Künigsperger, auss allen fürtreflichen Astronomis und Medicis, fleissiglich zussammen geschrieben. Itzundt von newen verlesen gebessert. - - - Getruckt zu Strassburg bei Jacob Kammerlandern. Anno, M. D. XXXVII.

with a convenient almanack, as to facilitate to him the astrological choice of days proper for taking medicine, as well as for other affairs, and consequently the greater part of them is devoted to medicine.

In the Brunswick *Anzeigen* for the year 1745,* and the following year,† there is an account of the oldest printed almanacks, an abridgement of which I shall here insert with a few observations.

The oldest mentioned is of the year 1491, printed at Augsburg in octavo, without the name of the editor or printer. The poetical title is in substance as follows.

"This small book is divided, as the year is supposed to be, into months. It teaches farther, when to use food and drink, and when to take physic, according to the nature and influence of the stars. When to bathe, and how to regulate pregnant women who are fruitful; how children are to be educated, and how to guard against the plague. It is therefore a book of medicine."

Except the tables of the twelve months, the whole work is written in German rhyme, and every where ornamented with a great number of woodcuts. It consists of twenty-three sheets, and at the end has: "Printed at Augsburg in the year LXXXXI." No mention of this almanack is to be found in the *Annales typographiæ Augustanæ*, 1778, 4to.

* P. 1659, and 2037. † P. 138.

In the year 1519, an almanack was printed at Lubec, in the dialect of Lower Saxony, by Stephen Arndes. It consists of twenty-one sheets and a half quarto, and has exactly the same title as the next of the year 1523. At the end is the following notice: "Here ends the new Calendar. Printed in the imperial city of Lubec. In the printing house of Stephen Arndes. In the year after the birth of Christ our Lord, as we write it, one thousand five hundred and nineteen."

There is no account of this almanack according to Mr. Ballenstedt, in whose possession it is, either in the well known work of Mattaire, or in von Seelens *Selecta litteraria*, or in the account of the origin and progress of printing at Lubec.

In the year 1523, Louis Dyetz printed an almanack at Rostock, in eighteen sheets quarto, with beautiful wood cuts, under the following title; "The Shepherds' Calendar, a very pretty and useful book, containing much valuable matter, an account of which will be found on the back of this leaf; also at the end of this book, will be found a small treatise of Physiognomy, from which one may learn to know the character and natural disposition of men."* On the reverse of the title page,

* Der Schapherders Kalender. Ein sere schone unde nutthe Boek, myt velen fruchtbaren materien, so tho rügge düsses Blades klarliken gefunden wert. Item tho Ende düsses Boeks, vyndet men de Kleyne Physonomie, uth welkerer des mynschen complexie unde toneghynghe der natuer klarlyk to erkennen wert.

the contents are given in the following words: "A new Calendar, and an ingenious usefull book, in which will be found the new moon, the dominical letter, the golden number, and how many weeks there are between Christmas and the first Sunday of Lent, also in what sign the moon is for every day in the year; and the nature of the twelve-signs, and the seven planets, the course of the heavens and of the terrestrial sphere, also of phlebotomy, cupping, bathing, and on taking medicine; also the inspection of man's urine, by which one can discover all human diseases, and many other articles of information and knowledge useful to mankind." In the Brunswick *Anzeigen*, a passage is printed from the preface, in which the author compares the life of man to the twelve months of the year, and to each month reckons six years of man's life.

As I have not seen any of these almanacks I am not able to determine how far they resemble ours at present; but, in all probability, they belong to those calculated for several years, of which I have already spoken.

From the title, "The Shepherds' Calendar," I should be induced to conjecture, did not the contents seem to show the contrary, that it consisted only of a collection of meteorological observations and prognostics of the weather. At any rate, this is the case with the *Shepherds' Calendar*, which has been often and still is printed in England. Haller, in his *Bibliotheca Botanica*, quotes a

London edition of 1579. 4to.* In the *Haussvater*, I find: "The Shepherd of Banbury's Rules to judge of the changes of the weather, grounded on forty years' experience, by John Claridge, London, 1744. 8vo. John Mills, the well known compiler of economical works, caused this book to be reprinted in 1770, 8vo. and a German translation of it was published at Leipsic, in 1772, 8vo. I have given an account both of the original and the translation in my Physical and Economical Bibliotheque.†

I consider, with more certainty, the following as an annual almanack, similar to those now in use; and if I am not mistaken, it is the oldest that I can at present point out. I know it, however, only from the Brunswick *Anzeigen. Almanack, and Practica Doctoris Johannis Wolmar*, for the year M.D.XLVI. in 16mo. On the reverse stands: "Calculated for the meridian of the highly celebrated and honourable city of Hamburgh." Then follows an explanation of the characters used in almanacks. Under each month there are four lines of poetry. Some of them, with other extracts, may be found in the Brunswick *Anzeigen.*

In the above quoted dissertation of Mr. Rabe, there is a whole series of French almanacks, the

* I. p. 359. † Vol. iii. p. 51.

oldest of which, however, is only of the year 1576. Highly worthy of notice, in particular, is the account given of those published by the celebrated astronomer, Simon Marius, of Gunzenhausen, after the year 1610, when he styled himself mathematician to the prince and student of medicine. In the dedication to the *Practica* of 1612, he mentions the new instrument, invented in the Netherlands, by which, in the month of December, 1609, he discovered that the milky way and nebulous stars were a *congeries plurimarum fixarum;* also that Venus was illuminated by the sun and had phases; and from the end of December, 1609, till the middle of April, observed four new planets around Jupiter, the revolutions of the two outermost of which he had already calculated.

The oldest almanack in the library of our university, at present, is the following: *An Universal Almanack and short Practica for several years, together with a calendar newly corrected,* printed at Munich, by Adam Berg, in the year MDLXXXIII. sixteen leaves in quarto.* One page is always left blank for memorandums, as in our annual pocket-books.

In the Brunswick *Anzeigen,* the large Roman

* Alt Gemain Almanach, und kurze Practica auff etliche Jar, sambt dem New Corrigirten Calender - - - Auff das Jar MDLXXXIII. Gedruckt zu München bey Adam Berg.

Catholic calendar, published by John Stöffler, celebrated on account of the service which he rendered to the mathematics, and by his prediction of a great flood, which spread terror throughout all Europe, is given as one of the first publications of this kind. But though that work contributed greatly towards the improvement of the calendar, it does not properly belong to this head, but rather to the astronomical ephemerides, in which are given the sun's place, the longitude and latitude of all the planets, and other phenomena of the heavenly bodies, calculated for several years. I have now before me two editions. One is entitled, *Calendarium Romanum magnum Cæsareæ majestati dicatum* D. Joanne Stoefflero Justingensi mathematico authore, fol. At the end stands: *Impressum in Oppenheym per Jacobum Köbel, anno* 1518. The other is a German translation: "The New large Romish Calendar, printed in the year 1522, at Oppenheim, fol." In this work is already seen the whimsical figure of the blood-letting man, which was afterwards introduced into common almanacks to ridicule the credulity of mankind. Of this kind also is the following work: *Allmanach nova plurimis annis venturis inservientia:* per Joannem Stoefflerum Justingensem et Jacobum Pflaumen Ulmensem *accuratissime supputata et toti fere Europæ dextro sydere impertita.* In quarto. The copy in the library of our university is inscribed *Venetiis* 1507.

The *Almanach nova* of Stoeffler must have been printed also at Olmutz, in quarto, so early as the year 1499; but this edition seems to be very scarce. It became known to me by the following circumstance. In 1765 the gymnasium of Strengnæs, in Sweden, exposed to sale by public auction a great number of books printed in the fifteenth and sixteenth centuries, the principal part of which Gustavus Adolphus had sent to Sweden from Prague, along with a great number of shields and other curiosities, which were shown to me in the castle of Drotningholm. The catalogue of the books was entitled: *Catalogus librorum ab antiquis bibliothecis Pragensi et Olmuciensi, quibus olim regium gymnasium Gustavianum Strengnesense donaverat gl. m. Regina Christina. Horum vero non nisi superflua et in duplo inventa exemplaria a cæteris separata, sub hastâ publica vendentur Stockholmiæ m. Octob.* 1765.* In this catalogue was the almanack above-mentioned. A good account of Stöffler may be found in Bayle's Dictionary.

Mr. Weisser was so kind as to send me an

* In this catalogue, among other scarce books, I observed: *Hieronymi epistolare* 1471, fol. A Latin bible of 1491; another of 1489, and a third *cum interpretationibus* 1486, fol. *Ludolphi de Saxonia comment. in vitam Christi.* Norimb. 1483, fol. *Historia Lombardica sive Legendæ Sanctorum. Argent.* 1486, fol. The same book Ulm 1488, and at Basle, 1486: *Gregorii* ix. *compilatio Decretalium* Basil. 1482, fol. The same Colon. 1481. *Thomæ Aquin. Summa theologiæ,* iii. vol. fol. Mogunt. 1467.

account of some very old almanacks which he had an opportunity of seeing at Stutgart; and I here insert it with the more readiness, as they are mentioned in other works only in a very brief or imperfect manner.

"A calendar newly arranged, with much information in regard to the celestial motions of the time; the Christian precepts also briefly expressed in rhyme, and printed with pleasing examples and figures."* Twenty-four leaves in quarto not paged; printed in German characters, with a great many wood-cuts. Each month occupies a page; and there are as many verses as there are days, in which the names that belong to these days are inserted. Then follows the *Practica*, and a preface by James Köbel, town clerk of Oppenheim. The *Practica* treats on the division of time, prognostications of the weather, phlebotomy, cupping, &c. At the end stands: "Printed at Oppenheim," without any date, though there is reason to think that the year was 1512, because that year is used in the introduction, where the method of finding the dominical letter is exemplified, and in other problems. James Köbel, here mentioned, is the same person whose Treatise of Geometry was published after his death, at

* Kalender. Newgeordnet, mitt viele underweisungen der Himelischen leuff der zeit, der Christlichen Gesetze auch kurzweilig (gereympt) und lustig mitt Exempeln und Figuren getruckt. Oppenheim.

Franckfort on the Mayn, in 1563, 4to. with a great many beautiful wood-cuts.*

"The German Calendar of Master Joannis Küngsberger." Each month has two pages, and for each is given the length of the day, the rising and setting of the sun, &c. It contains seventy-one leaves in quarto; but, as the last are wanting, the date and place where printed cannot be known: it is not improbable, however, that the date was 1513, which is that placed over each month in the calendar. It is ornamented with a great many wood-cuts.

"German Calendar of Master Joannis Küngsperger, printed at Augsburg, 1518.† This calendar is mentioned both by Zapf and Panzer.‡ Mr. Weisser remarks, that the 29th of February, which does not occur in the preceding calendars, is not marked with a letter like the other days, and therefore the week from the 26th of February to the 4th of March comprehends eight days.§

* Respecting Köbel, see Scheibel's *Einleitung zur mathematischen Bücherkentniss*, ii. p. 525. where *Oygenheim*, however, is an error of the press; also Panzer's *Annalen der Teutschen Litteratur*, Nurnberg 1778, 4to. p. 385 and 446, where he is named Kölbel. Zapf, *Annales typographiæ Augustanæ*. Augustæ Vindel. 1778, 4to. p. 58 and 64, where he is again named Köbel.

† In Kostung und verlegung - - - Hans Millers am Kalende Julii MD. xviii.

‡ By the former, p. 71. and the latter, p. 422.

§ This calendar, printed in July 1518, was intended for the following year, which was leap-year; and therefore in February had

Cathechismus Joannis Brentii, by Philip Melanchthon, &c. At the end stands: "Printed by Valentine Otthmar,* Sedez." The first sixteen leaves contain a calendar, in which the 29th of February is reckoned; and therefore the week runs only from the 26th of February to the 3d of March.

In the library of the Grey Monastery at Berlin, there is a collection of old almanacks, from 1578 to 1700, amounting to one hundred and twenty different articles, a catalogue of which professor Ditmar was so kind as to send me. The following are extracted from it.

Calendar and Memorandum Book for the year 1578, by Victorius Schönfeld, doctor of physic and mathematician at Marpurg, in Hesse, printed at Leipsic, by Nicholas Nerlich, die-cutter, with an imperial privilege, fourteen leaves quarto.

1579. Calculated by Mauricius Steinmetz, Gersbachius, licentiate of physic, printed at Erfurt, by Melchior Sechsen.

1581. Almanack by Leonnard Thurneysser, of Thurn, physician to the elector of Brandenburgh, printed at Berlin, with an imperial permission, for the heir of Michael Hentzken. In the printing-

only twenty-eight days. On that account the 29th could have no letter, even though it was marked in it.

* Of this Otthmar see Zapf, p. lxvii. He was a printer at Augsburg about the year 1540.

office of Simon Hütter and Sigismund Feyerabend.

1588. By M. Valent Steinmetz, Gersbachius, curate of Tunzenhauzen.

1589. By M. Albinus Moller, Straupicensis, Lusatius, ecclesiastes et astronomus.

1590. By the same. At the end is a catalogue of the fairs.

1593. Per Heinric. Windanum Corbach. Ossenb. schol. lector.

1594. Per Casparum Bucham medicum ordin. at Quedlinburg.

1602. Per M. Sim. Mentium of Quedlinburg, professor of mathematics at Helmstadt.

1611. Per Sam. Frobergium a Ronnenburg, med. doctor at Northeim. Printed at Erfurt.

H. Mann, bookseller at Nuremburg, had in his possession a large collection of old almanacks, the earliest of which was of the year 1490. A catalogue of them was reprinted in thirty-one pages, 8vo.; the beginning of which may be seen in Hirsching's Description of remarkable Libraries.*

* Beschreibung sehenswürdiger Bibliotheken. Erlangen, 1788. 8vo. iii. p. 142.--- Those who may be desirous of giving a fuller history of almanacks, will find much useful matter in the following books: Scheibel's valuable *Einleitung zur mathematischen Bücherkentniss*, Breslau 1718, 8vo. parts 13 and 14. p. 1 to 142. Panzer's *Annalen der alten Teutschen Litterat.* p. 76, 77, 92, 93, 168, &c. Pilgram *Calendarium chronolog. medii ævi*, Viennæ 1781. 4to. and

The oldest Ephemerides *, are those which the celebrated John Muller Regiomontanus caused to

in H. Spiess observations on this work in *Archivischen Nebenarbeiten*, Halle 1783, 4to. ii. p. 90. where mention is made of a printed calendar, with German verses of the year 1470. In Möhsen's *Beschreibung einer Berlin Medaillen—Samlung* ii. p. 418, 421, various medical almanacks are mentioned. Denis *Bücherkunde*, ii. p. 236. Reinmann in the *Histor. Litterar.* of Germany, iv. p. 257. has given some account of the Practica of John Carion, who published that work for several years, and of other old almanacks. The nature of the first almanacks is described by professor Grellman, in his *Historischen Kleinigkeiten*, 1794, 8vo. p. 1.

* A brief history of Astronomical Ephemerides is given by de la Lande, in his *Ephemerides des mouvemens celestes*, Paris 1774. 4to. Of the scarcest editions of Muller's Ephemerides, an account may be seen in Doppelmayr von Nurnb. Mathematicis, p. 8, 9, 10. also in G. M. Bose. Diss. Otia Wittembergensia, 1739, 4to. and in his Program. Eclipseos lunaris 1457 secularia. Scheibel remarks, part iii. p. 10, that John de Sacro Bosco's work *de Sphæra*, was the next printed astronomical book to Manilius. Respecting the Calendar-Practica of Schöner, which he published till 1543, see Doppelmayr, p. 47. Stöfler's *Almanach nova*, already mentioned, was first printed at Ulm, in 1499, and continued from that year to 1531. Oelnitz is a typographical error, which has some how or other arisen from Ulm. See Hauber Historische nachricht von den Landcharten des Schwäbischen Kreises, Ulm 1724, 8vo. p. 70. A cöpy of this calendar: *Almanach nova per* Joan. Stoefflerinum et Jacobum Pflaumen Opera Joan. Reger. Ulmæ, 1499. 4to. is described in Seemiller *Incunabula* typographica Bibliothecæ Ingolstadiensis. Fascic. iv. p. 119, and in Strauss *Opera rariora*, p. 244. In the edition of the *Almanach nova*, Venetiis 1518, 4to. in ædibus Lichtenstein, which is not often quoted under Stöfler's dedication, stand the following words; Ex Ulma Idibus Februarii anno millesimo quadringentesimo nonagesimo nono. A good account of the calendar, printed by Erhard Ratdolt at Venice, in 1476 and 1483, is given by Marchand, in *Dictionnaire historique* ii. p. 157. An old Practica of 1538 and 1539 is described in Köhlers *Beyträgen zur*

be printed at Nuremberg, in 1474, and which, with the poem of Manilius, were the first astronomical books that issued from the press. They extend from 1474 to 1505. If there are any older, they certainly are not worth notice. In France the first were calculated by Noël Duret de Montbrison, and printed in 1641, under the following title: *Novæ motuum cælestium Ephemerides Richelianæ.* They extend from the year 1637 to 1700. A chronological catalogue of the principal Ephemerides was given by de la Lande, in *Supplement à l'Encyclopedie*, Amsterdam, 1776, fol.*

The Connoissances des Tems was first printed at Paris, in 1678, in sixty pages, small duodecimo, with the following title: *La Connoissance des tems, ou Calendrier et éphemérides du lever et du coucher du soleil, de la lune, et des autres planetes, avec les éclipses pour l'année*, 1679, *calculés sur Paris, et la maniere de s'en servir pour les autres élevations, avec plusieurs autres tables et traités d'astronomie et de physique, et des éphémé-*

Teutschen Litteratur. und Kunstgeschichte, i. p. 245. It is remarked in C. L. Lieberkühn's *Miscellaneen.* Stettin, 1779. 8vo. p. 87. from Lewezow's *Abhundlung von der Wanderung der Buchdrucker kunst und ihrer Ankunft in Pommern*, Stettin, 1774. 4to. that the first annual almanacks were printed at Stettin, in 1577, by George Rhete, pastor of the church of St. Peter and St. Paul. In France the *Almanach Royal*, according to d'Origny, i. p. 35. was first printed in 1679.

* II. p. 817.

rides de toutes les planetes, en figures. The author was the celebrated astronomer Picard, though he no where announced his name. In the year following he improved the plan of this work, and made it still more valuable. He was followed in this labour by Le Febure, 1685; Lieutaud, 1702; and Godin 1730. In 1760 the publication of it was intrusted to De la Lande.*

The Nautical Almanack was first published by Dr. Maskelyne, in 1767. The *Ephemerides astronomicæ* of Vienna were begun by Maximilian Hell, in 1757.

Möhsen says† that the Germans have this advantage, that astrological rules respecting the health and various affairs, as well as predictions in regard to the fate of nations, are to be found in their almanacks only, and not in those of the Italians, French, and English. But this cannot be correct, for in the *Dictionnaire historique et geographique de Bretagne*, par Ogée,‡ it is said: "Le premier faiseur d'almanach ou tireur d'horoscope parut à Nantes, en 1463 ou 1464;" and from other information, it is known that Charles IX, in the year 1560, and Henry III, in 1579, forbade almanack-makers to introduce into them any predictions. The severe prohibitions issued

* See his account in Supplément à l'Encyclopédie, ii. p. 548.

† Beschreibung einer Berlin. Medaillen-samlung, ii. p. 420.

‡ Nantes, 1779. 4to. iii. p. 135.

on these occasions, may be seen in *De la Mare Traité de la Police.**

That the days of the month were not marked in the first almanacks with numbers, as at present, but with the names of the saints and according to the festivals, has been already observed by Fries. †

The first almanack in Russia was: "The St. Petersburgh almanack for leap year, 1728. St. Petersburgh, printed in the typographic establishment of the Imperial Academy of Sciences." On a copy sent to me by professor Reuss, from the library of the University of Tubingen, the following words were written: Calendarium hoc ex duplici capite rarum, primo, quod primum omnium est in Russia ipsa elaboratum, et typis expressum; secundo, quod computatum est calculis M. Christoph. Frid. Maieri, nostratis, Kircho-Teccensis, Academiæ Scient. Petropolitanæ professoris matheseos, et ibidem pie defuncti anno 1729, die 24 Novembris, veteris hujus styli, quem calendarium hoc præcipue ostendit. Inclytæ hujus universitatis biliothecæ insertum esse optavit M. Georg. Wolffgangus Krafft, physices et mathesios professoris p. o Tubingæ die 18 Dec. 1744.

The history of Court Calendars has been given in a particular work, by H. von Schwarzkopf,

* I p. 561.

† In Abhandlnng vom Pfeiffergerichte Frank. 1757, 8vo. Preface, p. 13 and p. 108.

printed at Berlin, 1792. 8vo. I am, however, inclined to carry the origin of them to an earlier period; not to the *Fasti*, but to the so called *Notitiæ*, which contain the first lists of public officers of state. I here include both the well known *Notitia Imperii*, the editions of which may be seen in *Fabricii Bibliotheca Græca*,* and the *Notitiæ Episcopatuum*, and *Provinciarum et Civitatum*.†

Mr. von Schwarzkopf makes the Hamburgh directory of the year 1787 the first work of the kind published in that city; but Mr. Gunther, one of the senators, asserts that the oldest state calendar for Hamburgh, was printed so early as 1698.

Among the oldest court calendars, not mentioned by Mr. Schwarzkopf, the most remarkable perhaps is the Austrian of the year 1636. It was printed in 1637 in small duodecimo,‡ without the name of the author, printer, or place, under the following title: *Status particularis regiminis sacræ Cæsareæ majestatis Ferdinandi* II. This small work is sometimes found in libraries among the Elzevir Republics, with which it can be classed only on

* Lib. iv. cap. v. § 6. vol. i. p. 752.

† A good account of these may be found in Fabricii Bib. Græca, lib. iv. cap. 2. § 19. vol. iii. p. 85. and in Bosii Introductio in Notitiam Scriptor. ecclesiast. inserted in T. Crenii Tractatus de Eruditione comparanda. Lug. Bat. 1669. 4to. p. 413.

‡ It contains 365 pages.

account of its size. It begins with a short statistical view of the Austrian states: then come the topography of Vienna; the virtues and manner of living of the emperor; on the ceremonial of the court; the different colleges; of the empress, and the foreign ambassadors at the imperial court. In the part relating to the imperial table,* court fools are mentioned: Moriones tunc etiam jocoseria facetiasque, inter hos vero potissimum Jonas morionum alpha pro re nata, producunt et effundunt prout tempus et occasio exigit; nunquam vero majores ac liberiores quam cum Cæsarea majestas peregre seu venando occupata est.

The court calendar, which begins properly at the ninety-third page, has this title: Sacræ Cæsareæ majestatis Ferdinandi II. completus imperialis status aulicus, ubi agitur de omnibus superioribus et inferioribus ministris et officialibus, consiliariisque intimis - - - item de negotiatoribus opificiariisque aulicis, musicis, &c. sicuti hic status in urbe Vienna, quæ nunc imperialis est sedes, constitutus erat anno 1636. The first article is: Supremus aulæ magister D. Leonhard. Hellfried, comes a Meggav. Then follow the *consiliarii intimi*, and all the other persons in office; but the inferior ones are not mentioned by name, but according to their number. Thus, for example, in page 114: Culina aulica: 1 coquus oralis seu oris, ut sonat

* Page 47.

idioma Germanicum *Mundkoch;* 6 coqui magistri; 10 coqui inferiores; 2 assatores; 2 adjuncti; 2 coqui jusculariі; 2 appositores; 8 culinæ pueri; 2 culinæ latores seu geruli; 1 culinæ ostiarius; 1 lignator. Page 115, Lotrices: 1 lotrix corporis, female washer of the body; 1 lotrix oris, female washer of the mouth; 1 lotrix mensæ, female washer of the table; 1 lotrix culinæ, female washer of the kitchen. The concluding servants are the musici: namely, duo organici; musici instrumentales; vocales: bassistæ, tenoristæ, altistæ, discantistæ, tubicines musicales, non musicales, all according to their names.

In page 132 is Libellus titularis, ubi Cæsareæ majestatis - - - integri convenientesque tituli reperiuntur. Page 173, Salutandi modus, ad pontificem, Turcam, et hujus præcipuos ministros et regentes - - Page 202, designatio omnium a Ferdinando II creatorum principum, comitum, et baronum. Page 225, Ferdin. II diplomatum formæ. At the end is added: Dan. Eremitæ, Belgæ, *Iter Germanicum, sive Epistola de legatione Magni Hetruriæ ducis ad Rudolphum* II *et aliquot Germaniæ principes* 1609.

The first edition of this small work was certainly printed in Holland; but I obtained through the kindness of Mr. Runde, to whom I am indebted for a knowledge of this court calendar, a German reprint of it, with somewhat coarser and worn down letters, consisting of 302 pages.

Nothing farther is wanting in this edition than the above mentioned *Iter Germanicum,* which the German editor perhaps would not venture to publish, because the characters of the emperor Rodolphus II, the elector of Saxony, the margrave of Brandenburgh and other German princes are drawn in it in too natural colours. The mention of this journey, however, in the preface, is retained in the reprint. Those who may be desirous of seeing it, will find it more correctly given in *Dan. Eremitæ Aulicæ Vitæ* lib. iv. *ejusdem Opuscola varia cum præfatione,* J. G. Grævii Ultrajecti 1701, 8vo.

The court calendar was first printed in Sweden in 1761. I however consider as the first, that printed in 1729, both in Swedish and German. The German edition was printed by Green, bookseller at Lubec, with the following title: "Flourishing Sweden, in the year 1729, by A. J. von Henel." I have now before me a copy from the library of Mr. Runde: It contains, besides the preface and index, 276 pages in quarto. The author was Major, who caused to be published in the year 1728, in Swedish, another work entitled: "The present flourishing and far famed city of Stockholm."

RIBBON-LOOM.

Among the inventions, which, by lessening labour, render a great number of workmen unnecessary, and consequently deprive many of bread; and which, with whatever ingenuity they may be contrived, have been considered as hurtful, and were for a long time suppressed by governments, may be reckoned the ribbon-loom. In its general construction, this machine approaches very near to that of the common weaving-loom; but the workman, instead of weaving one piece, or one ribbon, as is the case when the latter is used, can, on the former when it has all the necessary apparatus, weave sixteen or twenty pieces at the same time, and even of different patterns. Such a loom is so made, that the workman can move the batton as in the common loom, towards him and from him, and also to the right and left, with all the shuttles it contains; or, it is furnished with certain machinery below, which can be moved by a boy unacquainted with the art of weaving, and which keeps the whole loom with all its shuttles in motion. Looms of the former kind are certainly much simpler than those of the latter, and in all probability are older. To the first kind belongs the loom at Erfurt, and that which was lately brought thence, to Gottingen. Of the other kind there are two at Berlin; and some of them may be seen in many other places.

The art has been discovered also of causing such looms to be driven by water; and an instance of this may be found, as I have been told, in the neighbourhood of Iserlohe.* The proprietors, however, in most places, keep the construction of their looms a secret, and as far as appears, no complete description or figure of them has ever been published.† There is reason to believe that this invention is as yet little used in France: no mention at least is made of it in the *Encyclopedie*, where, however, the common loom of the ribbon-weavers and lace-weavers is fully represénted with all its parts in ten copper-plates.

Attempts were made in Europe to suppress this

* Looms of the first kind are seldom capable of weaving above sixteen pieces at one time; and very rarely eighteen, because the breadth necessary for that purpose would render them highly inconvenient. At a ribbon manufactory in the Milanese, there were some years ago, thirty looms of an excellent construction, each of which could weave twenty-four pieces together, so that sixty dozen of pieces were wove by the whole at the same time. See *Voyage d'un François par Italie*, i. p. 387. and Volkmann in his *Nachrichten von Italien*, i. p. 285, where the account is copied from the former work. We are told in Schrebers *Ersten Samlung*, i. p. 205, that Mr. Escher, at Zurich, had a large ribbon-loom which was driven by water. The same thing is said by Bergius in *Neuen Cameral-Magazin*, i. p. 191; but a traveller who saw the work, assured me, that it was a machine for winding silk; and this seems to be probable, from the short account given of it by Mr. Andreæ, in his *Briefen aus der Schweitz*, p. 49, 50.

† That to be found in Halle's *Werkstate der Kunste*, ii. p. 223, is defective. That given by Jacobson, in *Schauplatz der zeugmanufakturen*, iv. p. 411. is better; but the author could not obtain permission to illustrate it by a figure.

invention, as was the case with printing in Turkey; but the consequences have been different; for the Europeans have ribbon-looms, but the Turks have no printing; and for this reason, because the former are not in general such slaves to their rulers as the latter. But without here inquiring whether inventions may not save too much labour, and be therefore hurtful, as Montesquieu affirms; and whether it would be possible to suppress them throughout all Europe, should such a thing be attempted, I shall only give the history of the ribbon-loom as far as I have been able to find information on the subject.

We are told by Mr. Jacobson, that it is believed that the Swiss invented such looms above a hundred years ago; but I do not know any grounds upon which this conjecture can be supported. To me it appears much more probable that this invention had its rise in the Netherlands or Germany, either about the end of the sixteenth or the beginning of the seventeenth century. The oldest account with which I am acquainted, seems to be in favour of Germany, and the sixteenth century. Lancellotti, in a work* published at Venice in 1636, says, "Anthony Moller of Dantzic relates, that he saw in that city about fifty years before, a very ingenious machine, on which, from four to six pieces could

* L'Hoggidi overo gl'ingegni non inferiori a' passati; dell' abbate D. Secondo Lancellotti da Perugia. Parte Secondo. In Venetia 1636, 8vo. p. 457.

be wove at the same time; but, as the council were afraid that by this invention a great many workmen might be reduced to beggary, they suppressed it, and caused the inventor to be privately strangled or drowned.* Who this Anthony Moller, whom the author again mentions, may have been, I do not know; but that he saw a ribbon-loom at Dantzic is beyond all doubt. If the date of the book be taken as the time in which Lancellotti wrote, there is reason to believe, that there was a ribbon-loom at Dantzic about the year 1586; but it appears to me that the book was written in 1629, which would bring us to the year 1579.†

The next oldest information with which I am acquainted, is that given by Boxhorn, who says, "About twenty years ago, some persons in this city (Leyden) invented a weaving machine on which one workman could, with ease, make more cloth than several others in the same space of time. This gave rise to rioting among the weavers, and to such loud complaints, that the use of this machine

* In Danzica citá della Prussia, Antonino Moller, refericca non sono 50 anni d'haver veduto co' propri occhi un' artificio ingegnosissimo, col quale si facevano lavorare da se stessi quattro, sei e quanti telai s'havesse voluto in una stanza temperati et accommodati per 24 hore come gli horivoli qual si voglia tela o drappo. Ma perche tanti poveri huomini que vivevano col tessere sarebbono morti di fame, fù dal magistrato di quella città prohibita quell' invenzione, e l'autore segretamente fatto affogare.

† Of this circumstance, no mention is made in *Curicken Historischer Beschreibung von Danzig* 1688, fol.

was at length prohibited by the magistrates."* According to this account, Leyden was the place of the invention; but, in order to determine the time, it will be necessary to attend to the following circumstances. Boxhorn's *Institutiones politicæ* have been often printed, as for example, at Amsterdam 1663 in 12mo. The title of this edition is, *Marci Zuerii Boxhornii Varii Tractatus politici*, and besides the *Institutiones*, contains the *Disquisitiones Politicæ* and other pieces. Boxhorn read lectures on the *Institutiones Politicæ*, and gave verbal illustrations of them to his scholars, one of whom, in the year 1641, carried a fairly written copy of the latter to Germany, and gave them to professor C. F. Franckenstein, who caused them to be printed for the first time at Leipsic in 1658, and again in 1665, 12mo. The last edition has the following title: Institutionum politicarum libri duo conscripti a Boxhornio; accessit explanatio ab eodem auctore profecta. The passage above quoted is to be found in the illustrations: hence there is reason to conclude, that the ribbon-loom was known in Holland about the year 1621. The prohibition mentioned by Boxhorn, is not to be

* In hac urbe (Lugd. Batavorum) ante hos viginti circiter annos instrumentum quidam invenerunt textorium, quo solus quis plus panni et facilius conficere poterat, quam plures æquali tempore. Hinc turbæ ortæ et querelæ textorum, tandemque usus hujus instrumenti a magistratu prohibitus est.

found in *Handvesten der stad Leyden door*, Frans. van Mieris. Te Leyden 1759, fol.

It is some confirmation of Boxhorn's account, that the States General, so early as the 11th of August 1623, if they did not totally prohibit the use of the ribbon-loom, as commonly asserted at any rate greatly circumscribed it. The proclamation for that purpose may be found in the *Groot Placaet-Boeck*,* a valuable collection published at the Hague in seven large folio volumes, between the years 1658 and 1746. Nothing farther, however, is found there respecting the history of ribbon-looms, which are called *Lint-molens*,than that they had been in use for several years to the great injury, and even total ruin of many thousands of workmen, who were accustomed to weave ribbons on the common loom.† This prohibition was renewed on the 14th of March 1639, and again on the 17th of September 1648, as appears by the same work.‡ On the 5th of December 1661, the use of them was extended a little longer, and defined with more precision; § but, as far as I have been able

* Page 7.

† Hoe dat over eenige jaren gepractiseert ende ingevoert zijn eenige instrumenten van Lint-molens, omme daer mede vele linten t'effens te konnen maecken, tot merckelijcke schade jae totale ruine van veel duysenden menschen, die de selve linten mette voet-getouwen plachten te wercken.

‡ Page 1191.

§ Ibid. Part ii. p. 2762.

to find, no other regulations were made respecting these machines in the Netherlands.

The council of Nuremberg, it is said, prohibited the use of them in 1664, as is mentioned in the Hanau work, which I shall soon have occasion to quote.

On the 24th of December, the same year, ribbon-looms were prohibited in the Spanish Netherlands.* In the proclamation for that purpose it is stated, that a great number of articles manufactured on these looms were privately imported from Viane and Culenburg.

In the year 1665, there was to be seen, at Franckfort on the Mayn, a loom, which of itself, wove all kinds of lace, tape, &c. provided the silk or yarn was properly arranged in the usual manner, but if a thread happened to break, it was necessary that some one should again join it by means of a knot.† The year following, some person in that city applied not only to the council, but even to the emperor, for permission to establish such a loom, but was not able to obtain it.

In 1676, the ribbon-loom was prohibited at Cologne, and the same year some disturbance took place in consequence of its being introduced into England.‡ It is probable that Anderson § alludes

* Tweede deel van den derden Placaet-boeck van Vlaenderen, Te Ghendt 1685, fol. or in the fifth vol. p. 191.

† Von Lersner Chronica der Stadt Frankfurt, ii. p. 566.

‡ Relatio Historica semestralis vernalis 1776. Art. 10.

§ Geschichte des Handels, ii. p. 159.

to this loom, when he says, speaking of the above year, "As was also brought from Holland to London, the weavers loom-engine, then called the Dutch loom-engine." He however, praises the machine without describing it; nor does he mention that it occasioned any commotion.

The lace-weavers in Germany, but in particular the councils of Augsburg and Cologne, applied to Frederick Casimir, count of Hanau, who had great influence in the empire, and requested that he would endeavour to procure a general prohibition of ribbon-looms throughout all Germany; and the count accordingly presented a representation on this subject to the electors and states.*

On the 8th of January 1681 it was declared by Imperial authority, that a prohibition of ribbon-looms was both useful and neccessary. This was followed by an imperial decree, dated January the 5th, 1685,† and on the first of September following, it was strengthened by a *conclusum in senatu* of the council of Franckfort.‡

The council of Hamburgh, it is said, ordered a loom to be publicly burnt; and the emperor Charles VI caused the prohibition of 1685, to be renewed on the 19th of February 1719; though

* Faber's Staats-Canzley, i. p. 94.

† See Pachner's Samlung der Reichschlusse, ii. p. 287. *Neuer Samlung der Reichs-Abschiede*, Frankf. 1747. fol. iv. p. 153, and *Neuen Beytragen zur Cameral—und haushaltungs wissenschaft von einer Societät in Thüringen*, Jena 1769, 8vo. p. 145.

‡ Lersner Chronica der Stadt Frankfurt. i. p. 568.

some mercantile people made considerable opposition to this measure.* A general prohibition was likewise issued in the electorate of Saxony, on the 29th of July 1720. All these coercive means, however, were ineffectual; and the ribbon-loom being found useful, has now become common.

In the year 1718, the first loom of this kind was brought from Holland to Charlottenburg on the Spree;† but Mr. Nicolai, in his Description of Berlin,‡ says that this circumstance took place in the year 1728. The workmen were then engaged from foreign countries; and the loom was supported at the king's expense. The electorate of Saxony also, in the year 1765, revoked its prohibition, and permitted such looms to be publicly used. In the rescript, dated March the 20th, it is said, that as things were much changed, and as other German states had annulled the prohibitions against ribbon-looms, it was induced to grant full liberty to the lace-weavers to employ freely and publicly, in future, ribbon and lace-looms, and to manufacture all kinds of ribbons and other articles of the like kind that could be wove on them. It stated further, that the lace-weavers should give notice whether any of them wished to establish ribbon-looms, and how soon they could get them ready for work; that such of them as did not choose to

* Beyträgen der Thuringischen Societät. p. 47.

† Breslauer Samlungen 1720, May, p. 584.

‡ Beschreibung von Berlin, p. 986.

be at the expense, should for every loom constructed receive a certain sum, besides being admitted a member of the company; and that three months after the publication of this order, fifty rix-dollars would be given, by way of premium, for every loom on which from twelve to fifteen pieces of silk-ribbon could be wove; and thirty rix-dollars for every loom employed to weave ferret and articles of woollen.*

TURKISH PAPER. MARBLED PAPER.

Some persons having expressed astonishment at seeing Heraclitus in a smith's shop, he desired them to enter boldly without any fear, observing, "The gods are here also."† This is related by Aristotle, where he proposes to treat on subjects which, as he apprehends, may to the generality of mankind appear of too little importance. I might apply the same observation to those readers to whom the art, respecting which I mean to offer a few remarks, may appear unworthy of their attention. Every

* This rescript may be found in the *Leipsiger* Intelligenz-Blattern, 1765, p. 119.

† Ἐκέλευσε γὰρ ἀυτοὺς εἰσιεναι θαῤῥοῦντας, ἔιναι γὰρ καὶ ενταῦθα θεούς. Ingredi eos fidenter jussit, quoniam, inquit, ne huic quidem loco dii desunt immortales. *Aristot. de partibus Animal.* l. 5. p. 481.

occupation, indeed, which affords an honest livelihood to those who exercise it, especially when it furnishes articles for foreign trade, deserves the attention of a man of prudence; and every art, however mean or common, is attended with processes, preparations, and advantages, which can scarcely be known to those who have never thought them worthy of examination; and which, however, fill with an agreeable astonishment those who have become acquainted with them, and which sometimes are applied with great advantage, by persons of reflection, to new and more important uses.*

That shining paper with undulated or marbled figures, which is known under the name of Turkish paper, and is used in great quantities, is neither painted, printed with blocks, nor stained (for the figures are only upon one side), but is prepared in

* In G. F. Meiers Vernunftlehre. Halle 1752, 8vo. p. 104, it is said: "The common handicraft arts are below the horizon of learned knowledge, and therefore they may be reckoned among mean things." Another writer however, observes: Cum in officinis artistarum plus philosophiæ realis et veræ habeatur, quam in scholis philosophorum, consulendi sunt diligenter pictores, tinctores, ferrarii, aurifices, auriductores, agricolæ, milites, bombardarii, pannifici, destillatores et id genus reliqui. *Thom. Campanella de Libris propriis et recta Ratione Studendi*, lib. ii. cap. 5. Both these philosophers have widely erred, but in different directions, from the truth found by the two Grecian philosophers Heraclitus and Aristotle. This small work of Campanella was first published by Naudæus at Paris 1642, 8vo. I found it in a collection entitled *H. Grotii et aliorum Dissertationes de studiis instituendis*. Amstel. apud Elzevirium, 1645, 12mo. p. 392.

a manner which one would scarcely conceive possible; and which, as I conjecture, will one day be employed in a way much more advantageous.* Without giving a complete description, which may be found in various books,† I shall only briefly remark, that the artist pours into a shallow form, capable of containing a sheet of paper, a dye-liquor, composed of gum tragacanth and ox-gall; drops into it the pigments, or sprinkles them over its surface with a stiff hair brush; mixes them by drawing through it a comb or feather, or blows them through each other with a pair of bellows; and then lays the sheets of paper, which are deposited near each other, on the dye-liquor in the form; and, having carefully removed them, afterwards dries and glazes them. In almost all the directions given for this process, it is said that the sheets must be previously moistened; but Breitkopf, who judged from his own experience, wrote to me that they ought to be laid on dry.

However plain and simple all this may appear,

* Might not the so called wax-cloth, and leather for hangings, coaches, book-binding, and other purposes of the like kind, be variegated with different colours in the same manner? Is this process altogether inapplicable to oil-colours?—Many experiments must be made before questions of this kind can be answered.

† I have pointed out these works in my *Beyträgen zur ökonomie Technologie*, &c. iii. p. 471, and shall here mention only *Dictionnaire des Arts, par Jaubert*, ii. p. 38. *Zahn Oculus Artificialis*, iii. p. 158.

it is certain that much practice, dexterity, and care, are necessary to produce the best kinds of marbled paper; and because these are only seldom sought for, or must be sold at a cheap rate, especially since the so called Herrenhutter-paper, first made at Herrenhut, from which it takes its name, and cotton-paper made at Augsburg by the calico-printers, at their leisure hours, with the worn-out blocks used for calico-printing, are more esteemed on account of their handsome appearance and low price. Thus there are arts which the ignorant consider as easy, but which require great skill and attention; are seldom employed, produce little emolument, and being learned by few, are banished by arts easier to be acquired, and better suited to the taste of the public.

The time of this invention, which may have been occasioned by a sheet of paper accidentally falling into some dye-liquor, is as difficult to be determined with any certainty as the name of the inventor. I however believe that the art is a German invention, and belongs to the beginning of the seventeenth century. With the name, which seems to ascribe it to the Turks, no one can contradict me, for it is fully proved that it was once usual to give the epithet of Turkish to foreign, or even new and uncommon articles. Were it called Chinese paper, it might with more probability be considered as having been invented in China; for the Chinese

have an infinite variety of coloured kinds of paper, a large collection of which I formed at Amsterdam and at Petersburgh; and I procured likewise, to enrich it, a great number of beautiful patterns from Professor Pallas. There are some pieces in it which I doubt much whether the Europeans could imitate. I am unacquainted with arts of this kind practised by the Turks, who procure the greater part of their paper from Venice and Marseilles.

I am induced to form the above conjecture respecting the invention of this paper, by not finding any account of it earlier than the before-mentioned period but in German books. The oldest description of the manner of preparing it with which I am at present acquainted, is that made known by Kunkel; who however remarks, that it had before been kept secret. It may be found in the second part of his Art of Making Glass, which was published, I think for the first time, in two parts; the one printed at Franckfort and Leipsic, or at Jena, in 1674, and the other in 1679.* Few German books on the arts appeared after that time into which Kunkel's directions for making this paper were not copied.

I shall here observe, as an additional proof that the French, among whom this paper was particularly admired, acknowledge that they learned

* These editions are quoted by Lippenius in *Biblioth. Philos.* p. 1570, and by Georgi.

the art from the Germans. Such is the account given in the *Encyclopedie*,* where the process is fully described; and the same thing is repeated by Jaubert, D'Origny, and others. About the end of the seventeenth, or the beginning of the last century, there was in France an artist named Lebreton, who prepared the most beautiful.

The method of manufacturing this paper was made known, as far as I know, about the middle of the seventeenth century, by Evelyn, who thought it worth while to read a description of it before the Royal Society; but which I cannot find in their Transactions. His directions for preparing it were, however, copied afterwards by Houghton,† and by several others. That it was known to Dr. Sprat, we have reason to conclude from his History of the Royal Society.‡ It had been spoken of before by Lord Bacon, but with this remark, that his countrymen had not then learned how to make

* Article *Marbreur de papier*. Cet petit art a pris naissance en Allemagne. On a appellé la Suede, Norvege et les contrées septentrionales *officina* gentium. On pourroit appeller l'Allemagne *officina artium*. This, therefore, is an honest confession, such as one does not often read of from a Frenchman.

† Husbandry and Trade improved, by J. Houghton, London, 1727, 8vo. II. p. 419.

‡ The oldest edition with which I am acquainted is that of 1667, 4to. I have in my possession only the French translation, *Histoire de la Soc. de Londres*, Geneve, 1669, 8vo. in which the following passage occurs, p. 348: Le papièr marbré qui se fait en detrempant les couleurs avec le fiel de bœuf et les appliquant sur un liqueur fortement gommée.

it.* He considered the art as a Turkish invention, and imagined that the paper was previously soaked in oil;† and the same thing is said in the French Dictionary of Richelet, and in that of Trevoux. This imperfect account was left by Bacon in a book, in which he was accustomed to write down useful observations of every kind as they occurred to him. It was not printed till after his death;‡ and as he died in 1626, and as his account is the oldest with which I am acquainted, I have assigned this invention to the beginning of the seventeenth century.

* In his Natural History, centur. 8, No. 741; or in the edition of all his works, printed at London, 1740, in four volumes, folio III. p. 150: "Experiment solitary, touching chambletting of paper. The Turks have a pretty art of chambletting of paper, which is not with us in use. They take divers oiled papers, and put them severally (in drops) upon water, and stir the water lightly, and then wet their paper (being of some thickness with it), and the paper will be waved and veined like chamblet or marble." The Natural History is better known under the name of *Silva Silvarum*. There is a Latin translation of it by J. Gruter, which is not bad, and which was printed at London, in 1648, 12mo. The translator generally adds terms of art, and frequently also obscure passages in English, which few common translators do. Whether he has been altogether fortunate in his translation of the above passage my readers may judge for themselves: "Experimentum solitarium spectans chartam undulatam. Turcæ egregii sunt artifices chartæ quam vocamus undulatam; industria nostratibus ignota. Varios sumunt colores oleo tinctos eosque singulis aquæ guttis inspergunt, et aquam leviter motitant, qua deinde chartam crassiusculam humectant, quæ venarum undantium ductus trahit ut vestis aut marmor."

† Kircher entertained the same opinion. See his *Ars Umbræ et Lucis*, p. 714.

‡ See his Life, p. 63, prefixed to his works.

LEATHER SNUFF-BOXES.

The astonishing influence which the American plant tobacco has had on our agriculture, and the finances of the great land-holders in Europe, has often been the subject of admiration; but I do not know whether on these occasions attention has been paid to the number of workmen, merchants, and shopkeepers, who find employment by making and selling snuff-boxes. Could a calculation be made, one would be astonished at the sums of money expended on these articles, and at the number of those who thereby gain their bread, especially since people, by means of a new fashioned box, and the manner of opening it, presenting it or playing with it, can show their taste, politeness, rank in society, or riches; and since these articles, when given in presents, are considered as the rewards of uncommon merit, or the marks of peculiar favour. There are also few objects of luxury which by the ingenuity and emulation of artists have been so often and so speedily changed, ornamented, or enhanced in price, as snuff-boxes. A collection of them, chronologically arranged, would serve to illustrate the history of our artists, gold and silversmiths, jewellers, miniature and enamel-painters, and many others; and on that account would be of more value than a collection of engravings, which serves only to throw light on the history of

one single art. Were it to be hoped that such a collection would descend to succeeding generations, I should wish that the most ingenious artists would inscribe their name and the date on their works; and for this small trouble they would receive the thanks of those who might be desirous of writing a history of the arts. At present one may, without incurring censure or ridicule, admire these works of art; but I do not know whether an author would not be laughed at, were he to attempt giving to posterity an account of all the new inventions in this department, which have from time to time been made. No one, however, laughs when it is recorded for the information of foreigners, or of posterity, who performed the part of Hamlet in the theatre, or appeared in any other first-rate character. I will, however, make a small attempt.

Within these few years, snuff-boxes, cases of different kinds, and other articles, have been made of leather, prepared in such a manner that by its hardness, smoothness, colour, brightness, and transparency it seems equal to tortoise-shell. The boxes exhibit sometimes impressions of figures, which seem as if carved, and sometimes they are lined in the inside with metal, or outwardly inchased in it. The hinges even are of leather. Arnot in his History of Edinburgh, * asserts, that the art was invented in that city by Thomas Clark

* Page 595.

and his son, and that in 1756, he obtained a patent for it during fourteen years. After the expiration of that term the invention was employed at Birmingham, and in other parts of England and Scotland, but the Edinburgh boxes were every where preferred. Similar boxes, however, were made at Bologna, at the time Flachat* was there, and some of a good quality were made in Germany. Had I been able to procure farther information respecting this art, the present article would have been more worthy of notice; and if communications on the subject should still be sent, they will not be without use. I shall here remark, that the Calmucks prepare from the skins of their horses vessels and tea basons which have the appearance of horn, and contain boiling water, without turning soft, or communicating to the water any foreign taste. By continual exposure to smoke these vessels become transparent like horn, and almost everlasting. As our artists, perhaps, may be able to turn to advantage the process of the Calmucks,

* Observations sur le commerce et sur les arts, per Jean Claude Flachat, Lyon, 1766, II. vol. 12mo. I. p. 122; and in the German translation, I. p. 104. The latter was published at Leipsic, in 1767, in two parts, 8vo. under the title, *Flachat Untersuchung zur beförderung der Handlung und Künste*; but I must inform the reader that little confidence is to be placed in it, as the translator C. H. Wilke seems not to have understood the original; for he calls *le poil du chameau* (gemsenhaar) goat's hair, *galbanum*, gum, &c. His notes contain useless ridicule of the author, who, indeed, travelled too young, and was besides too credulous.

I refer them for farther information to Pallas's Travels.*

THE PANTALEON.

UNDER this name are known at present two musical instruments, which, however, are essentially different. The one is that which is more commonly and with greater propriety called the *Forte-piano*, or *Piano-forte;* and in French *Clavecin à Marteau.* It is a variation from the harpsichord, or an improvement on that instrument, in common with which it has a sounding-board, and a similar arrangement of the strings; but instead of quills, like the harpsichord, it is furnished with small hammers. These, which are moved by the keys, are sometimes made of wood or leather, and sometimes of paper, *papier maché*, or other materials. By touching the keys in a stronger or gentler manner, the tone can be strengthened or weakened; but this instrument always requires a pretty strong touch, and therefore it tires and hurts the fingers.†

* Pallas Reise, I. p. 320.

† Musical instruments are capable of so many variations, that it would be difficult even for connoisseurs, among whom I cannot pretend to class myself, to give a complete description of them. I will, however, remark, that the upright harpsichord, which is commonly called *clavicytheria*, instead of quills may have hammers. More information on this subject may be found in Adlung's *Anleitung zu der musikalischen Gelehrtheit.* Erfurt, 1758, 8vo. p. 559—562.

For the first public information in regard to this instrument, we are indebted to the celebrated Scipio Maffei. In his description, which is also translated into German, the arrangement of the hammers is illustrated by an engraving.* According to his assertion, it was invented by Bartolo Christofoli, of Padua, who lived as harpsichord-maker in the service of the grand duke of Tuscany. This honour, however, is disputed with him by Christopher Gottlob Schröter, who, in a letter written in the year 1738, asserts, that he caused to be made at Dresden, so early as 1717, the model of a harpsichord with hammers, partly with and partly without springs, on which one could play at pleasure either *forte* or *piano*. He showed this model twice to the king of Poland, who approved of it, and caused one to be constructed in a more complete manner, which, however, after Schröter's departure from Saxony, was broken by some persons, who made it known in Germany and other countries.† Whether Dr. Schröter,

* Rime e prose del Sign. Marchese Scipione Maffei, parte raccolte da vari libri, e parte non più stampate. In Venezia, 1719, 4to. p. 309. The translation may be found in Matheson's Criticæ Musicæ Tomus secundus; that is, Critique of Works on Music. Hamburgh, 1725, 4to. p. 335. It is there called a harpsichord, on which one can play *piano* and *forte*. A short description of the present construction of this instrument may be seen in *Sprengels Handwerken und Kunsten-Eilfte Samlung*, p. 267, and in *Jacobson's Technologischem Wörterbuche* I. p. 785.

† Lorenz Mizlers Musikalische Bibliothek. Leipzig, 1739—1752, III. Theile, 8vo. III. p. 474.

who was born on the frontiers of Bohemia in 1699, and lived after the year 1732, as organist at the principal church of Nordhausen, ever gave an accurate description of his invention, I do not know.

Though this instrument met with general approbation, connoisseurs at first complained of the strong after-sound, by which the tones were rendered obscure and confused; but on this account artists more and more exerted themselves to remove this fault; and even Christofoli himself found out a method of correcting it, by applying dampers to the hammers, which touched the strings with a piece of cloth as soon as they had been struck. A similar arrangement recommends those instruments of this kind, which are made by Francis Jacob Spath, an ingenious musical instrument-maker of Ratisbon, with the assistance of his son-in-law Schmal. In these instruments the damping apparatus is applied above the strings, and rises and falls at each touch; that is to say, as long as the keys are pressed down, the damping apparatus is kept at a distance from the strings, on which it again falls down on the finger being removed from the keys. By these means the forte piano is brought to such perfection, that it is esteemed equal to the best clavichord. At Ratisbon the price is forty ducats. No less celebrated are those instruments of this kind made by John Henry Silbermann, organ-builder and musical instrument-maker at Strasburgh, which are commonly sold

for three hundred dollars. The best instruments at Paris are of his making. He is celebrated on account of his excellent instruments of this kind, which are partly his own invention, and partly improved by him. The most remarkable of them are a large and very fine-toned harpsichord, a pedal *forte piano*, and a *forte piano manuel*. His brother, John Andrew Silbermann, born in 1712, was also a celebrated organ-builder, and wrote a local history of Strasburgh, the first part of which was printed in 1775. He built about fifty organs in Alsace and the neighbouring districts; two of which deserve particular notice, one in the church of the Dominicans, at Strasburgh, and the other in the abbey of St. Blaise, in the Schwarzwalde. He left behind him a collection of Strasburgh coins, together with a description of them, which deserves to be printed.

Among the late improvements of the forte-piano, is the observation made by count Bruhl, the Saxon envoy at the court of London, that the best tone is produced by blue steel strings. This invention is described at greater length in the Leipsic Intelligencer for the year 1776. M. le Roi, in his *Memoire sur la meilleure manière de mesurer le tems en mer*, remarks, that a piece of blue steel wire is the best thing that can be employed for a pendulum, because it retains its motion longest. He conceived, therefore, that the tone of harpsi-

chord strings could be improved by making them blue. In consequence of this hint, count Bruhl caused a piano-forte to be constructed in England under his own inspection, with blue steel wire strings, by which means he produced, instead of the harsh tones observed in that instrument, especially in discords, the most delightful flute tones. These new piano-fortes were much approved, both in England and France. The name of piano-forte given to this instrument is very proper, as it ought not to be called the pantaleon;* for in the latter the hammers are made in a manner entirely different. The pantaleon, properly so called, is of meaner extraction, being originally the *hackebrett* on which strolling musicians perform at village festive meetings; but sometimes in higher society, even with the approbation of connoisseurs, and which by the ingenuity of a great artist has been made the most perfect of instruments, superior even to the harpsichord, and the admiration of all Europe; but at the same time it requires in the performer great dexterity, many years' practice, and uncommon patience. Besides the inventor of it, none but a person named Noelli ever ventured to travel with this instrument, in order to exhibit his performance; yet Dr. Burney extols one

* Sprengel, Jacobson, and several other writers, have considered both these terms as synonymous.

Gumpenhover as a very skilful performer on the pantaleon.*

The pantaleon is four times as large as the *hackebrett*; has a double row of strings, that is to say, a row of steel and brass wire strings on the one side, and a row of cat-gut strings on the other. It is played like the *hackebrett* with two sticks, which are either half or entirely covered with cotton or woollen cloth, and is struck sometimes in a strong and sometimes in a soft manner. That a stringed instrument, with such a multiplicity of strings, and of so great a length, requires to be often and almost continually put in order, needs hardly to be mentioned.

That this instrument was invented by a German, and that it acquired its name from the Christian name of the inventor Pantaleon Hebenstreit, is universally admitted; but writers are not agreed in regard to the history of this ingenious mechanic and the time of the invention. The completest account is given by Mr. von Stählin, in his History of Music in Russia,† and I once had some intention of here inserting it; but Dr. Weiss, and in particular Mr. Forkel, that learned connoisseur in

* Burney's Tagebuch einer Musikalischen Reise durch Frankreich und Italien, aus dem Englischen übersetzt von C. D. Ebeling. Hamburg, 1772, 1773, III. Theile, 8vo. III. p. 32.

† Printed, for the first time, in the second part of *Beylage zum Neuveränderten Russland.* Riga and Leipsig, 1770, 8vo. p. 142, published by Professor Schlözer, under the name of Haigold, borrowed from that of his maternal grandfather.

music, have referred me to sources from which the above account may be corrected. This appears to me to be the more necessary, as Mr. von Stählin's account has been reprinted in various works,* and lately in the Musical Almanac. Some one, perhaps, may hence be induced to collect fuller and more certain information on this subject, and to publish it, which I wish may be done for the honour of our nation.

Pantaleon Hebenstreit, as Mr. von Stählin formerly related at Leipsic, taught music and dancing in that city, between the years 1713 and 1715; but being obliged to leave it in consequence of debt, went to teach the children of a country clergyman at a village in the district of Merseburg. While in that situation, he endeavoured to improve the hackebrett used among the villagers, and, with the assistance of his landlord, who knew something of cabinet-making, he brought it to perfection. In the year 1718, a young gentleman named von Dieskau, belonging to the court of Saxony, passing through the village where Hebenstreit resided, became acquainted with him and his new instrument, and made it known to king Augustus. This prince, who with his whole court admired Hebenstreit's invention and ingenuity, appointed him

* Hillers Musicalische Nachrichten und Anmerkungen auf das Jahr 1770. Erster Theile. Leipzig, 1770, 4to. p. 199. *Musikalischer Almanach für Teutschland auf das Jahr* 1782. Leipzig, 8vo. p. 28.

musician to his court, and settled on him an annual pension of two thousand dollars.

In order to rectify this account, I shall observe that Hebenstreit certainly constructed his instrument before the year 1697, and was at that time much admired. It appears also that he was in great repute at Leipsic, much earlier than is above stated, as a performer on the violin and harpsichord, and that he gave lessons in music and dancing. All this is confirmed in a letter written by John Kühnau, formerly cantor and director of music at Leipsic, dated December 18th 1717, to the well known Mattheson.* Kühnau there extols the instrument, which he calls the Pantalonic Cymbal, and says that about twenty years before Pantaleon the dancing master had performed on it at Leipsic, in a concert given at the house of count Logi, who was himself an excellent musician, to the astonishment of all connoisseurs, and that the hammers were bound round with cotton.

In the year 1705 he performed at the French court on this instrument, to which at that time Louis XIV had given the name of Pantaleon.† After his return from France in 1706, he was ap-

* Mattheson's Critica Musica, ii. p. 236. Kühnau himself had an instrument of this kind. "Mine," says he "begins at sixteen feet E, and continues in *genere diatonico* to eight-feet G, at which the chromatic tones begin, and proceed to three-barred E.

† Critica Musica, ii. p. 248. Burney's Tagebuch, iii. p. 30. The latter adds that on this occasion the abbé Chateaneuf published an ingenious small work entitled: *Dialogue sur la musique des anciens.*

pointed director of music, and dancing master at Eisenach. This is related by J. W. Hertel in the life of his father,* and by Telemann in his own life; the latter extols Hebenstreit on account of his extraordinary skill on the violin, and adds that he sometimes performed at the court of Eisenach on his wonderful cymbal.† In the year 1708, Hebenstreit removed to Dresden, after having introduced Telemann as his successor.‡ Kühnau relates that Pantaleon had a salary of twelve hundred dollars at the court of Saxony, and yet performed only twice a year before the king. In 1717, he performed at Vienna, before the emperor,§ who afterwards sent a person to Dresden, in order to learn to play on this instrument.‖ The same Mattheson saw the instrument for the first time in the possession of Grünewald, master of the band at Darmstädt; and he acknowledges, that he was frightened at the great labour requisite before one could learn to play on it.¶ I do not know the year in which Hebenstreit died, but he

* Beyträge zur Aufnahme der Musik von F. W. Marpurg, Berlin 1757, 8vo. Dritter Band. p. 53.

† Mattheson Grundlage einer Ehrenpforte; woran der Tonkünstler Leben, Verdienste erscheinen sollen. Hamburg 1740, 4to. p. 361.

‡ Marpurgs Beyträge, ut supra.

§ I. A. Scheibe über die musikalische composition. Erster Theile. Leipzig 1773, 4to. Vorrede p. lvii.

‖ Keysslers Reisen. Hannover 1771, 4to. p. 1092.

¶ Critica Musica, ii. p. 248.

was alive at Dresden in 1732, as is expressly stated in J. G. Walther's Musical Lexicon,* where it is said that he was son to the town musician of Eisleben. Professor Diez, who knew him, told me that he died in poverty and want at Dresden.

Keissler, who visited Hebenstreit in 1730, and saw his instrument, gives the following description of it. "It is made hollow in such a manner that one can invert it without trouble, and play on both sides of it with two small pieces of wood, as on a double *hackebrett*. It is thirteen and a half spans in length, and three and a half in breadth. The body is hollow, and on the one side is furnished with violin strings wound round with silver wire, and on the other for the high tones with strings of steel-wire. To keep it in order, as it consists of a hundred and eighty-five strings, costs about a hundred dollars a year. Dr. Burney saw the remains of this pantaleon some years ago, in the hands of an organist named Binder, who had been one of Hebenstreit's scholars. He found the instrument to be above nine feet in length; but all the strings were broken, because it was no longer considered as a court instrument, and kept in order at its expense.

When Noelli, musician to the court of Mecklenburg Schwerin, performed at Gottingen on the pantaleon in the year 1782, he announced in his bills that the instrument had been invented by

† J. G. Walthers Musikalischen Lexicon, Leipzig 1732, 8vo. p. 461.

Pantaleon Hebenstreit, about the beginning of that century; that he possessed the original instrument of the inventor, which was ten feet in length, had two hundred and seventy-six strings, and was played on with two sticks; and he added, that he was the only person at that time who could perform on it.

LEYDEN FLASK.

At the present period, when electrical experiments are well known, it is hardly needless to state, that under this name is understood a glass flask, partly filled with water, and having a wire passing through its stopper, one end of which reaches to the water while the other is connected with the conductor, so that those who hold the flask in one hand, and with the other touch the wire or the conductor, receive a violent shock. It is also scarcely necessary to remark, that this apparatus in the course of time has been altered and improved in many different ways. It appears, however, not superfluous to mention here the names of those Germans who first performed this remarkable experiment, and made it known by their friends.* For even at present this discovery is ascribed by most foreigners

* Priestley Geschichte der Elektricität, ubersetzt von Krünitz. Berlin 1772, 4to. p. 53. *Cavallo Abhandlung von der Elektricität. Leipzig* 8vo. p. 41.

to two Dutchmen, to whom however it does not belong, and whose merits are so great, that they can suffer little by being deprived of the honour of it. Nay, people in Germany continue to use the term Leyden Flask, though the impropriety of the appellation has been already shown, and particularly by Professor Tietz of Wittenberg, in a dissertation expressly written for the purpose.*

Mr. Von Kleist dean of the cathedral of Camin, is the person who first made this remarkable experiment on the 11th of October 1745. On the 4th of November the same year he wrote to Mr. Lieberkühn at Berlin, on the 28th of the same month to Mr. Swietlicki a clergyman at Dantzic, and soon after to Professor Krüger† of Halle, a particular account of it; which the first mentioned transmitted to the Academy of Sciences at Berlin, the second to the Society of the Searchers into Nature at Dantzic, and the last caused to be printed in 1746. Even in 1745 some persons at Dantzic endeavoured to perform this experiment; and as it did not succeed, they obtained from the dean fuller instructions, which were made publicly known by Gralath in 1747.‡ At the end of the year 1745, therefore, this experiment was well

* J. D. Titius De electrici experimenti Lugdunensis inventore primo. Wittebergæ 1771, 4to.

† J. G. Krügers Geschichte der Erde. Halle 1746, 8vo. p. 177.

‡ Abhandlungen der Naturforschenden Gesellschaft in Danzig. Erster Theil, 1747. 4to. p. 512.

known at Dantzic, Berlin, and Halle; and it cannot appear extraordinary that it should soon be conveyed from some of these places to Leyden, especially as people were at that time exceedingly curious after new electrical experiments.

About the beginning of the year 1746, Muschenbroek wrote to Reaumur in what manner he had fallen upon this terrible experiment. Immediately after Professor Allaman at Leyden communicated the same thing in a letter to Nollet; and made it known also in February, in a paper which was sent to the Royal Society of London;* but neither of these gave any hint that they had been conducted to the experiment by another person. On this account, the philosophic people, both at London and Paris, were induced to give to this apparatus the name of the Leyden Flask; but when it began to be considered as an invention of Muschenbroek, Mr. Allaman in 1746 informed both Nollet and Gralath, that Cunæus, a man of some distinction at Leyden, who amused himself with electrical experiments, had made the discovery about the year 1745.†

Now if it should be admitted that Cunæus, without knowing any thing of Kleist's discovery, had actually performed the experiment himself, and

* Memoires de l'Académ. des Sciences, 1746, p. 2.

† Abhandlungen der Danziger Gesellschaft, ii. p. 431. The author of the letter from Leyden here inserted is not known; but Tietz says it was from H. Allaman.

this, considering the ardour with which people at that time applied to philosophical pursuits does not seem improbable, it is certain that Muschenbroek was not the inventor;* and that a German philosopher found out this method of increasing the strength of an electric shock, and made it publicly known. Besides, Professor Tietz had before remarked that Gray, in the year 1735, entertained some idea of this method of strengthening electricity, and conceived that by its means the effects of it might be made equal to those of lightning, though he carried the observation no farther.†

PRICE CURRENTS.

Price Currents are a kind of printed bills, which show the prices of the principal articles of merchandise, and in large commercial cities are published once or twice a week by brokers properly authorised for that purpose. They appear to have been first introduced about the beginning of the seventeenth century. At any rate the oldest order

* Nevertheless this merit is taken from Cunæus and given to Muschenbroek, in *Histoire général et particuliere de l'electricité*, Paris 1752, iii. Parts, 8vo. i. p. 29. The author of this history has not announced his name; but from the unfavorable account given of it by Nollet in *Lettres sur l'electricité*, Paris 1753, 8vo. one might almost conclude that it was the abbé Mangin.

† Philosoph. Transactions, No. 436.

at Amsterdam, in regard to the publication of these bills, is dated January the 31st 1613.*

In the year 1634, John Day, a sworn broker in London, obtained permission to print weekly bills of the several rates of prices of all commodities; and it is expressly said in the privilege or patent,† that such bills had been a long time in use in foreign countries, but had never before been brought to perfection in London.

Bills of the course of exchange show the rate of exchange at the different foreign places of trade. They were first published at Hamburgh in the year 1659. Bills of the price of gold show the agio which is paid on exchanging inferior money or coin for others of a better quality. These were first published at Hamburgh in 1687.‡ At present in general the whole three make only one kind of bill, in which, at Amsterdam, Hamburgh, and other places, the rates of insurance on outward or homeward-bound ships are also given.

* It may be seen in *Handvesten of te privilegien ende octroyen der Stad Amstelredam*, 1748, fol. ii. p. 1064.

† Rymer's Fœdera, xix. p. 577.

‡ Krusens Hamburgischer Contorist. Erster Theil, 1771. 4to, p. 467.

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END OF THE THIRD VOLUME.

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